hipBLAS Documentation

Advanced Micro Devices

May 24, 2023

CONTENTS:

CHAPTER

ONE

USER GUIDE

1.1 Disclaimer

The information contained herein is for informational purposes only and is subject to change without notice. While every precaution has been taken in the preparation of this document, it may contain technical inaccuracies, omissions and typographical errors, and AMD is under no obligation to update or otherwise correct this information. Advanced Micro Devices, Inc. makes no representations or warranties with respect to the accuracy or completeness of the contents of this document, and assumes no liability of any kind, including the implied warranties of noninfringement, merchantability or fitness for particular purposes, with respect to the operation or use of AMD hardware, software or other products described herein. No license, including implied or arising by estoppel, to any intellectual property rights is granted by this document. Terms and limitations applicable to the purchase or use of AMD's products are as set forth in a signed agreement between the parties or in AMD's Standard Terms and Conditions of Sale.

- AMD, the AMD Arrow logo, Radeon, Ryzen, Epyc, and combinations thereof are trademarks of Advanced Micro Devices, Inc.
- Google(R) is a registered trademark of Google LLC.
- PCIe(R) is a registered trademark of PCI-SIG Corporation.
- Linux is the registered trademark of Linus Torvalds in the U.S. and other countries.
- Ubuntu and the Ubuntu logo are registered trademarks of Canonical Ltd.
- Other product names used in this publication are for identification purposes only and may be trademarks of their respective companies.

1.2 Introduction

AMD **ROCm** has two classification of libraries,

- **roc*** : AMD GPU Libraries, written in HIP.
- **hip*** : AMD CPU library that is a thin interface to either AMD **roc*** or Nvidia **cu*** libraries.

Users targetting both CUDA and AMD devices must use the **hip*** libraries.

hipBLAS is a BLAS marshaling library with multiple supported backends. It sits between the application and a 'worker' BLAS library, marshalling inputs into the backend library and marshalling results back to the application. hipBLAS exports an interface that does not require the client to change, regardless of the chosen backend. Currently, it supports rocBLAS and cuBLAS as backends.

1.3 Building and Installing

1.3.1 Prerequisites

- If using the rocBLAS backend on an AMD machine:
  - A ROCm enabled platform, more information ROCm Documentation.
  - A compatible version of rocBLAS
  - A compatible version of rocSOLVER for full functionality
- If using the cuBLAS backend on a Nvidia machine:
  - A HIP enabled platform, more information HIP installation.
  - A working CUDA toolkit, including cuBLAS, see CUDA toolkit.

1.3.2 Installing pre-built packages

Download pre-built packages either from ROCm's package servers or by clicking the GitHub releases tab and manually downloading, which could be newer. Release notes are available for each release on the releases tab.

1.3.3 hipBLAS build

1.3.3.1 Build library dependencies + library

The root of this repository has a helper bash script *install.sh* to build and install hipBLAS with a single command. It does take a lot of options and hard-codes configuration that can be specified through invoking cmake directly, but it's a great way to get started quickly and can serve as an example of how to build/install. A few commands in the script need sudo access so that it may prompt you for a password.

Typical uses of install.sh to build (library dependencies + library) are in the table below.

Command	Description
`./install.sh -h`	Help information.
`./install.sh -d`	Build library dependencies and library in your local directory. The -d flag only needs to be used once. For subsequent invocations of install.sh it is not necessary to rebuild the dependencies.
`./install.sh`	Build library in your local directory. It is assumed dependencies have been built.
`./install.sh -i`	Build library, then build and install hipBLAS package in */opt/rocm/hipblas*. You will be prompted for sudo access. This will install for all users. If you want to keep hipBLAS in your local directory, you do not need the -i flag.

1.3.3.2 Build library dependencies + client dependencies + library + client

The client contains executables in the table below.

executable name	description
hipblas-test	runs Google Tests to test the library
hipblas-bench	executable to benchmark or test individual functions
example-sscal	example C code calling hipblas_sscal function

Common uses of install.sh to build (dependencies + library + client) are in the table below.

Command	Description
`./install.sh -h`	Help information.
`./install.sh -dc`	Build library dependencies, client dependencies, library, and client in your local directory. The -d flag only needs to be used once. For subsequent invocations of install.sh it is not necessary to rebuild the dependencies.
`./install.sh -c`	Build library and client in your local directory. It is assumed the dependencies have been built.
`./install.sh -idc`	Build library dependencies, client dependencies, library, client, then build and install the hipBLAS package. You will be prompted for sudo access. It is expected that if you want to install for all users you use the -i flag. If you want to keep hipBLAS in your local directory, you do not need the -i flag.
`./install.sh -ic`	Build and install hipBLAS package, and build the client. You will be prompted for sudo access. This will install for all users. If you want to keep hipBLAS in your local directory, you do not need the -i flag.

1.3.4 Dependencies

Dependencies are listed in the script install.sh. Use `install.sh` with `-d` option to install dependencies. CMake has a minimum version requirement listed in the file install.sh. See –cmake_install flag in install.sh to upgrade automatically.

1.3.5 Manual build (all supported platforms)

This section has useful information on how to configure cmake and manually build.

1.3.5.1 Dependencies For Building Library

1.3.5.2 Build Library Using Individual Commands

1.3.5.3 Build Library + Tests + Benchmarks + Samples Using Individual Commands

The repository contains source for clients that serve as samples, tests and benchmarks. Clients source can be found in the clients subdir.

Dependencies (only necessary for hipBLAS clients)

The hipBLAS samples have no external dependencies, but our unit test and benchmarking applications do. These clients introduce the following dependencies:

- lapack, lapack itself brings a dependency on a fortran compiler
- googletest

Unfortunately, googletest and lapack are not as easy to install. Many distros do not provide a googletest package with pre-compiled libraries, and the lapack packages do not have the necessary cmake config files for cmake to configure linking the cblas library. hipBLAS provide a cmake script that builds the above dependencies from source. This is an optional step; users can provide their own builds of these dependencies and help cmake find them by setting the CMAKE_PREFIX_PATH definition. The following is a sequence of steps to build dependencies and install them to the cmake default /usr/local.

(optional, one time only)

Once dependencies are available on the system, it is possible to configure the clients to build. This requires a few extra cmake flags to the library cmake configure script. If the dependencies are not installed into system defaults (like /usr/local), you should pass the CMAKE_PREFIX_PATH to cmake to help find them.

1.4 Deprecations by version

1.4.1 Announced in hipBLAS 0.49

1.4.1.1 Replace inplace hipblasXtrmm with out of place hipblasXtrmm

The hipblasXtrmm API, along with batched versions, will be changing in hipBLAS 1.0 release to allow in-place and out-of-place behavior. This change will introduce an output matrix 'C', matching the rocblas_xtrmm_outofplace API and the cublasXtrmm API.

1.4.2 Announced in hipBLAS 0.53

1.4.2.1 Remove packed_int8x4 datatype

The packed_int8x4 datatype will be removed in hipBLAS 1.0. There are two int8 datatypes:

- int8_t
- packed_int8x4

int8_t is the C99 unsigned 8 bit integer. packed_int8x4 has 4 consecutive int8_t numbers in the k dimension packed into 32 bits. packed_int8x4 is only used in hipblasGemmEx. int8_t will continue to be available in hipblasGemmEx.

1.5 Library Source Code Organization

The hipBLAS code is split into two major parts:

- The *library* directory contains all source code for the library.
- The *clients* directory contains all test code and code to build clients.
- Infrastructure

1.5.1 The *library* directory

1.5.1.1 library/include

Contains C98 include files for the external API. These files also contain Doxygen comments that document the API.

1.5.1.2 library/src/amd_detail

Implementation of hipBLAS interface compatible with rocBLAS APIs.

1.5.1.3 library/src/nvidia_detail

Implementation of hipBLAS interface compatible with cuBLAS-v2 APIs.

1.5.1.4 library/src/include

Internal include files for:

- Converting C++ exceptions to hipBLAS status.

1.5.2 The *clients* directory

1.5.2.1 clients/gtest

Code for client hipblas-test. This client is used to test hipBLAS.

1.5.2.2 clients/benchmarks

Code for client hipblas-benchmark. This client is used to benchmark hipBLAS functions.

1.5.2.3 clients/include

Code for testing and benchmarking individual hipBLAS functions, and utility code for testing.

1.5.2.4 clients/common

Common code used by both hipblas-benchmark and hipblas-test.

1.5.2.5 clients/samples

Sample code for calling hipBLAS functions.

1.5.3 Infrastructure

- CMake is used to build and package hipBLAS. There are CMakeLists.txt files throughout the code.
- Doxygen/Breathe/Sphinx/ReadTheDocs are used to produce documentation. Content for the documentation is from:
  - Doxygen comments in include files in the directory library/include
  - files in the directory docs/source.
- Jenkins is used to automate Continuous Integration testing.
- clang-format is used to format C++ code.

1.6 API

1.6.1 hipBLAS interface examples

The hipBLAS interface is compatible with rocBLAS and cuBLAS-v2 APIs. Porting a CUDA application which originally calls the cuBLAS API to an application calling hipBLAS API should be relatively straightforward. For example, the hipBLAS SGEMV interface is

1.6.2 GEMV API

```
hipblasStatus_t
hipblasSgemv( hipblasHandle_t handle,
            hipblasOperation_t trans,
            int m, int n, const float *alpha,
            const float *A, int lda,
            const float *x, int incx, const float *beta,
            float *y, int incy );
```

1.6.3 Batched and strided GEMM API

hipBLAS GEMM can process matrices in batches with regular strides. There are several permutations of these API's, the following is an example that takes everything

```
hipblasStatus_t
hipblasSgemmStridedBatched( hipblasHandle_t handle,
            hipblasOperation_t transa, hipblasOperation_t transb,
            int m, int n, int k, const float *alpha,
```

(continues on next page)

(continued from previous page)

```
             const float *A, int lda, long long bsa,
             const float *B, int ldb, long long bsb, const float *beta,
             float *C, int ldc, long long bsc,
             int batchCount);
```

hipBLAS assumes matrices A and vectors x, y are allocated in GPU memory space filled with data. Users are responsible for copying data from/to the host and device memory.

1.7 Guidelines

1.7.1 Naming conventions

hipBLAS follows the following naming conventions,

- Big case for matrix, e.g. matrix A, B, C GEMM (C = A*B)
- Lower case for vector, e.g. vector x, y GEMV (y = A*x)

1.7.2 Notations

hipBLAS function uses the following notations to denote precisions,

- h = half
- bf = 16 bit brian floating point
- s = single
- d = double
- c = single complex
- z = double complex

1.8 hipBLAS Types

1.8.1 Definitions

1.8.1.1 hipblasHandle_t

typedef void ***hipblasHandle_t**
hipblasHanlde_t is a void pointer, to store the library context (either rocBLAS or cuBLAS)

1.8.1.2 hipblasHalf

typedef uint16_t **hipblasHalf**

To specify the datatype to be unsigned short.

1.8.1.3 hipblasInt8

typedef int8_t **hipblasInt8**

To specify the datatype to be signed char.

1.8.1.4 hipblasStride

typedef int64_t **hipblasStride**

Stride between matrices or vectors in strided_batched functions.

1.8.1.5 hipblasBfloat16

struct **hipblasBfloat16**

Struct to represent a 16 bit Brain floating-point number.

1.8.1.6 hipblasComplex

struct **hipblasComplex**

Struct to represent a complex number with single precision real and imaginary parts.

1.8.1.7 hipblasDoubleComplex

struct **hipblasDoubleComplex**

Struct to represent a complex number with double precision real and imaginary parts.

1.8.2 Enums

Enumeration constants have numbering that is consistent with CBLAS, ACML and most standard C BLAS libraries.

1.8.2.1 hipblasStatus_t

enum **hipblasStatus_t**

hipblas status codes definition

Values:

enumerator **HIPBLAS_STATUS_SUCCESS**

Function succeeds

enumerator **HIPBLAS_STATUS_NOT_INITIALIZED**
HIPBLAS library not initialized

enumerator **HIPBLAS_STATUS_ALLOC_FAILED**
resource allocation failed

enumerator **HIPBLAS_STATUS_INVALID_VALUE**
unsupported numerical value was passed to function

enumerator **HIPBLAS_STATUS_MAPPING_ERROR**
access to GPU memory space failed

enumerator **HIPBLAS_STATUS_EXECUTION_FAILED**
GPU program failed to execute

enumerator **HIPBLAS_STATUS_INTERNAL_ERROR**
an internal HIPBLAS operation failed

enumerator **HIPBLAS_STATUS_NOT_SUPPORTED**
function not implemented

enumerator **HIPBLAS_STATUS_ARCH_MISMATCH**
architecture mismatch

enumerator **HIPBLAS_STATUS_HANDLE_IS_NULLPTR**
hipBLAS handle is null pointer

enumerator **HIPBLAS_STATUS_INVALID_ENUM**
unsupported enum value was passed to function

enumerator **HIPBLAS_STATUS_UNKNOWN**
back-end returned an unsupported status code

1.8.2.2 hipblasOperation_t

enum **hipblasOperation_t**
Used to specify whether the matrix is to be transposed or not.

Values:

enumerator **HIPBLAS_OP_N**
Operate with the matrix.

enumerator **HIPBLAS_OP_T**
Operate with the transpose of the matrix.

enumerator **HIPBLAS_OP_C**
Operate with the conjugate transpose of the matrix.

1.8.2.3 hipblasPointerMode_t

enum **hipblasPointerMode_t**

Indicates if scalar pointers are on host or device. This is used for scalars alpha and beta and for scalar function return values.

Values:

enumerator **HIPBLAS_POINTER_MODE_HOST**

Scalar values affected by this variable will be located on the host.

enumerator **HIPBLAS_POINTER_MODE_DEVICE**

Scalar values affected by this variable will be located on the device.

1.8.2.4 hipblasFillMode_t

enum **hipblasFillMode_t**

Used by the Hermitian, symmetric and triangular matrix routines to specify whether the upper or lower triangle is being referenced.

Values:

enumerator **HIPBLAS_FILL_MODE_UPPER**

Upper triangle

enumerator **HIPBLAS_FILL_MODE_LOWER**

Lower triangle

enumerator **HIPBLAS_FILL_MODE_FULL**

1.8.2.5 hipblasDiagType_t

enum **hipblasDiagType_t**

It is used by the triangular matrix routines to specify whether the matrix is unit triangular.

Values:

enumerator **HIPBLAS_DIAG_NON_UNIT**

Non-unit triangular.

enumerator **HIPBLAS_DIAG_UNIT**

Unit triangular.

1.8.2.6 hipblasSideMode_t

enum **hipblasSideMode_t**

Indicates the side matrix A is located relative to matrix B during multiplication.

Values:

enumerator **HIPBLAS_SIDE_LEFT**

Multiply general matrix by symmetric, Hermitian or triangular matrix on the left.

enumerator **HIPBLAS_SIDE_RIGHT**

Multiply general matrix by symmetric, Hermitian or triangular matrix on the right.

enumerator **HIPBLAS_SIDE_BOTH**

1.8.2.7 hipblasDatatype_t

enum **hipblasDatatype_t**

Indicates the precision width of data stored in a blas type.

Values:

enumerator **HIPBLAS_R_16F**

16 bit floating point, real

enumerator **HIPBLAS_R_32F**

32 bit floating point, real

enumerator **HIPBLAS_R_64F**

64 bit floating point, real

enumerator **HIPBLAS_C_16F**

16 bit floating point, complex

enumerator **HIPBLAS_C_32F**

32 bit floating point, complex

enumerator **HIPBLAS_C_64F**

64 bit floating point, complex

enumerator **HIPBLAS_R_8I**

8 bit signed integer, real

enumerator **HIPBLAS_R_8U**

8 bit unsigned integer, real

enumerator **HIPBLAS_R_32I**

32 bit signed integer, real

enumerator **HIPBLAS_R_32U**

32 bit unsigned integer, real

enumerator **HIPBLAS_C_8I**
8 bit signed integer, complex

enumerator **HIPBLAS_C_8U**
8 bit unsigned integer, complex

enumerator **HIPBLAS_C_32I**
32 bit signed integer, complex

enumerator **HIPBLAS_C_32U**
32 bit unsigned integer, complex

enumerator **HIPBLAS_R_16B**
16 bit bfloat, real

enumerator **HIPBLAS_C_16B**
16 bit bfloat, complex

enumerator **HIPBLAS_DATATYPE_INVALID**
Invalid datatype value, do not use

1.8.2.8 hipblasGemmAlgo_t

enum **hipblasGemmAlgo_t**
Indicates if layer is active with bitmask.

Values:

enumerator **HIPBLAS_GEMM_DEFAULT**
enumerator rocblas_gemm_algo_standard

1.8.2.9 hipblasAtomicsMode_t

enum **hipblasAtomicsMode_t**
Indicates if atomics operations are allowed. Not allowing atomic operations may generally improve determinism and repeatability of results at a cost of performance.

Values:

enumerator **HIPBLAS_ATOMICS_NOT_ALLOWED**
Algorithms will refrain from atomics where applicable.

enumerator **HIPBLAS_ATOMICS_ALLOWED**
Algorithms will take advantage of atomics where applicable.

1.9 hipBLAS Functions

1.9.1 Level 1 BLAS

List of Level-1 BLAS Functions

1.9.1.1 hipblasIXamax + Batched, StridedBatched

hipblasStatus_t **hipblasIsamax**(*hipblasHandle_t* handle, int n, const float *x, int incx, int *result)

hipblasStatus_t **hipblasIdamax**(*hipblasHandle_t* handle, int n, const double *x, int incx, int *result)

hipblasStatus_t **hipblasIcamax**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *x, int incx, int *result)

hipblasStatus_t **hipblasIzamax**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *x, int incx, int *result)

BLAS Level 1 API.

amax finds the first index of the element of maximum magnitude of a vector x.

- Supported precisions in rocBLAS : s,d,c,z.
- Supported precisions in cuBLAS : s,d,c,z.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in x.

- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of y.
- **result** – **[inout]** device pointer or host pointer to store the amax index. return is 0.0 if n, incx<=0.

hipblasStatus_t **hipblasIsamaxBatched**(*hipblasHandle_t* handle, int n, const float *const x[], int incx, int batchCount, int *result)

hipblasStatus_t **hipblasIdamaxBatched**(*hipblasHandle_t* handle, int n, const double *const x[], int incx, int batchCount, int *result)

hipblasStatus_t **hipblasIcamaxBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *const x[], int incx, int batchCount, int *result)

hipblasStatus_t **hipblasIzamaxBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *const x[], int incx, int batchCount, int *result)

BLAS Level 1 API.

amaxBatched finds the first index of the element of maximum magnitude of each vector x_i in a batch, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : s,d,c,z.
- Supported precisions in cuBLAS : No support.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] number of elements in each vector x_i
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i. incx must be > 0.
- **batchCount** – **[in]** [int] number of instances in the batch, must be > 0.
- **result** – **[out]** device or host array of pointers of batchCount size for results. return is 0 if n, incx<=0.

hipblasStatus_t **hipblasIsamaxStridedBatched**(*hipblasHandle_t* handle, int n, const float *x, int incx, *hipblasStride* stridex, int batchCount, int *result)

hipblasStatus_t **hipblasIdamaxStridedBatched**(*hipblasHandle_t* handle, int n, const double *x, int incx, *hipblasStride* stridex, int batchCount, int *result)

hipblasStatus_t **hipblasIcamaxStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, int batchCount, int *result)

hipblasStatus_t **hipblasIzamaxStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, int batchCount, int *result)

BLAS Level 1 API.

amaxStridedBatched finds the first index of the element of maximum magnitude of each vector x_i in a batch, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] number of elements in each vector x_i
- **x** – **[in]** device pointer to the first vector x_1.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i. incx must be > 0.
- **stridex** – **[in]** [hipblasStride] specifies the pointer increment between one x_i and the next x_(i + 1).
- **batchCount** – **[in]** [int] number of instances in the batch
- **result** – **[out]** device or host pointer for storing contiguous batchCount results. return is 0 if n <= 0, incx<=0.

1.9.1.2 hipblasIXamin + Batched, StridedBatched

hipblasStatus_t **hipblasIsamin**(*hipblasHandle_t* handle, int n, const float *x, int incx, int *result)

hipblasStatus_t **hipblasIdamin**(*hipblasHandle_t* handle, int n, const double *x, int incx, int *result)

hipblasStatus_t **hipblasIcamin**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *x, int incx, int *result)

hipblasStatus_t **hipblasIzamin**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *x, int incx, int *result)

BLAS Level 1 API.

amin finds the first index of the element of minimum magnitude of a vector x.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in x.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of y.
- **result** – **[inout]** device pointer or host pointer to store the amin index. return is 0.0 if n, incx<=0.

hipblasStatus_t **hipblasIsaminBatched**(*hipblasHandle_t* handle, int n, const float *const x[], int incx, int batchCount, int *result)

hipblasStatus_t **hipblasIdaminBatched**(*hipblasHandle_t* handle, int n, const double *const x[], int incx, int batchCount, int *result)

hipblasStatus_t **hipblasIcaminBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *const x[], int incx, int batchCount, int *result)

hipblasStatus_t **hipblasIzaminBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *const x[], int incx, int batchCount, int *result)

BLAS Level 1 API.

aminBatched finds the first index of the element of minimum magnitude of each vector x_i in a batch, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] number of elements in each vector x_i
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i. incx must be > 0.
- **batchCount** – **[in]** [int] number of instances in the batch, must be > 0.
- **result** – **[out]** device or host pointers to array of batchCount size for results. return is 0 if n, incx<=0.

hipblasStatus_t **hipblasIsaminStridedBatched**(*hipblasHandle_t* handle, int n, const float *x, int incx, *hipblasStride* stridex, int batchCount, int *result)

hipblasStatus_t **hipblasIdaminStridedBatched**(*hipblasHandle_t* handle, int n, const double *x, int incx, *hipblasStride* stridex, int batchCount, int *result)

hipblasStatus_t **hipblasIcaminStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, int batchCount, int *result)

hipblasStatus_t **hipblasIzaminStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, int batchCount, int *result)

BLAS Level 1 API.

aminStridedBatched finds the first index of the element of minimum magnitude of each vector x_i in a batch, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] number of elements in each vector x_i
- **x** – **[in]** device pointer to the first vector x_1.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i. incx must be > 0.
- **stridex** – **[in]** [hipblasStride] specifies the pointer increment between one x_i and the next x_(i + 1)
- **batchCount** – **[in]** [int] number of instances in the batch
- **result** – **[out]** device or host pointer to array for storing contiguous batchCount results. return is 0 if n <= 0, incx<=0.

1.9.1.3 hipblasXasum + Batched, StridedBatched

hipblasStatus_t **hipblasSasum**(*hipblasHandle_t* handle, int n, const float *x, int incx, float *result)

hipblasStatus_t **hipblasDasum**(*hipblasHandle_t* handle, int n, const double *x, int incx, double *result)

hipblasStatus_t **hipblasScasum**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *x, int incx, float *result)

hipblasStatus_t **hipblasDzasum**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *x, int incx, double *result)

BLAS Level 1 API.

asum computes the sum of the magnitudes of elements of a real vector x, or the sum of magnitudes of the real and imaginary parts of elements if x is a complex vector.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in x and y.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x. incx must be > 0.
- **result** – **[inout]** device pointer or host pointer to store the asum product. return is 0.0 if n <= 0.

hipblasStatus_t **hipblasSasumBatched**(*hipblasHandle_t* handle, int n, const float *const x[], int incx, int batchCount, float *result)

hipblasStatus_t **hipblasDasumBatched**(*hipblasHandle_t* handle, int n, const double *const x[], int incx, int batchCount, double *result) *hipblasStatus_t* **hipblasScasumBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *const x[], int incx, int batchCount, float *result)

hipblasStatus_t **hipblasDzasumBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *const x[], int incx, int batchCount, double *result)

BLAS Level 1 API.

asumBatched computes the sum of the magnitudes of the elements in a batch of real vectors x_i, or the sum of magnitudes of the real and imaginary parts of elements if x_i is a complex vector, for i = 1, …, batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] number of elements in each vector x_i
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i. incx must be > 0.
- **batchCount** – **[in]** [int] number of instances in the batch.
- **result** – **[out]** device array or host array of batchCount size for results. return is 0.0 if n, incx<=0.

hipblasStatus_t **hipblasSasumStridedBatched**(*hipblasHandle_t* handle, int n, const float *x, int incx, *hipblasStride* stridex, int batchCount, float *result)

hipblasStatus_t **hipblasDasumStridedBatched**(*hipblasHandle_t* handle, int n, const double *x, int incx, *hipblasStride* stridex, int batchCount, double *result)

hipblasStatus_t **hipblasScasumStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, int batchCount, float *result)

hipblasStatus_t **hipblasDzasumStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, int batchCount, double *result)

BLAS Level 1 API.

asumStridedBatched computes the sum of the magnitudes of elements of a real vectors x_i, or the sum of magnitudes of the real and imaginary parts of elements if x_i is a complex vector, for i = 1, …, batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] number of elements in each vector x_i
- **x** – **[in]** device pointer to the first vector x_1.

- **incx** – **[in]** [int] specifies the increment for the elements of each x_i. incx must be > 0.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1). There are no restrictions placed on stride_x, however the user should take care to ensure that stride_x is of appropriate size, for a typical case this means stride_x >= n * incx.
- **batchCount** – **[in]** [int] number of instances in the batch
- **result** – **[out]** device pointer or host pointer to array for storing contiguous batchCount results. return is 0.0 if n, incx<=0.

1.9.1.4 hipblasXaxpy + Batched, StridedBatched

hipblasStatus_t **hipblasHaxpy**(*hipblasHandle_t* handle, int n, const *hipblasHalf* *alpha, const *hipblasHalf* *x, int incx, *hipblasHalf* *y, int incy)

hipblasStatus_t **hipblasSaxpy**(*hipblasHandle_t* handle, int n, const float *alpha, const float *x, int incx, float *y, int incy)

hipblasStatus_t **hipblasDaxpy**(*hipblasHandle_t* handle, int n, const double *alpha, const double *x, int incx, double *y, int incy)

hipblasStatus_t **hipblasCaxpy**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *x, int incx, *hipblasComplex* *y, int incy)

hipblasStatus_t **hipblasZaxpy**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *x, int incx, *hipblasDoubleComplex* *y, int incy)

BLAS Level 1 API.

axpy computes constant alpha multiplied by vector x, plus vector y

```
y := alpha * x + y
```

- Supported precisions in rocBLAS : h,s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in x and y.
- **alpha** – **[in]** device pointer or host pointer to specify the scalar alpha.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **y** – **[out]** device pointer storing vector y.
- **incy** – **[inout]** [int] specifies the increment for the elements of y.

hipblasStatus_t **hipblasHaxpyBatched**(*hipblasHandle_t* handle, int n, const *hipblasHalf* *alpha, const *hipblasHalf* *const x[], int incx, *hipblasHalf* *const y[], int incy, int batchCount)

hipblasStatus_t **hipblasSaxpyBatched**(*hipblasHandle_t* handle, int n, const float *alpha, const float *const x[], int incx, float *const y[], int incy, int batchCount)

hipblasStatus_t **hipblasDaxpyBatched**(*hipblasHandle_t* handle, int n, const double *alpha, const double *const x[], int incx, double *const y[], int incy, int batchCount)

hipblasStatus_t **hipblasCaxpyBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *const x[], int incx, *hipblasComplex* *const y[], int incy, int batchCount)

hipblasStatus_t **hipblasZaxpyBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const x[], int incx, *hipblasDoubleComplex* *const y[], int incy, int batchCount)

BLAS Level 1 API.

axpyBatched compute y := alpha * x + y over a set of batched vectors.

- Supported precisions in rocBLAS : h,s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in x and y.
- **alpha** – **[in]** specifies the scalar alpha.
- **x** – **[in]** pointer storing vector x on the GPU.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **y** – **[out]** pointer storing vector y on the GPU.
- **incy** – **[inout]** [int] specifies the increment for the elements of y.
- **batchCount** – **[in]** [int] number of instances in the batch

hipblasStatus_t **hipblasHaxpyStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasHalf* *alpha, const *hipblasHalf* *x, int incx, *hipblasStride* stridex, *hipblasHalf* *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasSaxpyStridedBatched**(*hipblasHandle_t* handle, int n, const float *alpha, const float *x, int incx, *hipblasStride* stridex, float *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasDaxpyStridedBatched**(*hipblasHandle_t* handle, int n, const double *alpha, const double *x, int incx, *hipblasStride* stridex, double *y, int incy, *hipblasStride* stridey, int batchCount) *hipblasStatus_t* **hipblasCaxpyStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, *hipblasComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasZaxpyStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

BLAS Level 1 API.

axpyStridedBatched compute y := alpha * x + y over a set of strided batched vectors.

- Supported precisions in rocBLAS : h,s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int]
- **alpha** – **[in]** specifies the scalar alpha.
- **x** – **[in]** pointer storing vector x on the GPU.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **stridex** – **[in]** [hipblasStride] specifies the increment between vectors of x.
- **y** – **[out]** pointer storing vector y on the GPU.
- **incy** – **[inout]** [int] specifies the increment for the elements of y.
- **stridey** – **[in]** [hipblasStride] specifies the increment between vectors of y.
- **batchCount** – **[in]** [int] number of instances in the batch

1.9.1.5 hipblasXcopy + Batched, StridedBatched

hipblasStatus_t **hipblasScopy**(*hipblasHandle_t* handle, int n, const float *x, int incx, float *y, int incy)

hipblasStatus_t **hipblasDcopy**(*hipblasHandle_t* handle, int n, const double *x, int incx, double *y, int incy)

hipblasStatus_t **hipblasCcopy**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *x, int incx, *hipblasComplex* *y, int incy)

hipblasStatus_t **hipblasZcopy**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *x, int incx, *hipblasDoubleComplex* *y, int incy)

BLAS Level 1 API.

copy copies each element x[i] into y[i], for i = 1 , … , n

```
y := x,
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in x to be copied to y.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **y** – **[out]** device pointer storing vector y.
- **incy** – **[in]** [int] specifies the increment for the elements of y.

hipblasStatus_t **hipblasScopyBatched**(*hipblasHandle_t* handle, int n, const float *const x[], int incx, float *const y[], int incy, int batchCount)

hipblasStatus_t **hipblasDcopyBatched**(*hipblasHandle_t* handle, int n, const double *const x[], int incx, double *const y[], int incy, int batchCount)

hipblasStatus_t **hipblasCcopyBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *const x[], int incx, *hipblasComplex* *const y[], int incy, int batchCount)

hipblasStatus_t **hipblasZcopyBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *const x[], int incx, *hipblasDoubleComplex* *const y[], int incy, int batchCount)

BLAS Level 1 API.

copyBatched copies each element x_i[j] into y_i[j], for j = 1 , … , n; i = 1 , … , batchCount

```
y_i := x_i,
```

where (x_i, y_i) is the i-th instance of the batch. x_i and y_i are vectors.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in each x_i to be copied to y_i.
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each vector x_i.
- **y** – **[out]** device array of device pointers storing each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of each vector y_i.
- **batchCount** – **[in]** [int] number of instances in the batch

hipblasStatus_t **hipblasScopyStridedBatched**(*hipblasHandle_t* handle, int n, const float *x, int incx, *hipblasStride* stridex, float *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasDcopyStridedBatched**(*hipblasHandle_t* handle, int n, const double *x, int incx, *hipblasStride* stridex, double *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasCcopyStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, *hipblasComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasZcopyStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

BLAS Level 1 API.

copyStridedBatched copies each element x_i[j] into y_i[j], for j = 1 , … , n; i = 1 , … , batchCount

```
y_i := x_i,
```

where (x_i, y_i) is the i-th instance of the batch. x_i and y_i are vectors.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in each x_i to be copied to y_i.
- **x** – **[in]** device pointer to the first vector (x_1) in the batch.
- **incx** – **[in]** [int] specifies the increments for the elements of vectors x_i.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1). There are no restrictions placed on stride_x, however the user should take care to ensure that stride_x is of appropriate size, for a typical case this means stride_x >= n * incx.
- **y** – **[out]** device pointer to the first vector (y_1) in the batch.
- **incy** – **[in]** [int] specifies the increment for the elements of vectors y_i.
- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) and the next one (y_i+1). There are no restrictions placed on stride_y, however the user should take care to ensure that stride_y is of appropriate size, for a typical case this means stride_y >= n * incy. stridey should be non zero.
- **batchCount** – **[in]** [int] number of instances in the batch

1.9.1.6 hipblasXdot + Batched, StridedBatched

hipblasStatus_t **hipblasHdot**(*hipblasHandle_t* handle, int n, const *hipblasHalf* *x, int incx, const *hipblasHalf* *y, int incy, *hipblasHalf* *result)

hipblasStatus_t **hipblasBfdot**(*hipblasHandle_t* handle, int n, const *hipblasBfloat16* *x, int incx, const *hipblasBfloat16* *y, int incy, *hipblasBfloat16* *result)

hipblasStatus_t **hipblasSdot**(*hipblasHandle_t* handle, int n, const float *x, int incx, const float *y, int incy, float *result)

hipblasStatus_t **hipblasDdot**(*hipblasHandle_t* handle, int n, const double *x, int incx, const double *y, int incy, double *result)

hipblasStatus_t **hipblasCdotc**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *x, int incx, const *hipblasComplex* *y, int incy, *hipblasComplex* *result)

hipblasStatus_t **hipblasCdotu**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *x, int incx, const *hipblasComplex* *y, int incy, *hipblasComplex* *result)

hipblasStatus_t **hipblasZdotc**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *x, int incx, const *hipblasDoubleComplex* *y, int incy, *hipblasDoubleComplex* *result)

hipblasStatus_t **hipblasZdotu**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *x, int incx, const *hipblasDoubleComplex* *y, int incy, *hipblasDoubleComplex* *result)

BLAS Level 1 API.

dot(u) performs the dot product of vectors x and y

```
result = x * y;
```

dotc performs the dot product of the conjugate of complex vector x and complex vector y

```
result = conjugate (x) * y;
```

- Supported precisions in rocBLAS : h,bf,s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in x and y.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of y.
- **y** – **[in]** device pointer storing vector y.
- **incy** – **[in]** [int] specifies the increment for the elements of y.

- **result** – **[inout]** device pointer or host pointer to store the dot product. return is 0.0 if n <= 0.

hipblasStatus_t **hipblasHdotBatched**(*hipblasHandle_t* handle, int n, const *hipblasHalf* *const x[], int incx, const *hipblasHalf* *const y[], int incy, int batchCount, *hipblasHalf* *result)

hipblasStatus_t **hipblasBfdotBatched**(*hipblasHandle_t* handle, int n, const *hipblasBfloat16* *const x[], int incx, const *hipblasBfloat16* *const y[], int incy, int batchCount, *hipblasBfloat16* *result)

hipblasStatus_t **hipblasSdotBatched**(*hipblasHandle_t* handle, int n, const float *const x[], int incx, const float *const y[], int incy, int batchCount, float *result)

hipblasStatus_t **hipblasDdotBatched**(*hipblasHandle_t* handle, int n, const double *const x[], int incx, const double *const y[], int incy, int batchCount, double *result)

hipblasStatus_t **hipblasCdotcBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *const x[], int incx, const *hipblasComplex* *const y[], int incy, int batchCount, *hipblasComplex* *result)

hipblasStatus_t **hipblasCdotuBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *const x[], int incx, const *hipblasComplex* *const y[], int incy, int batchCount, *hipblasComplex* *result)

hipblasStatus_t **hipblasZdotcBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *const x[], int incx, const *hipblasDoubleComplex* *const y[], int incy, int batchCount, *hipblasDoubleComplex* *result)

hipblasStatus_t **hipblasZdotuBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *const x[], int incx, const *hipblasDoubleComplex* *const y[], int incy, int batchCount, *hipblasDoubleComplex* *result)

BLAS Level 1 API.

dotBatched(u) performs a batch of dot products of vectors x and y

```
result_i = x_i * y_i;
```

dotcBatched performs a batch of dot products of the conjugate of complex vector x and complex vector y

```
result_i = conjugate (x_i) * y_i;
```

where (x_i, y_i) is the i-th instance of the batch. x_i and y_i are vectors, for i = 1, …, batchCount

- Supported precisions in rocBLAS : h,bf,s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in each x_i and y_i.

- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **y** – **[in]** device array of device pointers storing each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.
- **batchCount** – **[in]** [int] number of instances in the batch
- **result** – **[inout]** device array or host array of batchCount size to store the dot products of each batch. return 0.0 for each element if n <= 0.

hipblasStatus_t **hipblasHdotStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasHalf* *x, int incx, *hipblasStride* stridex, const *hipblasHalf* *y, int incy, *hipblasStride* stridey, int batchCount, *hipblasHalf* *result)

hipblasStatus_t **hipblasBfdotStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasBfloat16* *x, int incx, *hipblasStride* stridex, const *hipblasBfloat16* *y, int incy, *hipblasStride* stridey, int batchCount, *hipblasBfloat16* *result)

hipblasStatus_t **hipblasSdotStridedBatched**(*hipblasHandle_t* handle, int n, const float *x, int incx, *hipblasStride* stridex, const float *y, int incy, *hipblasStride* stridey, int batchCount, float *result)

hipblasStatus_t **hipblasDdotStridedBatched**(*hipblasHandle_t* handle, int n, const double *x, int incx, *hipblasStride* stridex, const double *y, int incy, *hipblasStride* stridey, int batchCount, double *result)

hipblasStatus_t **hipblasCdotcStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, const *hipblasComplex* *y, int incy, *hipblasStride* stridey, int batchCount, *hipblasComplex* *result)

hipblasStatus_t **hipblasCdotuStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, const *hipblasComplex* *y, int incy, *hipblasStride* stridey, int batchCount, *hipblasComplex* *result)

hipblasStatus_t **hipblasZdotcStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, const *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, int batchCount, *hipblasDoubleComplex* *result)

hipblasStatus_t **hipblasZdotuStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, const *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, int batchCount, *hipblasDoubleComplex* *result)

BLAS Level 1 API.

dotStridedBatched(u) performs a batch of dot products of vectors x and y

```
result_i = x_i * y_i;
```

dotcStridedBatched performs a batch of dot products of the conjugate of complex vector x and complex vector y

```
result_i = conjugate (x_i) * y_i;
```

where (x_i, y_i) is the i-th instance of the batch. x_i and y_i are vectors, for i = 1, …, batchCount

- Supported precisions in rocBLAS : h,bf,s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in each x_i and y_i.
- **x** – **[in]** device pointer to the first vector (x_1) in the batch.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1)
- **y** – **[in]** device pointer to the first vector (y_1) in the batch.
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.
- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) and the next one (y_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch
- **result** – **[inout]** device array or host array of batchCount size to store the dot products of each batch. return 0.0 for each element if n <= 0.

1.9.1.7 hipblasXnrm2 + Batched, StridedBatched

hipblasStatus_t **hipblasSnrm2**(*hipblasHandle_t* handle, int n, const float *x, int incx, float *result)

hipblasStatus_t **hipblasDnrm2**(*hipblasHandle_t* handle, int n, const double *x, int incx, double *result)

hipblasStatus_t **hipblasScnrm2**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *x, int incx, float *result)

hipblasStatus_t **hipblasDznrm2**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *x, int incx, double *result)

BLAS Level 1 API.

nrm2 computes the euclidean norm of a real or complex vector

```
      result := sqrt( x'*x ) for real vectors
      result := sqrt( x**H*x ) for complex vectors
```

- Supported precisions in rocBLAS : s,d,c,z,sc,dz
- Supported precisions in cuBLAS : s,d,sc,dz

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in x.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of y.
- **result** – **[inout]** device pointer or host pointer to store the nrm2 product. return is 0.0 if n, incx<=0.

hipblasStatus_t **hipblasSnrm2Batched**(*hipblasHandle_t* handle, int n, const float *const x[], int incx, int batchCount, float *result)

hipblasStatus_t **hipblasDnrm2Batched**(*hipblasHandle_t* handle, int n, const double *const x[], int incx, int batchCount, double *result)

hipblasStatus_t **hipblasScnrm2Batched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *const x[], int incx, int batchCount, float *result)

hipblasStatus_t **hipblasDznrm2Batched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *const x[], int incx, int batchCount, double *result)

BLAS Level 1 API.

nrm2Batched computes the euclidean norm over a batch of real or complex vectors

```
    result := sqrt( x_i'*x_i ) for real vectors x, for i = 1, ..., batchCount
    result := sqrt( x_i**H*x_i ) for complex vectors x, for i = 1, ..., batchCount
```

- Supported precisions in rocBLAS : s,d,c,z,sc,dz
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] number of elements in each x_i.
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i. incx must be > 0.
- **batchCount** – **[in]** [int] number of instances in the batch
- **result** – **[out]** device pointer or host pointer to array of batchCount size for nrm2 results. return is 0.0 for each element if n <= 0, incx<=0.

hipblasStatus_t **hipblasSnrm2StridedBatched**(*hipblasHandle_t* handle, int n, const float *x, int incx, *hipblasStride* stridex, int batchCount, float *result)

hipblasStatus_t **hipblasDnrm2StridedBatched**(*hipblasHandle_t* handle, int n, const double *x, int incx, *hipblasStride* stridex, int batchCount, double *result) *hipblasStatus_t* **hipblasScnrm2StridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, int batchCount, float *result)

hipblasStatus_t **hipblasDznrm2StridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, int batchCount, double *result)

BLAS Level 1 API.

nrm2StridedBatched computes the euclidean norm over a batch of real or complex vectors

```
:= sqrt( x_i'*x_i ) for real vectors x, for i = 1, ..., batchCount
:= sqrt( x_i**H*x_i ) for complex vectors, for i = 1, ..., batchCount
```

- Supported precisions in rocBLAS : s,d,c,z,sc,dz
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] number of elements in each x_i.
- **x** – **[in]** device pointer to the first vector x_1.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i. incx must be > 0.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1). There are no restrictions placed on stride_x, however the user should take care to ensure that stride_x is of appropriate size, for a typical case this means stride_x >= n * incx.
- **batchCount** – **[in]** [int] number of instances in the batch
- **result** – **[out]** device pointer or host pointer to array for storing contiguous batchCount results. return is 0.0 for each element if n <= 0, incx<=0.

1.9.1.8 hipblasXrot + Batched, StridedBatched

hipblasStatus_t **hipblasSrot**(*hipblasHandle_t* handle, int n, float *x, int incx, float *y, int incy, const float *c, const float *s)

hipblasStatus_t **hipblasDrot**(*hipblasHandle_t* handle, int n, double *x, int incx, double *y, int incy, const double *c, const double *s)

hipblasStatus_t **hipblasCrot**(*hipblasHandle_t* handle, int n, *hipblasComplex* *x, int incx, *hipblasComplex* *y, int incy, const float *c, const *hipblasComplex* *s)

hipblasStatus_t **hipblasCsrot**(*hipblasHandle_t* handle, int n, *hipblasComplex* *x, int incx, *hipblasComplex* *y, int incy, const float *c, const float *s)

hipblasStatus_t **hipblasZrot**(*hipblasHandle_t* handle, int n, *hipblasDoubleComplex* *x, int incx, *hipblasDoubleComplex* *y, int incy, const double *c, const *hipblasDoubleComplex* *s) *hipblasStatus_t* **hipblasZdrot**(*hipblasHandle_t* handle, int n, *hipblasDoubleComplex* *x, int incx, *hipblasDoubleComplex* *y, int incy, const double *c, const double *s)

BLAS Level 1 API.

rot applies the Givens rotation matrix defined by c=cos(alpha) and s=sin(alpha) to vectors x and y. Scalars c and s may be stored in either host or device memory, location is specified by calling hipblasSetPointerMode.

- Supported precisions in rocBLAS : s,d,c,z,sc,dz
- Supported precisions in cuBLAS : s,d,c,z,cs,zd

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] number of elements in the x and y vectors.
- **x** – **[inout]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment between elements of x.
- **y** – **[inout]** device pointer storing vector y.
- **incy** – **[in]** [int] specifies the increment between elements of y.
- **c** – **[in]** device pointer or host pointer storing scalar cosine component of the rotation matrix.
- **s** – **[in]** device pointer or host pointer storing scalar sine component of the rotation matrix.

hipblasStatus_t **hipblasSrotBatched**(*hipblasHandle_t* handle, int n, float *const x[], int incx, float *const y[], int incy, const float *c, const float *s, int batchCount)

hipblasStatus_t **hipblasDrotBatched**(*hipblasHandle_t* handle, int n, double *const x[], int incx, double *const y[], int incy, const double *c, const double *s, int batchCount)

hipblasStatus_t **hipblasCrotBatched**(*hipblasHandle_t* handle, int n, *hipblasComplex* *const x[], int incx, *hipblasComplex* *const y[], int incy, const float *c, const *hipblasComplex* *s, int batchCount)

hipblasStatus_t **hipblasCsrotBatched**(*hipblasHandle_t* handle, int n, *hipblasComplex* *const x[], int incx, *hipblasComplex* *const y[], int incy, const float *c, const float *s, int batchCount)

hipblasStatus_t **hipblasZrotBatched**(*hipblasHandle_t* handle, int n, *hipblasDoubleComplex* *const x[], int incx, *hipblasDoubleComplex* *const y[], int incy, const double *c, const *hipblasDoubleComplex* *s, int batchCount)

hipblasStatus_t **hipblasZdrotBatched**(*hipblasHandle_t* handle, int n, *hipblasDoubleComplex* *const x[], int incx, *hipblasDoubleComplex* *const y[], int incy, const double *c, const double *s, int batchCount)

BLAS Level 1 API.

rotBatched applies the Givens rotation matrix defined by c=cos(alpha) and s=sin(alpha) to batched vectors x_i and y_i, for i = 1, …, batchCount. Scalars c and s may be stored in either host or device memory, location is specified by calling hipblasSetPointerMode.

- Supported precisions in rocBLAS : s,d,sc,dz
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] number of elements in each x_i and y_i vectors.
- **x** – **[inout]** device array of deivce pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment between elements of each x_i.
- **y** – **[inout]** device array of device pointers storing each vector y_i.
- **incy** – **[in]** [int] specifies the increment between elements of each y_i.
- **c** – **[in]** device pointer or host pointer to scalar cosine component of the rotation matrix.
- **s** – **[in]** device pointer or host pointer to scalar sine component of the rotation matrix.
- **batchCount** – **[in]** [int] the number of x and y arrays, i.e. the number of batches.

hipblasStatus_t **hipblasSrotStridedBatched**(*hipblasHandle_t* handle, int n, float *x, int incx, *hipblasStride* stridex, float *y, int incy, *hipblasStride* stridey, const float *c, const float *s, int batchCount)

hipblasStatus_t **hipblasDrotStridedBatched**(*hipblasHandle_t* handle, int n, double *x, int incx, *hipblasStride* stridex, double *y, int incy, *hipblasStride* stridey, const double *c, const double *s, int batchCount)

hipblasStatus_t **hipblasCrotStridedBatched**(*hipblasHandle_t* handle, int n, *hipblasComplex* *x, int incx, *hipblasStride* stridex, *hipblasComplex* *y, int incy, *hipblasStride* stridey, const float *c, const *hipblasComplex* *s, int batchCount)

hipblasStatus_t **hipblasCsrotStridedBatched**(*hipblasHandle_t* handle, int n, *hipblasComplex* *x, int incx, *hipblasStride* stridex, *hipblasComplex* *y, int incy, *hipblasStride* stridey, const float *c, const float *s, int batchCount)

hipblasStatus_t **hipblasZrotStridedBatched**(*hipblasHandle_t* handle, int n, *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, const double *c, const *hipblasDoubleComplex* *s, int batchCount)

hipblasStatus_t **hipblasZdrotStridedBatched**(*hipblasHandle_t* handle, int n, *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, const double *c, const double *s, int batchCount)

BLAS Level 1 API.

rotStridedBatched applies the Givens rotation matrix defined by c=cos(alpha) and s=sin(alpha) to strided batched vectors x_i and y_i, for i = 1, …, batchCount. Scalars c and s may be stored in either host or device memory, location is specified by calling hipblasSetPointerMode.

- Supported precisions in rocBLAS : s,d,sc,dz
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] number of elements in each x_i and y_i vectors.
- **x** – **[inout]** device pointer to the first vector x_1.
- **incx** – **[in]** [int] specifies the increment between elements of each x_i.
- **stridex** – **[in]** [hipblasStride] specifies the increment from the beginning of x_i to the beginning of x_(i+1)
- **y** – **[inout]** device pointer to the first vector y_1.
- **incy** – **[in]** [int] specifies the increment between elements of each y_i.
- **stridey** – **[in]** [hipblasStride] specifies the increment from the beginning of y_i to the beginning of y_(i+1)
- **c** – **[in]** device pointer or host pointer to scalar cosine component of the rotation matrix.
- **s** – **[in]** device pointer or host pointer to scalar sine component of the rotation matrix.
- **batchCount** – **[in]** [int] the number of x and y arrays, i.e. the number of batches.

1.9.1.9 hipblasXrotg + Batched, StridedBatched

hipblasStatus_t **hipblasSrotg**(*hipblasHandle_t* handle, float *a, float *b, float *c, float *s)

hipblasStatus_t **hipblasDrotg**(*hipblasHandle_t* handle, double *a, double *b, double *c, double *s)

hipblasStatus_t **hipblasCrotg**(*hipblasHandle_t* handle, *hipblasComplex* *a, *hipblasComplex* *b, float *c, *hipblasComplex* *s)

hipblasStatus_t **hipblasZrotg**(*hipblasHandle_t* handle, *hipblasDoubleComplex* *a, *hipblasDoubleComplex* *b, double *c, *hipblasDoubleComplex* *s)

BLAS Level 1 API.

rotg creates the Givens rotation matrix for the vector (a b). Scalars c and s and arrays a and b may be stored in either host or device memory, location is specified by calling hipblasSetPointerMode. If the pointer mode is set to HIPBLAS_POINTER_MODE_HOST, this function blocks the CPU until the GPU has finished and the results are available in host memory. If the pointer mode is set to HIPBLAS_POINTER_MODE_DEVICE, this function returns immediately and synchronization is required to read the results.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **a** – **[inout]** device pointer or host pointer to input vector element, overwritten with r.

- **b** – **[inout]** device pointer or host pointer to input vector element, overwritten with z.
- **c** – **[inout]** device pointer or host pointer to cosine element of Givens rotation.
- **s** – **[inout]** device pointer or host pointer sine element of Givens rotation.

hipblasStatus_t **hipblasSrotgBatched**(*hipblasHandle_t* handle, float *const a[], float *const b[], float *const c[], float *const s[], int batchCount)

hipblasStatus_t **hipblasDrotgBatched**(*hipblasHandle_t* handle, double *const a[], double *const b[], double *const c[], double *const s[], int batchCount)

hipblasStatus_t **hipblasCrotgBatched**(*hipblasHandle_t* handle, *hipblasComplex* *const a[], *hipblasComplex* *const b[], float *const c[], *hipblasComplex* *const s[], int batchCount)

hipblasStatus_t **hipblasZrotgBatched**(*hipblasHandle_t* handle, *hipblasDoubleComplex* *const a[], *hipblasDoubleComplex* *const b[], double *const c[], *hipblasDoubleComplex* *const s[], int batchCount)

BLAS Level 1 API.

rotgBatched creates the Givens rotation matrix for the batched vectors (a_i b_i), for i = 1, …, batchCount. a, b, c, and s may be stored in either host or device memory, location is specified by calling hipblasSetPointerMode. If the pointer mode is set to HIPBLAS_POINTER_MODE_HOST, this function blocks the CPU until the GPU has finished and the results are available in host memory. If the pointer mode is set to HIPBLAS_POINTER_MODE_DEVICE, this function returns immediately and synchronization is required to read the results.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **a** – **[inout]** device array of device pointers storing each single input vector element a_i, overwritten with r_i.
- **b** – **[inout]** device array of device pointers storing each single input vector element b_i, overwritten with z_i.
- **c** – **[inout]** device array of device pointers storing each cosine element of Givens rotation for the batch.
- **s** – **[inout]** device array of device pointers storing each sine element of Givens rotation for the batch.
- **batchCount** – **[in]** [int] number of batches (length of arrays a, b, c, and s).

hipblasStatus_t **hipblasSrotgStridedBatched**(*hipblasHandle_t* handle, float *a, *hipblasStride* stridea, float *b, *hipblasStride* strideb, float *c, *hipblasStride* stridec, float *s, *hipblasStride* strides, int batchCount) *hipblasStatus_t* **hipblasDrotgStridedBatched**(*hipblasHandle_t* handle, double *a, *hipblasStride* stridea, double *b, *hipblasStride* strideb, double *c, *hipblasStride* stridec, double *s, *hipblasStride* strides, int batchCount)

hipblasStatus_t **hipblasCrotgStridedBatched**(*hipblasHandle_t* handle, *hipblasComplex* *a, *hipblasStride* stridea, *hipblasComplex* *b, *hipblasStride* strideb, float *c, *hipblasStride* stridec, *hipblasComplex* *s, *hipblasStride* strides, int batchCount)

hipblasStatus_t **hipblasZrotgStridedBatched**(*hipblasHandle_t* handle, *hipblasDoubleComplex* *a, *hipblasStride* stridea, *hipblasDoubleComplex* *b, *hipblasStride* strideb, double *c, *hipblasStride* stridec, *hipblasDoubleComplex* *s, *hipblasStride* strides, int batchCount)

BLAS Level 1 API.

rotgStridedBatched creates the Givens rotation matrix for the strided batched vectors (a_i b_i), for i = 1, …, batchCount. a, b, c, and s may be stored in either host or device memory, location is specified by calling hipblasSetPointerMode. If the pointer mode is set to HIPBLAS_POINTER_MODE_HOST, this function blocks the CPU until the GPU has finished and the results are available in host memory. If the pointer mode is set to HIPBLAS_POINTER_MODE_HOST, this function returns immediately and synchronization is required to read the results.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **a** – **[inout]** device strided_batched pointer or host strided_batched pointer to first single input vector element a_1, overwritten with r.
- **stridea** – **[in]** [hipblasStride] distance between elements of a in batch (distance between a_i and a_(i + 1))
- **b** – **[inout]** device strided_batched pointer or host strided_batched pointer to first single input vector element b_1, overwritten with z.
- **strideb** – **[in]** [hipblasStride] distance between elements of b in batch (distance between b_i and b_(i + 1))
- **c** – **[inout]** device strided_batched pointer or host strided_batched pointer to first cosine element of Givens rotations c_1.
- **stridec** – **[in]** [hipblasStride] distance between elements of c in batch (distance between c_i and c_(i + 1))
- **s** – **[inout]** device strided_batched pointer or host strided_batched pointer to sine element of Givens rotations s_1.
- **strides** – **[in]** [hipblasStride] distance between elements of s in batch (distance between s_i and s_(i + 1))
- **batchCount** – **[in]** [int] number of batches (length of arrays a, b, c, and s).

1.9.1.10 hipblasXrotm + Batched, StridedBatched

hipblasStatus_t **hipblasSrotm**(*hipblasHandle_t* handle, int n, float *x, int incx, float *y, int incy, const float *param)

hipblasStatus_t **hipblasDrotm**(*hipblasHandle_t* handle, int n, double *x, int incx, double *y, int incy, const double *param)

BLAS Level 1 API.

rotm applies the modified Givens rotation matrix defined by param to vectors x and y.

- Supported precisions in rocBLAS : s,d
- Supported precisions in cuBLAS : s,d

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] number of elements in the x and y vectors.
- **x** – **[inout]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment between elements of x.
- **y** – **[inout]** device pointer storing vector y.
- **incy** – **[in]** [int] specifies the increment between elements of y.
- **param** – **[in]** device vector or host vector of 5 elements defining the rotation. param[0] = flag param[1] = H11 param[2] = H21 param[3] = H12 param[4] = H22 The flag parameter defines the form of H: flag = -1 => H = (H11 H12 H21 H22) flag = 0 => H = (1.0 H12 H21 1.0) flag = 1 => H = (H11 1.0 -1.0 H22) flag = -2 => H = (1.0 0.0 0.0 1.0) param may be stored in either host or device memory, location is specified by calling hipblasSetPointerMode.

hipblasStatus_t **hipblasSrotmBatched**(*hipblasHandle_t* handle, int n, float *const x[], int incx, float *const y[], int incy, const float *const param[], int batchCount)

hipblasStatus_t **hipblasDrotmBatched**(*hipblasHandle_t* handle, int n, double *const x[], int incx, double *const y[], int incy, const double *const param[], int batchCount)

BLAS Level 1 API.

rotmBatched applies the modified Givens rotation matrix defined by param_i to batched vectors x_i and y_i, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : s,d
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] number of elements in the x and y vectors.
- **x** – **[inout]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment between elements of each x_i.

- **y** – **[inout]** device array of device pointers storing each vector y_1.
- **incy** – **[in]** [int] specifies the increment between elements of each y_i.
- **param** – **[in]** device array of device vectors of 5 elements defining the rotation. param[0] = flag param[1] = H11 param[2] = H21 param[3] = H12 param[4] = H22 The flag parameter defines the form of H: flag = -1 => H = (H11 H12 H21 H22) flag = 0 => H = (1.0 H12 H21 1.0) flag = 1 => H = (H11 1.0 -1.0 H22) flag = -2 => H = (1.0 0.0 0.0 1.0) param may ONLY be stored on the device for the batched version of this function.
- **batchCount** – **[in]** [int] the number of x and y arrays, i.e. the number of batches.

hipblasStatus_t **hipblasSrotmStridedBatched**(*hipblasHandle_t* handle, int n, float *x, int incx, *hipblasStride* stridex, float *y, int incy, *hipblasStride* stridey, const float *param, *hipblasStride* strideParam, int batchCount)

hipblasStatus_t **hipblasDrotmStridedBatched**(*hipblasHandle_t* handle, int n, double *x, int incx, *hipblasStride* stridex, double *y, int incy, *hipblasStride* stridey, const double *param, *hipblasStride* strideParam, int batchCount)

BLAS Level 1 API.

rotmStridedBatched applies the modified Givens rotation matrix defined by param_i to strided batched vectors x_i and y_i, for i = 1, . . . , batchCount

- Supported precisions in rocBLAS : s,d
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] number of elements in the x and y vectors.
- **x** – **[inout]** device pointer pointing to first strided batched vector x_1.
- **incx** – **[in]** [int] specifies the increment between elements of each x_i.
- **stridex** – **[in]** [hipblasStride] specifies the increment between the beginning of x_i and x_(i + 1)
- **y** – **[inout]** device pointer pointing to first strided batched vector y_1.
- **incy** – **[in]** [int] specifies the increment between elements of each y_i.
- **stridey** – **[in]** [hipblasStride] specifies the increment between the beginning of y_i and y_(i + 1)
- **param** – **[in]** device pointer pointing to first array of 5 elements defining the rotation (param_1). param[0] = flag param[1] = H11 param[2] = H21 param[3] = H12 param[4] = H22 The flag parameter defines the form of H: flag = -1 => H = (H11 H12 H21 H22) flag = 0 => H = (1.0 H12 H21 1.0) flag = 1 => H = (H11 1.0 -1.0 H22) flag = -2 => H = (1.0 0.0 0.0 1.0) param may ONLY be stored on the device for the strided_batched version of this function.
- **strideParam** – **[in]** [hipblasStride] specifies the increment between the beginning of param_i and param_(i + 1)
- **batchCount** – **[in]** [int] the number of x and y arrays, i.e. the number of batches.

1.9.1.11 hipblasXrotmg + Batched, StridedBatched

hipblasStatus_t **hipblasSrotmg**(*hipblasHandle_t* handle, float *d1, float *d2, float *x1, const float *y1, float *param)

hipblasStatus_t **hipblasDrotmg**(*hipblasHandle_t* handle, double *d1, double *d2, double *x1, const double *y1, double *param)

BLAS Level 1 API.

rotmg creates the modified Givens rotation matrix for the vector (d1 * x1, d2 * y1). Parameters may be stored in either host or device memory, location is specified by calling hipblasSetPointerMode. If the pointer mode is set to HIPBLAS_POINTER_MODE_HOST, this function blocks the CPU until the GPU has finished and the results are available in host memory. If the pointer mode is set to HIPBLAS_POINTER_MODE_DEVICE, this function returns immediately and synchronization is required to read the results.

- Supported precisions in rocBLAS : s,d
- Supported precisions in cuBLAS : s,d

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **d1** – **[inout]** device pointer or host pointer to input scalar that is overwritten.
- **d2** – **[inout]** device pointer or host pointer to input scalar that is overwritten.
- **x1** – **[inout]** device pointer or host pointer to input scalar that is overwritten.
- **y1** – **[in]** device pointer or host pointer to input scalar.
- **param** – **[out]** device vector or host vector of 5 elements defining the rotation. param[0] = flag param[1] = H11 param[2] = H21 param[3] = H12 param[4] = H22 The flag parameter defines the form of H: flag = -1 => H = (H11 H12 H21 H22) flag = 0 => H = (1.0 H12 H21 1.0) flag = 1 => H = (H11 1.0 -1.0 H22) flag = -2 => H = (1.0 0.0 0.0 1.0) param may be stored in either host or device memory, location is specified by calling hipblasSetPointerMode.

hipblasStatus_t **hipblasSrotmgBatched**(*hipblasHandle_t* handle, float *const d1[], float *const d2[], float *const x1[], const float *const y1[], float *const param[], int batchCount)

hipblasStatus_t **hipblasDrotmgBatched**(*hipblasHandle_t* handle, double *const d1[], double *const d2[], double *const x1[], const double *const y1[], double *const param[], int batchCount)

BLAS Level 1 API.

rotmgBatched creates the modified Givens rotation matrix for the batched vectors (d1_i * x1_i, d2_i * y1_i), for i = 1, …, batchCount. Parameters may be stored in either host or device memory, location is specified by calling hipblasSetPointerMode. If the pointer mode is set to HIPBLAS_POINTER_MODE_HOST, this function blocks the CPU until the GPU has finished and the results are available in host memory. If the pointer mode is set to HIPBLAS_POINTER_MODE_DEVICE, this function returns immediately and synchronization is required to read the results.

- Supported precisions in rocBLAS : s,d
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **d1** – **[inout]** device batched array or host batched array of input scalars that is overwritten.
- **d2** – **[inout]** device batched array or host batched array of input scalars that is overwritten.
- **x1** – **[inout]** device batched array or host batched array of input scalars that is overwritten.
- **y1** – **[in]** device batched array or host batched array of input scalars.
- **param** – **[out]** device batched array or host batched array of vectors of 5 elements defining the rotation. param[0] = flag param[1] = H11 param[2] = H21 param[3] = H12 param[4] = H22 The flag parameter defines the form of H: flag = -1 => H = (H11 H12 H21 H22) flag = 0 => H = (1.0 H12 H21 1.0) flag = 1 => H = (H11 1.0 -1.0 H22) flag = -2 => H = (1.0 0.0 0.0 1.0) param may be stored in either host or device memory, location is specified by calling hipblasSetPointerMode.
- **batchCount** – **[in]** [int] the number of instances in the batch.

hipblasStatus_t **hipblasSrotmgStridedBatched**(*hipblasHandle_t* handle, float *d1, *hipblasStride* strided1, float *d2, *hipblasStride* strided2, float *x1, *hipblasStride* stridex1, const float *y1, *hipblasStride* stridey1, float *param, *hipblasStride* strideParam, int batchCount)

hipblasStatus_t **hipblasDrotmgStridedBatched**(*hipblasHandle_t* handle, double *d1, *hipblasStride* strided1, double *d2, *hipblasStride* strided2, double *x1, *hipblasStride* stridex1, const double *y1, *hipblasStride* stridey1, double *param, *hipblasStride* strideParam, int batchCount)

BLAS Level 1 API.

rotmgStridedBatched creates the modified Givens rotation matrix for the strided batched vectors (d1_i * x1_i, d2_i * y1_i), for i = 1, …, batchCount. Parameters may be stored in either host or device memory, location is specified by calling hipblasSetPointerMode. If the pointer mode is set to HIPBLAS_POINTER_MODE_HOST, this function blocks the CPU until the GPU has finished and the results are available in host memory. If the pointer mode is set to HIPBLAS_POINTER_MODE_DEVICE, this function returns immediately and synchronization is required to read the results.

- Supported precisions in rocBLAS : s,d
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **d1** – **[inout]** device strided_batched array or host strided_batched array of input scalars that is overwritten.
- **strided1** – **[in]** [hipblasStride] specifies the increment between the beginning of d1_i and d1_(i+1)
- **d2** – **[inout]** device strided_batched array or host strided_batched array of input scalars that is overwritten.
- **strided2** – **[in]** [hipblasStride] specifies the increment between the beginning of d2_i and d2_(i+1)

- **x1** – **[inout]** device strided_batched array or host strided_batched array of input scalars that is overwritten.
- **stridex1** – **[in]** [hipblasStride] specifies the increment between the beginning of x1_i and x1_(i+1)
- **y1** – **[in]** device strided_batched array or host strided_batched array of input scalars.
- **stridey1** – **[in]** [hipblasStride] specifies the increment between the beginning of y1_i and y1_(i+1)
- **param** – **[out]** device stridedBatched array or host stridedBatched array of vectors of 5 elements defining the rotation. param[0] = flag param[1] = H11 param[2] = H21 param[3] = H12 param[4] = H22 The flag parameter defines the form of H: flag = -1 => H = (H11 H12 H21 H22) flag = 0 => H = (1.0 H12 H21 1.0) flag = 1 => H = (H11 1.0 -1.0 H22) flag = -2 => H = (1.0 0.0 0.0 1.0) param may be stored in either host or device memory, location is specified by calling hipblasSetPointerMode.
- **strideParam** – **[in]** [hipblasStride] specifies the increment between the beginning of param_i and param_(i + 1)
- **batchCount** – **[in]** [int] the number of instances in the batch.

1.9.1.12 hipblasXscal + Batched, StridedBatched

hipblasStatus_t **hipblasSscal**(*hipblasHandle_t* handle, int n, const float *alpha, float *x, int incx)

hipblasStatus_t **hipblasDscal**(*hipblasHandle_t* handle, int n, const double *alpha, double *x, int incx)

hipblasStatus_t **hipblasCscal**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *alpha, *hipblasComplex* *x, int incx)

hipblasStatus_t **hipblasCsscal**(*hipblasHandle_t* handle, int n, const float *alpha, *hipblasComplex* *x, int incx)

hipblasStatus_t **hipblasZscal**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *alpha, *hipblasDoubleComplex* *x, int incx)

hipblasStatus_t **hipblasZdscal**(*hipblasHandle_t* handle, int n, const double *alpha, *hipblasDoubleComplex* *x, int incx)

BLAS Level 1 API.

scal scales each element of vector x with scalar alpha.

```
x := alpha * x
```

- Supported precisions in rocBLAS : s,d,c,z,cs,zd
- Supported precisions in cuBLAS : s,d,c,z,cs,zd

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in x.

- **alpha** – **[in]** device pointer or host pointer for the scalar alpha.
- **x** – **[inout]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.

hipblasStatus_t **hipblasSscalBatched**(*hipblasHandle_t* handle, int n, const float *alpha, float *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasDscalBatched**(*hipblasHandle_t* handle, int n, const double *alpha, double *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasCscalBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *alpha, *hipblasComplex* *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasZscalBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *alpha, *hipblasDoubleComplex* *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasCsscalBatched**(*hipblasHandle_t* handle, int n, const float *alpha, *hipblasComplex* *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasZdscalBatched**(*hipblasHandle_t* handle, int n, const double *alpha, *hipblasDoubleComplex* *const x[], int incx, int batchCount)

BLAS Level 1 API.

scalBatched scales each element of vector x_i with scalar alpha, for i = 1, … , batchCount.

```
x_i := alpha * x_i
```

where (x_i) is the i-th instance of the batch.

- Supported precisions in rocBLAS : s,d,c,z,cs,zd
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in each x_i.
- **alpha** – **[in]** host pointer or device pointer for the scalar alpha.
- **x** – **[inout]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **batchCount** – **[in]** [int] specifies the number of batches in x.

hipblasStatus_t **hipblasSscalStridedBatched**(*hipblasHandle_t* handle, int n, const float *alpha, float *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasDscalStridedBatched**(*hipblasHandle_t* handle, int n, const double *alpha, double *x, int incx, *hipblasStride* stridex, int batchCount) *hipblasStatus_t* **hipblasCscalStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasComplex* *alpha, *hipblasComplex* *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasZscalStridedBatched**(*hipblasHandle_t* handle, int n, const *hipblasDoubleComplex* *alpha, *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasCsscalStridedBatched**(*hipblasHandle_t* handle, int n, const float *alpha, *hipblasComplex* *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasZdscalStridedBatched**(*hipblasHandle_t* handle, int n, const double *alpha, *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, int batchCount)

BLAS Level 1 API.

scalStridedBatched scales each element of vector x_i with scalar alpha, for i = 1, … , batchCount.

```
x_i := alpha * x_i ,
```

where (x_i) is the i-th instance of the batch.

- Supported precisions in rocBLAS : s,d,c,z,cs,zd
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in each x_i.
- **alpha** – **[in]** host pointer or device pointer for the scalar alpha.
- **x** – **[inout]** device pointer to the first vector (x_1) in the batch.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1). There are no restrictions placed on stride_x, however the user should take care to ensure that stride_x is of appropriate size, for a typical case this means stride_x >= n * incx.
- **batchCount** – **[in]** [int] specifies the number of batches in x.

1.9.1.13 hipblasXswap + Batched, StridedBatched

hipblasStatus_t **hipblasSswap**(*hipblasHandle_t* handle, int n, float *x, int incx, float *y, int incy)

hipblasStatus_t **hipblasDswap**(*hipblasHandle_t* handle, int n, double *x, int incx, double *y, int incy)

hipblasStatus_t **hipblasCswap**(*hipblasHandle_t* handle, int n, *hipblasComplex* *x, int incx, *hipblasComplex* *y, int incy)

hipblasStatus_t **hipblasZswap**(*hipblasHandle_t* handle, int n, *hipblasDoubleComplex* *x, int incx, *hipblasDoubleComplex* *y, int incy)

BLAS Level 1 API.

swap interchanges vectors x and y.

```
y := x; x := y
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in x and y.
- **x** – **[inout]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **y** – **[inout]** device pointer storing vector y.
- **incy** – **[in]** [int] specifies the increment for the elements of y.

hipblasStatus_t **hipblasSswapBatched**(*hipblasHandle_t* handle, int n, float *x[], int incx, float *y[], int incy, int batchCount)

hipblasStatus_t **hipblasDswapBatched**(*hipblasHandle_t* handle, int n, double *x[], int incx, double *y[], int incy, int batchCount)

hipblasStatus_t **hipblasCswapBatched**(*hipblasHandle_t* handle, int n, *hipblasComplex* *x[], int incx, *hipblasComplex* *y[], int incy, int batchCount)

hipblasStatus_t **hipblasZswapBatched**(*hipblasHandle_t* handle, int n, *hipblasDoubleComplex* *x[], int incx, *hipblasDoubleComplex* *y[], int incy, int batchCount)

BLAS Level 1 API.

swapBatched interchanges vectors x_i and y_i, for i = 1 , … , batchCount

```
y_i := x_i; x_i := y_i
```

- Supported precisions in rocBLAS : s,d,c,z

- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in each x_i and y_i.
- **x** – **[inout]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **y** – **[inout]** device array of device pointers storing each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasSswapStridedBatched**(*hipblasHandle_t* handle, int n, float *x, int incx, *hipblasStride* stridex, float *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasDswapStridedBatched**(*hipblasHandle_t* handle, int n, double *x, int incx, *hipblasStride* stridex, double *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasCswapStridedBatched**(*hipblasHandle_t* handle, int n, *hipblasComplex* *x, int incx, *hipblasStride* stridex, *hipblasComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasZswapStridedBatched**(*hipblasHandle_t* handle, int n, *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

BLAS Level 1 API.

swapStridedBatched interchanges vectors x_i and y_i, for i = 1 , … , batchCount

```
y_i := x_i; x_i := y_i
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in each x_i and y_i.
- **x** – **[inout]** device pointer to the first vector x_1.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1). There are no restrictions placed on stride_x, however the user should take care to ensure that stride_x is of appropriate size, for a typical case this means stride_x >= n * incx.
- **y** – **[inout]** device pointer to the first vector y_1.
- **incy** – **[in]** [int] specifies the increment for the elements of y.

- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) and the next one (y_i+1). There are no restrictions placed on stride_x, however the user should take care to ensure that stride_y is of appropriate size, for a typical case this means stride_y >= n * incy. stridey should be non zero.
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.2 Level 2 BLAS

List of Level-2 BLAS Functions

- *hipblasXgbmv + Batched, StridedBatched*
- *hipblasXgemv + Batched, StridedBatched*
- *hipblasXger + Batched, StridedBatched*
- *hipblasXhbmv + Batched, StridedBatched*
- *hipblasXhemv + Batched, StridedBatched*
- *hipblasXher + Batched, StridedBatched*
- *hipblasXher2 + Batched, StridedBatched*
- *hipblasXhpmv + Batched, StridedBatched*
- *hipblasXhpr + Batched, StridedBatched*
- *hipblasXhpr2 + Batched, StridedBatched*
- *hipblasXsbmv + Batched, StridedBatched*
- *hipblasXspmv + Batched, StridedBatched*
- *hipblasXspr + Batched, StridedBatched*
- *hipblasXspr2 + Batched, StridedBatched*
- *hipblasXsymv + Batched, StridedBatched*
- *hipblasXsyr + Batched, StridedBatched*
- *hipblasXsyr2 + Batched, StridedBatched*
- *hipblasXtbmv + Batched, StridedBatched*
- *hipblasXtbsv + Batched, StridedBatched*
- *hipblasXtpmv + Batched, StridedBatched*
- *hipblasXtpsv + Batched, StridedBatched*
- *hipblasXtrmv + Batched, StridedBatched*
- *hipblasXtrsv + Batched, StridedBatched*

1.9.2.1 hipblasXgbmv + Batched, StridedBatched

hipblasStatus_t **hipblasSgbmv**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, int kl, int ku, const float *alpha, const float *AP, int lda, const float *x, int incx, const float *beta, float *y, int incy)

hipblasStatus_t **hipblasDgbmv**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, int kl, int ku, const double *alpha, const double *AP, int lda, const double *x, int incx, const double *beta, double *y, int incy)

hipblasStatus_t **hipblasCgbmv**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, int kl, int ku, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, const *hipblasComplex* *x, int incx, const *hipblasComplex* *beta, *hipblasComplex* *y, int incy)

hipblasStatus_t **hipblasZgbmv**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, int kl, int ku, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, const *hipblasDoubleComplex* *x, int incx, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *y, int incy)

BLAS Level 2 API.

gbmv performs one of the matrix-vector operations

```
y := alpha*A*x    + beta*y,   or
y := alpha*A**T*x + beta*y,   or
y := alpha*A**H*x + beta*y,
```

where alpha and beta are scalars, x and y are vectors and A is an m by n banded matrix with kl sub-diagonals and ku super-diagonals.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **trans** – **[in]** [hipblasOperation_t] indicates whether matrix A is tranposed (conjugated) or not
- **m** – **[in]** [int] number of rows of matrix A
- **n** – **[in]** [int] number of columns of matrix A
- **kl** – **[in]** [int] number of sub-diagonals of A
- **ku** – **[in]** [int] number of super-diagonals of A
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **AP** – **[in]** device pointer storing banded matrix A. Leading (kl + ku + 1) by n part of the matrix contains the coefficients of the banded matrix. The leading diagonal resides in row (ku + 1) with the first super-diagonal above on the RHS of row ku. The first sub-diagonal resides below on the LHS of row ku + 2. This propogates up and down across sub/super-diagonals. Ex: (m = n = 7; ku = 2, kl = 2) 1 2 3 0 0 0 0 0 0 3 3 3 3 3 4 1 2 3 0 0 0 0 2 2 2 2 2 2 5 4 1 2 3 0 0 -> 1 1 1 1 1 1 1 0 5 4 1 2 3 0 4 4 4 4 4 4 0 0 0 5 4 1 2 0 5 5 5 5 5 0 0 0 0

0 5 4 1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 5 4 1 0 0 0 0 0 0 0 Note that the empty elements which don't correspond to data will not be referenced.

- **lda** – **[in]** [int] specifies the leading dimension of A. Must be >= (kl + ku + 1)
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **beta** – **[in]** device pointer or host pointer to scalar beta.
- **y** – **[inout]** device pointer storing vector y.
- **incy** – **[in]** [int] specifies the increment for the elements of y.

hipblasStatus_t **hipblasSgbmvBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, int kl, int ku, const float *alpha, const float *const AP[], int lda, const float *const x[], int incx, const float *beta, float *const y[], int incy, int batchCount)

hipblasStatus_t **hipblasDgbmvBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, int kl, int ku, const double *alpha, const double *const AP[], int lda, const double *const x[], int incx, const double *beta, double *const y[], int incy, int batchCount)

hipblasStatus_t **hipblasCgbmvBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, int kl, int ku, const *hipblasComplex* *alpha, const *hipblasComplex* *const AP[], int lda, const *hipblasComplex* *const x[], int incx, const *hipblasComplex* *beta, *hipblasComplex* *const y[], int incy, int batchCount)

hipblasStatus_t **hipblasZgbmvBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, int kl, int ku, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const AP[], int lda, const *hipblasDoubleComplex* *const x[], int incx, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *const y[], int incy, int batchCount)

BLAS Level 2 API.

gbmvBatched performs one of the matrix-vector operations

```
y_i := alpha*A_i*x_i    + beta*y_i,   or
y_i := alpha*A_i**T*x_i + beta*y_i,   or
y_i := alpha*A_i**H*x_i + beta*y_i,
```

where (A_i, x_i, y_i) is the i-th instance of the batch. alpha and beta are scalars, x_i and y_i are vectors and A_i is an m by n banded matrix with kl sub-diagonals and ku super-diagonals, for i = 1, …, batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **trans** – **[in]** [hipblasOperation_t] indicates whether matrix A is tranposed (conjugated) or not
- **m** – **[in]** [int] number of rows of each matrix A_i

- **n** – **[in]** [int] number of columns of each matrix A_i
- **kl** – **[in]** [int] number of sub-diagonals of each A_i
- **ku** – **[in]** [int] number of super-diagonals of each A_i
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **AP** – **[in]** device array of device pointers storing each banded matrix A_i. Leading (kl + ku + 1) by n part of the matrix contains the coefficients of the banded matrix. The leading diagonal resides in row (ku + 1) with the first super-diagonal above on the RHS of row ku. The first sub-diagonal resides below on the LHS of row ku + 2. This propogates up and down across sub/super-diagonals. Ex: (m = n = 7; ku = 2, kl = 2) 1 2 3 0 0 0 0 0 0 0 3 3 3 3 3 4 1 2 3 0 0 0 0 2 2 2 2 2 2 5 4 1 2 3 0 0 -> 1 1 1 1 1 1 1 0 5 4 1 2 3 0 4 4 4 4 4 4 0 0 0 5 4 1 2 0 5 5 5 5 5 0 0 0 0 0 0 5 4 1 2 0 0 0 0 0 0 0 0 0 0 0 0 5 4 1 0 0 0 0 0 0 0 Note that the empty elements which don't correspond to data will not be referenced.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i. Must be >= (kl + ku + 1)
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **beta** – **[in]** device pointer or host pointer to scalar beta.
- **y** – **[inout]** device array of device pointers storing each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.
- **batchCount** – **[in]** [int] specifies the number of instances in the batch.

hipblasStatus_t **hipblasSgbmvStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, int kl, int ku, const float *alpha, const float *AP, int lda, *hipblasStride* strideA, const float *x, int incx, *hipblasStride* stridex, const float *beta, float *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasDgbmvStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, int kl, int ku, const double *alpha, const double *AP, int lda, *hipblasStride* strideA, const double *x, int incx, *hipblasStride* stridex, const double *beta, double *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasCgbmvStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, int kl, int ku, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, const *hipblasComplex* *beta, *hipblasComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasZgbmvStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, int kl, int ku, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

BLAS Level 2 API.

gbmvStridedBatched performs one of the matrix-vector operations

```
y_i := alpha*A_i*x_i    + beta*y_i,   or
y_i := alpha*A_i**T*x_i + beta*y_i,   or
y_i := alpha*A_i**H*x_i + beta*y_i,
```

where (A_i, x_i, y_i) is the i-th instance of the batch. alpha and beta are scalars, x_i and y_i are vectors and A_i is an m by n banded matrix with kl sub-diagonals and ku super-diagonals, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **trans** – **[in]** [hipblasOperation_t] indicates whether matrix A is tranposed (conjugated) or not
- **m** – **[in]** [int] number of rows of matrix A
- **n** – **[in]** [int] number of columns of matrix A
- **kl** – **[in]** [int] number of sub-diagonals of A
- **ku** – **[in]** [int] number of super-diagonals of A
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **AP** – **[in]** device pointer to first banded matrix (A_1). Leading (kl + ku + 1) by n part of the matrix contains the coefficients of the banded matrix. The leading diagonal resides in row (ku + 1) with the first super-diagonal above on the RHS of row ku. The first sub-diagonal resides below on the LHS of row ku + 2. This propogates up and down across sub/super-diagonals. Ex: (m = n = 7; ku = 2, kl = 2) 1 2 3 0 0 0 0 0 0 3 3 3 3 3 4 1 2 3 0 0 0 0 2 2 2 2 2 2 5 4 1 2 3 0 0 -> 1 1 1 1 1 1 1 0 5 4 1 2 3 0 4 4 4 4 4 4 0 0 0 5 4 1 2 0 5 5 5 5 5 0 0 0 0 0 5 4 1 2 0 0 0 0 0 0 0 0 0 0 0 0 5 4 1 0 0 0 0 0 0 0 Note that the empty elements which don't correspond to data will not be referenced.
- **lda** – **[in]** [int] specifies the leading dimension of A. Must be >= (kl + ku + 1)
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **x** – **[in]** device pointer to first vector (x_1).
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1)
- **beta** – **[in]** device pointer or host pointer to scalar beta.
- **y** – **[inout]** device pointer to first vector (y_1).
- **incy** – **[in]** [int] specifies the increment for the elements of y.
- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) and the next one (x_i+1)
- **batchCount** – **[in]** [int] specifies the number of instances in the batch.

1.9.2.2 hipblasXgemv + Batched, StridedBatched

hipblasStatus_t **hipblasSgemv**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, const float *alpha, const float *AP, int lda, const float *x, int incx, const float *beta, float *y, int incy)

hipblasStatus_t **hipblasDgemv**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, const double *alpha, const double *AP, int lda, const double *x, int incx, const double *beta, double *y, int incy)

hipblasStatus_t **hipblasCgemv**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, const *hipblasComplex* *x, int incx, const *hipblasComplex* *beta, *hipblasComplex* *y, int incy)

hipblasStatus_t **hipblasZgemv**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, const *hipblasDoubleComplex* *x, int incx, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *y, int incy)

BLAS Level 2 API.

gemv performs one of the matrix-vector operations

```
y := alpha*A*x    + beta*y,   or
y := alpha*A**T*x + beta*y,   or
y := alpha*A**H*x + beta*y,
```

where alpha and beta are scalars, x and y are vectors and A is an m by n matrix.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **trans** – **[in]** [hipblasOperation_t] indicates whether matrix A is tranposed (conjugated) or not
- **m** – **[in]** [int] number of rows of matrix A
- **n** – **[in]** [int] number of columns of matrix A
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **AP** – **[in]** device pointer storing matrix A.
- **lda** – **[in]** [int] specifies the leading dimension of A.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **beta** – **[in]** device pointer or host pointer to scalar beta.
- **y** – **[inout]** device pointer storing vector y.
- **incy** – **[in]** [int] specifies the increment for the elements of y.

hipblasStatus_t **hipblasSgemvBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, const float *alpha, const float *const AP[], int lda, const float *const x[], int incx, const float *beta, float *const y[], int incy, int batchCount)

hipblasStatus_t **hipblasDgemvBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, const double *alpha, const double *const AP[], int lda, const double *const x[], int incx, const double *beta, double *const y[], int incy, int batchCount)

hipblasStatus_t **hipblasCgemvBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *const AP[], int lda, const *hipblasComplex* *const x[], int incx, const *hipblasComplex* *beta, *hipblasComplex* *const y[], int incy, int batchCount)

hipblasStatus_t **hipblasZgemvBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const AP[], int lda, const *hipblasDoubleComplex* *const x[], int incx, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *const y[], int incy, int batchCount)

BLAS Level 2 API.

gemvBatched performs a batch of matrix-vector operations

```
y_i := alpha*A_i*x_i    + beta*y_i,   or
y_i := alpha*A_i**T*x_i + beta*y_i,   or
y_i := alpha*A_i**H*x_i + beta*y_i,
```

where (A_i, x_i, y_i) is the i-th instance of the batch. alpha and beta are scalars, x_i and y_i are vectors and A_i is an m by n matrix, for i = 1, …, batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **trans** – **[in]** [hipblasOperation_t] indicates whether matrices A_i are tranposed (conjugated) or not
- **m** – **[in]** [int] number of rows of each matrix A_i
- **n** – **[in]** [int] number of columns of each matrix A_i
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **AP** – **[in]** device array of device pointers storing each matrix A_i.
- **lda** – **[in]** [int] specifies the leading dimension of each matrix A_i.
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each vector x_i.
- **beta** – **[in]** device pointer or host pointer to scalar beta.
- **y** – **[inout]** device array of device pointers storing each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of each vector y_i.

- **batchCount** – **[in]** [int] number of instances in the batch

hipblasStatus_t **hipblasSgemvStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, int m, int n, const float *alpha, const float *AP, int lda, *hipblasStride* strideA, const float *x, int incx, *hipblasStride* stridex, const float *beta, float *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasDgemvStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, int m, int n, const double *alpha, const double *AP, int lda, *hipblasStride* strideA, const double *x, int incx, *hipblasStride* stridex, const double *beta, double *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasCgemvStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, const *hipblasComplex* *beta, *hipblasComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasZgemvStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

BLAS Level 2 API.

gemvStridedBatched performs a batch of matrix-vector operations

```
y_i := alpha*A_i*x_i    + beta*y_i,   or
y_i := alpha*A_i**T*x_i + beta*y_i,   or
y_i := alpha*A_i**H*x_i + beta*y_i,
```

where (A_i, x_i, y_i) is the i-th instance of the batch. alpha and beta are scalars, x_i and y_i are vectors and A_i is an m by n matrix, for i = 1, …, batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **transA** – **[in]** [hipblasOperation_t] indicates whether matrices A_i are tranposed (conjugated) or not
- **m** – **[in]** [int] number of rows of matrices A_i
- **n** – **[in]** [int] number of columns of matrices A_i
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **AP** – **[in]** device pointer to the first matrix (A_1) in the batch.

- **lda** – **[in]** [int] specifies the leading dimension of matrices A_i.
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **x** – **[in]** device pointer to the first vector (x_1) in the batch.
- **incx** – **[in]** [int] specifies the increment for the elements of vectors x_i.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1). There are no restrictions placed on stridex, however the user should take care to ensure that stridex is of appropriate size. When trans equals HIPBLAS_OP_N this typically means stridex >= n * incx, otherwise stridex >= m * incx.
- **beta** – **[in]** device pointer or host pointer to scalar beta.
- **y** – **[inout]** device pointer to the first vector (y_1) in the batch.
- **incy** – **[in]** [int] specifies the increment for the elements of vectors y_i.
- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) and the next one (y_i+1). There are no restrictions placed on stridey, however the user should take care to ensure that stridey is of appropriate size. When trans equals HIPBLAS_OP_N this typically means stridey >= m * incy, otherwise stridey >= n * incy. stridey should be non zero.
- **batchCount** – **[in]** [int] number of instances in the batch

1.9.2.3 hipblasXger + Batched, StridedBatched

hipblasStatus_t **hipblasSger**(*hipblasHandle_t* handle, int m, int n, const float *alpha, const float *x, int incx, const float *y, int incy, float *AP, int lda)

hipblasStatus_t **hipblasDger**(*hipblasHandle_t* handle, int m, int n, const double *alpha, const double *x, int incx, const double *y, int incy, double *AP, int lda)

hipblasStatus_t **hipblasCgeru**(*hipblasHandle_t* handle, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *x, int incx, const *hipblasComplex* *y, int incy, *hipblasComplex* *AP, int lda)

hipblasStatus_t **hipblasCgerc**(*hipblasHandle_t* handle, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *x, int incx, const *hipblasComplex* *y, int incy, *hipblasComplex* *AP, int lda)

hipblasStatus_t **hipblasZgeru**(*hipblasHandle_t* handle, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *x, int incx, const *hipblasDoubleComplex* *y, int incy, *hipblasDoubleComplex* *AP, int lda)

hipblasStatus_t **hipblasZgerc**(*hipblasHandle_t* handle, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *x, int incx, const *hipblasDoubleComplex* *y, int incy, *hipblasDoubleComplex* *AP, int lda)

BLAS Level 2 API.

ger,geru,gerc performs the matrix-vector operations

```
A := A + alpha*x*y**T , OR
A := A + alpha*x*y**H for gerc
```

where alpha is a scalar, x and y are vectors, and A is an m by n matrix.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **m** – **[in]** [int] the number of rows of the matrix A.
- **n** – **[in]** [int] the number of columns of the matrix A.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **y** – **[in]** device pointer storing vector y.
- **incy** – **[in]** [int] specifies the increment for the elements of y.
- **AP** – **[inout]** device pointer storing matrix A.
- **lda** – **[in]** [int] specifies the leading dimension of A.

hipblasStatus_t **hipblasSgerBatched**(*hipblasHandle_t* handle, int m, int n, const float *alpha, const float *const x[], int incx, const float *const y[], int incy, float *const AP[], int lda, int batchCount)

hipblasStatus_t **hipblasDgerBatched**(*hipblasHandle_t* handle, int m, int n, const double *alpha, const double *const x[], int incx, const double *const y[], int incy, double *const AP[], int lda, int batchCount)

hipblasStatus_t **hipblasCgeruBatched**(*hipblasHandle_t* handle, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *const x[], int incx, const *hipblasComplex* *const y[], int incy, *hipblasComplex* *const AP[], int lda, int batchCount)

hipblasStatus_t **hipblasCgercBatched**(*hipblasHandle_t* handle, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *const x[], int incx, const *hipblasComplex* *const y[], int incy, *hipblasComplex* *const AP[], int lda, int batchCount)

hipblasStatus_t **hipblasZgeruBatched**(*hipblasHandle_t* handle, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const x[], int incx, const *hipblasDoubleComplex* *const y[], int incy, *hipblasDoubleComplex* *const AP[], int lda, int batchCount) *hipblasStatus_t* **hipblasZgercBatched**(*hipblasHandle_t* handle, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const x[], int incx, const *hipblasDoubleComplex* *const y[], int incy, *hipblasDoubleComplex* *const AP[], int lda, int batchCount)

BLAS Level 2 API.

gerBatched,geruBatched,gercBatched performs a batch of the matrix-vector operations

```
A := A + alpha*x*y**T , OR
A := A + alpha*x*y**H for gerc
```

where (A_i, x_i, y_i) is the i-th instance of the batch. alpha is a scalar, x_i and y_i are vectors and A_i is an m by n matrix, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **m** – **[in]** [int] the number of rows of each matrix A_i.
- **n** – **[in]** [int] the number of columns of eaceh matrix A_i.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each vector x_i.
- **y** – **[in]** device array of device pointers storing each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of each vector y_i.
- **AP** – **[inout]** device array of device pointers storing each matrix A_i.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i.
- **batchCount** – **[in]** [int] number of instances in the batch

hipblasStatus_t **hipblasSgerStridedBatched**(*hipblasHandle_t* handle, int m, int n, const float *alpha, const float *x, int incx, *hipblasStride* stridex, const float *y, int incy, *hipblasStride* stridey, float *AP, int lda, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasDgerStridedBatched**(*hipblasHandle_t* handle, int m, int n, const double *alpha, const double *x, int incx, *hipblasStride* stridex, const double *y, int incy, *hipblasStride* stridey, double *AP, int lda, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasCgeruStridedBatched**(*hipblasHandle_t* handle, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, const *hipblasComplex* *y, int incy, *hipblasStride* stridey, *hipblasComplex* *AP, int lda, *hipblasStride* strideA, int batchCount) *hipblasStatus_t* **hipblasCgercStridedBatched**(*hipblasHandle_t* handle, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, const *hipblasComplex* *y, int incy, *hipblasStride* stridey, *hipblasComplex* *AP, int lda, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasZgeruStridedBatched**(*hipblasHandle_t* handle, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, const *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasZgercStridedBatched**(*hipblasHandle_t* handle, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, const *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, int batchCount)

BLAS Level 2 API.

gerStridedBatched,geruStridedBatched,gercStridedBatched performs the matrix-vector operations

```
A_i := A_i + alpha*x_i*y_i**T, OR
A_i := A_i + alpha*x_i*y_i**H  for gerc
```

where (A_i, x_i, y_i) is the i-th instance of the batch. alpha is a scalar, x_i and y_i are vectors and A_i is an m by n matrix, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **m** – **[in]** [int] the number of rows of each matrix A_i.
- **n** – **[in]** [int] the number of columns of each matrix A_i.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device pointer to the first vector (x_1) in the batch.
- **incx** – **[in]** [int] specifies the increments for the elements of each vector x_i.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1). There are no restrictions placed on stridex, however the user should take care to ensure that stridex is of appropriate size, for a typical case this means stridex >= m * incx.
- **y** – **[inout]** device pointer to the first vector (y_1) in the batch.
- **incy** – **[in]** [int] specifies the increment for the elements of each vector y_i.
- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) and the next one (y_i+1). There are no restrictions placed on stridey, however the user should take care to ensure that stridey is of appropriate size, for a typical case this means stridey >= n * incy.
- **AP** – **[inout]** device pointer to the first matrix (A_1) in the batch.

- **lda** – **[in]** [int] specifies the leading dimension of each A_i.
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch

1.9.2.4 hipblasXhbmv + Batched, StridedBatched

hipblasStatus_t **hipblasChbmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, const *hipblasComplex* *x, int incx, const *hipblasComplex* *beta, *hipblasComplex* *y, int incy)

hipblasStatus_t **hipblasZhbmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, const *hipblasDoubleComplex* *x, int incx, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *y, int incy)

BLAS Level 2 API.

hbmv performs the matrix-vector operations

```
y := alpha*A*x + beta*y
```

where alpha and beta are scalars, x and y are n element vectors and A is an n by n Hermitian band matrix, with k super-diagonals.

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : c,z

if uplo == HIPBLAS_FILL_MODE_LOWER: The leading (k + 1) by n part of A must contain the lower triangular band part of the Hermitian matrix, with the leading diagonal in row (1), the first sub-diagonal on the LHS of row 2, etc. The bottom right k by k triangle of A will not be referenced. Ex (lower, lda = 2, n = 4, k = 1): A Represented matrix (1,0) (2,0) (3,0) (4,0) (1, 0) (5,-9) (0, 0) (0, 0) (5,9) (6,8) (7,7) (0,0) (5, 9) (2, 0) (6,-8) (0, 0) (0, 0) (6, 8) (3, 0) (7,-7) (0, 0) (0, 0) (7, 7) (4, 0)

As a Hermitian matrix, the imaginary part of the main diagonal of A will not be referenced and is assumed to be == 0.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: The upper triangular part of A is being supplied. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of A is being supplied.
- **n** – **[in]** [int] the order of the matrix A.
- **k** – **[in]** [int] the number of super-diagonals of the matrix A. Must be >= 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **AP** – **[in]** device pointer storing matrix A. Of dimension (lda, n). if uplo == HIPBLAS_FILL_MODE_UPPER: The leading (k + 1) by n part of A must contain the upper triangular band part of the Hermitian matrix, with the leading diagonal in row (k + 1), the first super-diagonal on the RHS of row k, etc. The top left k by x triangle of A will not be

referenced. Ex (upper, lda = n = 4, k = 1): A Represented matrix (0,0) (5,9) (6,8) (7,7) (1, 0) (5, 9) (0, 0) (0, 0) (1,0) (2,0) (3,0) (4,0) (5,-9) (2, 0) (6, 8) (0, 0) (0,0) (0,0) (0,0) (0,0) (0, 0) (6,-8) (3, 0) (7, 7) (0,0) (0,0) (0,0) (0,0) (0, 0) (0, 0) (7,-7) (4, 0)

- **lda** – **[in]** [int] specifies the leading dimension of A. must be >= k + 1
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **beta** – **[in]** device pointer or host pointer to scalar beta.
- **y** – **[inout]** device pointer storing vector y.
- **incy** – **[in]** [int] specifies the increment for the elements of y.

hipblasStatus_t **hipblasChbmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *const AP[], int lda, const *hipblasComplex* *const x[], int incx, const *hipblasComplex* *beta, *hipblasComplex* *const y[], int incy, int batchCount)

hipblasStatus_t **hipblasZhbmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const AP[], int lda, const *hipblasDoubleComplex* *const x[], int incx, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *const y[], int incy, int batchCount)

BLAS Level 2 API.

hbmvBatched performs one of the matrix-vector operations

```
y_i := alpha*A_i*x_i + beta*y_i
```

where alpha and beta are scalars, x_i and y_i are n element vectors and A_i is an n by n Hermitian band matrix with k super-diagonals, for each batch in i = [1, batchCount].

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

if uplo == HIPBLAS_FILL_MODE_LOWER: The leading (k + 1) by n part of each A_i must contain the lower triangular band part of the Hermitian matrix, with the leading diagonal in row (1), the first sub-diagonal on the LHS of row 2, etc. The bottom right k by k triangle of each A_i will not be referenced. Ex (lower, lda = 2, n = 4, k = 1): A Represented matrix (1,0) (2,0) (3,0) (4,0) (1, 0) (5,-9) (0, 0) (0, 0) (5,9) (6,8) (7,7) (0,0) (5, 9) (2, 0) (6,-8) (0, 0) (0, 0) (6, 8) (3, 0) (7,-7) (0, 0) (0, 0) (7, 7) (4, 0)

As a Hermitian matrix, the imaginary part of the main diagonal of each A_i will not be referenced and is assumed to be == 0.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: The upper triangular part of each A_i is being supplied. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of each A_i is being supplied.
- **n** – **[in]** [int] the order of each matrix A_i.
- **k** – **[in]** [int] the number of super-diagonals of each matrix A_i. Must be >= 0.

- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **AP** – **[in]** device array of device pointers storing each matrix_i A of dimension (lda, n). if uplo == HIPBLAS_FILL_MODE_UPPER: The leading (k + 1) by n part of each A_i must contain the upper triangular band part of the Hermitian matrix, with the leading diagonal in row (k + 1), the first super-diagonal on the RHS of row k, etc. The top left k by x triangle of each A_i will not be referenced. Ex (upper, lda = n = 4, k = 1): A Represented matrix (0,0) (5,9) (6,8) (7,7) (1, 0) (5, 9) (0, 0) (0, 0) (1,0) (2,0) (3,0) (4,0) (5,-9) (2, 0) (6, 8) (0, 0) (0,0) (0,0) (0,0) (0,0) (0, 0) (6,-8) (3, 0) (7, 7) (0,0) (0,0) (0,0) (0,0) (0, 0) (0, 0) (7,-7) (4, 0)
- **lda** – **[in]** [int] specifies the leading dimension of each A_i. must be >= max(1, n)
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **beta** – **[in]** device pointer or host pointer to scalar beta.
- **y** – **[inout]** device array of device pointers storing each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of y.
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasChbmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, const *hipblasComplex* *beta, *hipblasComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasZhbmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

BLAS Level 2 API.

hbmvStridedBatched performs one of the matrix-vector operations

```
y_i := alpha*A_i*x_i + beta*y_i
```

where alpha and beta are scalars, x_i and y_i are n element vectors and A_i is an n by n Hermitian band matrix with k super-diagonals, for each batch in i = [1, batchCount].

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

if uplo == HIPBLAS_FILL_MODE_LOWER: The leading (k + 1) by n part of each A_i must contain the lower triangular band part of the Hermitian matrix, with the leading diagonal in row (1), the first sub-diagonal on the LHS of row 2, etc. The bottom right k by k triangle of each A_i will not be referenced. Ex (lower, lda = 2, n = 4, k = 1): A Represented matrix (1,0) (2,0) (3,0) (4,0) (1, 0) (5,-9) (0, 0) (0, 0) (5,9) (6,8) (7,7) (0,0) (5, 9) (2, 0) (6,-8) (0, 0) (0, 0) (6, 8) (3, 0) (7,-7) (0, 0) (0, 0) (7, 7) (4, 0)

As a Hermitian matrix, the imaginary part of the main diagonal of each A_i will not be referenced and is assumed to be == 0.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: The upper triangular part of each A_i is being supplied. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of each A_i is being supplied.
- **n** – **[in]** [int] the order of each matrix A_i.
- **k** – **[in]** [int] the number of super-diagonals of each matrix A_i. Must be >= 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **AP** – **[in]** device array pointing to the first matrix A_1. Each A_i is of dimension (lda, n). if uplo == HIPBLAS_FILL_MODE_UPPER: The leading (k + 1) by n part of each A_i must contain the upper triangular band part of the Hermitian matrix, with the leading diagonal in row (k + 1), the first super-diagonal on the RHS of row k, etc. The top left k by x triangle of each A_i will not be referenced. Ex (upper, lda = n = 4, k = 1): A Represented matrix (0,0) (5,9) (6,8) (7,7) (1, 0) (5, 9) (0, 0) (0, 0) (1,0) (2,0) (3,0) (4,0) (5,-9) (2, 0) (6, 8) (0, 0) (0,0) (0,0) (0,0) (0,0) (0, 0) (6,-8) (3, 0) (7, 7) (0,0) (0,0) (0,0) (0,0) (0, 0) (0, 0) (7,-7) (4, 0)
- **lda** – **[in]** [int] specifies the leading dimension of each A_i. must be >= max(1, n)
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **x** – **[in]** device array pointing to the first vector y_1.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1)
- **beta** – **[in]** device pointer or host pointer to scalar beta.
- **y** – **[inout]** device array pointing to the first vector y_1.
- **incy** – **[in]** [int] specifies the increment for the elements of y.
- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) and the next one (y_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.2.5 hipblasXhemv + Batched, StridedBatched

hipblasStatus_t **hipblasChemv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, const *hipblasComplex* *x, int incx, const *hipblasComplex* *beta, *hipblasComplex* *y, int incy)

hipblasStatus_t **hipblasZhemv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, const *hipblasDoubleComplex* *x, int incx, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *y, int incy)

BLAS Level 2 API.

hemv performs one of the matrix-vector operations

```
y := alpha*A*x + beta*y
```

where alpha and beta are scalars, x and y are n element vectors and A is an n by n Hermitian matrix.

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: the upper triangular part of the Hermitian matrix A is supplied. HIPBLAS_FILL_MODE_LOWER: the lower triangular part of the Hermitian matrix A is supplied.
- **n** – **[in]** [int] the order of the matrix A.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **AP** – **[in]** device pointer storing matrix A. Of dimension (lda, n). if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular part of A must contain the upper triangular part of a Hermitian matrix. The lower triangular part of A will not be referenced. if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular part of A must contain the lower triangular part of a Hermitian matrix. The upper triangular part of A will not be referenced. As a Hermitian matrix, the imaginary part of the main diagonal of A will not be referenced and is assumed to be == 0.
- **lda** – **[in]** [int] specifies the leading dimension of A. must be >= max(1, n)
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **beta** – **[in]** device pointer or host pointer to scalar beta.
- **y** – **[inout]** device pointer storing vector y.
- **incy** – **[in]** [int] specifies the increment for the elements of y.

hipblasStatus_t **hipblasChemvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *const AP[], int lda, const *hipblasComplex* *const x[], int incx, const *hipblasComplex* *beta, *hipblasComplex* *const y[], int incy, int batchCount)

hipblasStatus_t **hipblasZhemvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const AP[], int lda, const *hipblasDoubleComplex* *const x[], int incx, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *const y[], int incy, int batchCount)

BLAS Level 2 API.

hemvBatched performs one of the matrix-vector operations

```
y_i := alpha*A_i*x_i + beta*y_i
```

where alpha and beta are scalars, x_i and y_i are n element vectors and A_i is an n by n Hermitian matrix, for each batch in i = [1, batchCount].

- Supported precisions in rocBLAS : c,z

- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: the upper triangular part of the Hermitian matrix A is supplied. HIPBLAS_FILL_MODE_LOWER: the lower triangular part of the Hermitian matrix A is supplied.
- **n** – **[in]** [int] the order of each matrix A_i.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **AP** – **[in]** device array of device pointers storing each matrix A_i of dimension (lda, n). if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular part of each A_i must contain the upper triangular part of a Hermitian matrix. The lower triangular part of each A_i will not be referenced. if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular part of each A_i must contain the lower triangular part of a Hermitian matrix. The upper triangular part of each A_i will not be referenced. As a Hermitian matrix, the imaginary part of the main diagonal of each A_i will not be referenced and is assumed to be == 0.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i. must be >= max(1, n)
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **beta** – **[in]** device pointer or host pointer to scalar beta.
- **y** – **[inout]** device array of device pointers storing each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of y.
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasChemvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, const *hipblasComplex* *beta, *hipblasComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasZhemvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

BLAS Level 2 API.

hemvStridedBatched performs one of the matrix-vector operations

```
y_i := alpha*A_i*x_i + beta*y_i
```

where alpha and beta are scalars, x_i and y_i are n element vectors and A_i is an n by n Hermitian matrix, for each batch in i = [1, batchCount].

- Supported precisions in rocBLAS : c,z

- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: the upper triangular part of the Hermitian matrix A is supplied. HIPBLAS_FILL_MODE_LOWER: the lower triangular part of the Hermitian matrix A is supplied.
- **n** – **[in]** [int] the order of each matrix A_i.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **AP** – **[in]** device array of device pointers storing each matrix A_i of dimension (lda, n). if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular part of each A_i must contain the upper triangular part of a Hermitian matrix. The lower triangular part of each A_i will not be referenced. if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular part of each A_i must contain the lower triangular part of a Hermitian matrix. The upper triangular part of each A_i will not be referenced. As a Hermitian matrix, the imaginary part of the main diagonal of each A_i will not be referenced and is assumed to be == 0.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i. must be >= max(1, n)
- **strideA** – **[in]** [hipblasStride] stride from the start of one (A_i) to the next (A_i+1)
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1).
- **beta** – **[in]** device pointer or host pointer to scalar beta.
- **y** – **[inout]** device array of device pointers storing each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of y.
- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) and the next one (y_i+1).
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.2.6 hipblasXher + Batched, StridedBatched

hipblasStatus_t **hipblasCher**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const *hipblasComplex* *x, int incx, *hipblasComplex* *AP, int lda)

hipblasStatus_t **hipblasZher**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const *hipblasDoubleComplex* *x, int incx, *hipblasDoubleComplex* *AP, int lda)

BLAS Level 2 API.

her performs the matrix-vector operations

```
A := A + alpha*x*x**H
```

where alpha is a real scalar, x is a vector, and A is an n by n Hermitian matrix.

- Supported precisions in rocBLAS : c,z

- Supported precisions in cuBLAS : c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of A is supplied in A. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of A is supplied in A.
- **n** – **[in]** [int] the number of rows and columns of matrix A, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **AP** – **[inout]** device pointer storing the specified triangular portion of the Hermitian matrix A. Of size (lda * n). if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of the Hermitian matrix A is supplied. The lower triangluar portion will not be touched. if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of the Hermitian matrix A is supplied. The upper triangular portion will not be touched. Note that the imaginary part of the diagonal elements are not accessed and are assumed to be 0.
- **lda** – **[in]** [int] specifies the leading dimension of A. Must be at least max(1, n).

hipblasStatus_t **hipblasCherBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const *hipblasComplex* *const x[], int incx, *hipblasComplex* *const AP[], int lda, int batchCount)

hipblasStatus_t **hipblasZherBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const *hipblasDoubleComplex* *const x[], int incx, *hipblasDoubleComplex* *const AP[], int lda, int batchCount)

BLAS Level 2 API.

herBatched performs the matrix-vector operations

```
A_i := A_i + alpha*x_i*x_i**H
```

where alpha is a real scalar, x_i is a vector, and A_i is an n by n symmetric matrix, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of each A_i is supplied in A. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of each A_i is supplied in A.
- **n** – **[in]** [int] the number of rows and columns of each matrix A_i, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.

- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **AP** – **[inout]** device array of device pointers storing the specified triangular portion of each Hermitian matrix A_i of at least size ((n * (n + 1)) / 2). Array is of at least size batchCount. if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of each Hermitian matrix A_i is supplied. The lower triangular portion of each A_i will not be touched. if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of each Hermitian matrix A_i is supplied. The upper triangular portion of each A_i will not be touched. Note that the imaginary part of the diagonal elements are not accessed and are assumed to be 0.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i. Must be at least max(1, n).
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasCherStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, *hipblasComplex* *AP, int lda, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasZherStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, int batchCount)

BLAS Level 2 API.

herStridedBatched performs the matrix-vector operations

```
A_i := A_i + alpha*x_i*x_i**H
```

where alpha is a real scalar, x_i is a vector, and A_i is an n by n Hermitian matrix, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of each A_i is supplied in A. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of each A_i is supplied in A.
- **n** – **[in]** [int] the number of rows and columns of each matrix A_i, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device pointer pointing to the first vector (x_1).
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1).
- **AP** – **[inout]** device array of device pointers storing the specified triangular portion of each Hermitian matrix A_i. Points to the first matrix (A_1). if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of each Hermitian matrix A_i

is supplied. The lower triangular portion of each A_i will not be touched. if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of each Hermitian matrix A_i is supplied. The upper triangular portion of each A_i will not be touched. Note that the imaginary part of the diagonal elements are not accessed and are assumed to be 0.

- **lda** – **[in]** [int] specifies the leading dimension of each A_i.
- **strideA** – **[in]** [hipblasStride] stride from the start of one (A_i) and the next (A_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.2.7 hipblasXher2 + Batched, StridedBatched

hipblasStatus_t **hipblasCher2**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *x, int incx, const *hipblasComplex* *y, int incy, *hipblasComplex* *AP, int lda)

hipblasStatus_t **hipblasZher2**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *x, int incx, const *hipblasDoubleComplex* *y, int incy, *hipblasDoubleComplex* *AP, int lda)

BLAS Level 2 API.

her2 performs the matrix-vector operations

```
A := A + alpha*x*y**H + conj(alpha)*y*x**H
```

where alpha is a complex scalar, x and y are vectors, and A is an n by n Hermitian matrix.

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of A is supplied. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of A is supplied.
- **n** – **[in]** [int] the number of rows and columns of matrix A, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **y** – **[in]** device pointer storing vector y.
- **incy** – **[in]** [int] specifies the increment for the elements of y.
- **AP** – **[inout]** device pointer storing the specified triangular portion of the Hermitian matrix A. Of size (lda, n). if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of the Hermitian matrix A is supplied. The lower triangular portion of A will not be touched. if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of the Hermitian matrix A is supplied. The upper triangular portion of A will not be touched. Note that the imaginary part of the diagonal elements are not accessed and are assumed to be 0.

- **lda** – **[in]** [int] specifies the leading dimension of A. Must be at least max(lda, 1).

hipblasStatus_t **hipblasCher2Batched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *const x[], int incx, const *hipblasComplex* *const y[], int incy, *hipblasComplex* *const AP[], int lda, int batchCount)

hipblasStatus_t **hipblasZher2Batched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const x[], int incx, const *hipblasDoubleComplex* *const y[], int incy, *hipblasDoubleComplex* *const AP[], int lda, int batchCount)

BLAS Level 2 API.

her2Batched performs the matrix-vector operations

```
A_i := A_i + alpha*x_i*y_i**H + conj(alpha)*y_i*x_i**H
```

where alpha is a complex scalar, x_i and y_i are vectors, and A_i is an n by n Hermitian matrix for each batch in i = [1, batchCount].

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of each A_i is supplied. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of each A_i is supplied.
- **n** – **[in]** [int] the number of rows and columns of each matrix A_i, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **y** – **[in]** device array of device pointers storing each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.
- **AP** – **[inout]** device array of device pointers storing the specified triangular portion of each Hermitian matrix A_i of size (lda, n). if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of each Hermitian matrix A_i is supplied. The lower triangular portion of each A_i will not be touched. if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of each Hermitian matrix A_i is supplied. The upper triangular portion of each A_i will not be touched. Note that the imaginary part of the diagonal elements are not accessed and are assumed to be 0.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i. Must be at least max(lda, 1).
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasCher2StridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, const *hipblasComplex* *y, int incy, *hipblasStride* stridey, *hipblasComplex* *AP, int lda, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasZher2StridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, const *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, int batchCount)

BLAS Level 2 API.

her2StridedBatched performs the matrix-vector operations

```
A_i := A_i + alpha*x_i*y_i**H + conj(alpha)*y_i*x_i**H
```

where alpha is a complex scalar, x_i and y_i are vectors, and A_i is an n by n Hermitian matrix for each batch in i = [1, batchCount].

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of each A_i is supplied. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of each A_i is supplied.
- **n** – **[in]** [int] the number of rows and columns of each matrix A_i, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device pointer pointing to the first vector x_1.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] specifies the stride between the beginning of one vector (x_i) and the next (x_i+1).
- **y** – **[in]** device pointer pointing to the first vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.
- **stridey** – **[in]** [hipblasStride] specifies the stride between the beginning of one vector (y_i) and the next (y_i+1).
- **AP** – **[inout]** device pointer pointing to the first matrix (A_1). Stores the specified triangular portion of each Hermitian matrix A_i. if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of each Hermitian matrix A_i is supplied. The lower triangular portion of each A_i will not be touched. if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of each Hermitian matrix A_i is supplied. The upper triangular portion of each A_i will not be touched. Note that the imaginary part of the diagonal elements are not accessed and are assumed to be 0.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i. Must be at least max(lda, 1).

- **strideA** – **[in]** [hipblasStride] specifies the stride between the beginning of one matrix (A_i) and the next (A_i+1).
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.2.8 hipblasXhpmv + Batched, StridedBatched

hipblasStatus_t **hipblasChpmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, const *hipblasComplex* *x, int incx, const *hipblasComplex* *beta, *hipblasComplex* *y, int incy)

hipblasStatus_t **hipblasZhpmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, const *hipblasDoubleComplex* *x, int incx, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *y, int incy)

BLAS Level 2 API.

hpmv performs the matrix-vector operation

```
y := alpha*A*x + beta*y
```

where alpha and beta are scalars, x and y are n element vectors and A is an n by n Hermitian matrix, supplied in packed form (see description below).

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: the upper triangular part of the Hermitian matrix A is supplied in AP. HIPBLAS_FILL_MODE_LOWER: the lower triangular part of the Hermitian matrix A is supplied in AP.
- **n** – **[in]** [int] the order of the matrix A, must be >= 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **AP** – **[in]** device pointer storing the packed version of the specified triangular portion of the Hermitian matrix A. Of at least size ((n * (n + 1)) / 2). if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of the Hermitian matrix A is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(0,1) AP(2) = A(1,1), etc. Ex: (HIPBLAS_FILL_MODE_UPPER; n = 3) (1, 0) (2, 1) (3, 2) (2,-1) (4, 0) (5,-1) –> [(1,0), (2,1), (4,0), (3,2), (5,-1), (6,0)] (3,-2) (5, 1) (6, 0) if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of the Hermitian matrix A is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(1,0) AP(2) = A(2,1), etc. Ex: (HIPBLAS_FILL_MODE_LOWER; n = 3) (1, 0) (2, 1) (3, 2) (2,-1) (4, 0) (5,-1) –> [(1,0), (2,-1), (3,-2), (4,0), (5,1), (6,0)] (3,-2) (5, 1) (6, 0) Note that the imaginary part of the diagonal elements are not accessed and are assumed to be 0.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.

- **beta** – **[in]** device pointer or host pointer to scalar beta.
- **y** – **[inout]** device pointer storing vector y.
- **incy** – **[in]** [int] specifies the increment for the elements of y.

hipblasStatus_t **hipblasChpmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *const AP[], const *hipblasComplex* *const x[], int incx, const *hipblasComplex* *beta, *hipblasComplex* *const y[], int incy, int batchCount)

hipblasStatus_t **hipblasZhpmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const AP[], const *hipblasDoubleComplex* *const x[], int incx, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *const y[], int incy, int batchCount)

BLAS Level 2 API.

hpmvBatched performs the matrix-vector operation

```
y_i := alpha*A_i*x_i + beta*y_i
```

where alpha and beta are scalars, x_i and y_i are n element vectors and A_i is an n by n Hermitian matrix, supplied in packed form (see description below), for each batch in i = [1, batchCount].

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: the upper triangular part of each Hermitian matrix A_i is supplied in AP. HIPBLAS_FILL_MODE_LOWER: the lower triangular part of each Hermitian matrix A_i is supplied in AP.
- **n** – **[in]** [int] the order of each matrix A_i.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **AP** – **[in]** device pointer of device pointers storing the packed version of the specified triangular portion of each Hermitian matrix A_i. Each A_i is of at least size ((n * (n + 1)) / 2). if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of each Hermitian matrix A_i is supplied. The matrix is compacted so that each AP_i contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(0,1) AP(2) = A(1,1), etc. Ex: (HIPBLAS_FILL_MODE_UPPER; n = 3) (1, 0) (2, 1) (3, 2) (2,-1) (4, 0) (5,-1) –> [(1,0), (2,1), (4,0), (3,2), (5,-1), (6,0)] (3,-2) (5, 1) (6, 0) if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of each Hermitian matrix A_i is supplied. The matrix is compacted so that each AP_i contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(1,0) AP(2) = A(2,1), etc. Ex: (HIPBLAS_FILL_MODE_LOWER; n = 3) (1, 0) (2, 1) (3, 2) (2,-1) (4, 0) (5,-1) –> [(1,0), (2,-1), (3,-2), (4,0), (5,1), (6,0)] (3,-2) (5, 1) (6, 0) Note that the imaginary part of the diagonal elements are not accessed and are assumed to be 0.
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.

- **beta** – **[in]** device pointer or host pointer to scalar beta.
- **y** – **[inout]** device array of device pointers storing each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of y.
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasChpmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, *hipblasStride* strideA, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, const *hipblasComplex* *beta, *hipblasComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasZhpmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, *hipblasStride* strideA, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

BLAS Level 2 API.

hpmvStridedBatched performs the matrix-vector operation

```
y_i := alpha*A_i*x_i + beta*y_i
```

where alpha and beta are scalars, x_i and y_i are n element vectors and A_i is an n by n Hermitian matrix, supplied in packed form (see description below), for each batch in i = [1, batchCount].

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: the upper triangular part of each Hermitian matrix A_i is supplied in AP. HIPBLAS_FILL_MODE_LOWER: the lower triangular part of each Hermitian matrix A_i is supplied in AP.
- **n** – **[in]** [int] the order of each matrix A_i.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **AP** – **[in]** device pointer pointing to the beginning of the first matrix (AP_1). Stores the packed version of the specified triangular portion of each Hermitian matrix AP_i of size ((n * (n + 1)) / 2). if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of each Hermitian matrix A_i is supplied. The matrix is compacted so that each AP_i contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(0,1) AP(2) = A(1,1), etc. Ex: (HIPBLAS_FILL_MODE_UPPER; n = 3) (1, 0) (2, 1) (3, 2) (2,-1) (4, 0) (5,-1) –> [(1,0), (2,1), (4,0), (3,2), (5,-1), (6,0)] (3,-2) (5, 1) (6, 0) if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of each Hermitian matrix A_i is supplied. The matrix is compacted so that each AP_i contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(1,0) AP(2) = A(2,1), etc. Ex: (HIPBLAS_FILL_MODE_LOWER; n = 3) (1, 0) (2, 1) (3, 2) (2,-1) (4, 0) (5,-1) –> [(1,0), (2,-1),

(3,-2), (4,0), (5,1), (6,0)] (3,-2) (5, 1) (6, 0) Note that the imaginary part of the diagonal elements are not accessed and are assumed to be 0.

- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (AP_i) and the next one (AP_i+1).
- **x** – **[in]** device array pointing to the beginning of the first vector (x_1).
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1).
- **beta** – **[in]** device pointer or host pointer to scalar beta.
- **y** – **[inout]** device array pointing to the beginning of the first vector (y_1).
- **incy** – **[in]** [int] specifies the increment for the elements of y.
- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) and the next one (y_i+1).
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.2.9 hipblasXhpr + Batched, StridedBatched

hipblasStatus_t **hipblasChpr**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const *hipblasComplex* *x, int incx, *hipblasComplex* *AP)

hipblasStatus_t **hipblasZhpr**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const *hipblasDoubleComplex* *x, int incx, *hipblasDoubleComplex* *AP)

BLAS Level 2 API.

hpr performs the matrix-vector operations

```
A := A + alpha*x*x**H
```

where alpha is a real scalar, x is a vector, and A is an n by n Hermitian matrix, supplied in packed form.

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of A is supplied in AP. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of A is supplied in AP.
- **n** – **[in]** [int] the number of rows and columns of matrix A, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.

- **AP** – **[inout]** device pointer storing the packed version of the specified triangular portion of the Hermitian matrix A. Of at least size ((n * (n + 1)) / 2). if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of the Hermitian matrix A is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(0,1) AP(2) = A(1,1), etc. Ex: (HIPBLAS_FILL_MODE_UPPER; n = 3) (1, 0) (2, 1) (4,9) (2,-1) (3, 0) (5,3) –> [(1,0), (2,1), (3,0), (4,9), (5,3), (6,0)] (4,-9) (5,-3) (6,0) if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of the Hermitian matrix A is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(1,0) AP(2) = A(2,1), etc. Ex: (HIPBLAS_FILL_MODE_LOWER; n = 3) (1, 0) (2, 1) (4,9) (2,-1) (3, 0) (5,3) –> [(1,0), (2,-1), (4,-9), (3,0), (5,-3), (6,0)] (4,-9) (5,-3) (6,0) Note that the imaginary part of the diagonal elements are not accessed and are assumed to be 0.

hipblasStatus_t **hipblasChprBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const *hipblasComplex* *const x[], int incx, *hipblasComplex* *const AP[], int batchCount)

hipblasStatus_t **hipblasZhprBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const *hipblasDoubleComplex* *const x[], int incx, *hipblasDoubleComplex* *const AP[], int batchCount)

BLAS Level 2 API.

hprBatched performs the matrix-vector operations

```
A_i := A_i + alpha*x_i*x_i**H
```

where alpha is a real scalar, x_i is a vector, and A_i is an n by n symmetric matrix, supplied in packed form, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of each A_i is supplied in AP. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of each A_i is supplied in AP.
- **n** – **[in]** [int] the number of rows and columns of each matrix A_i, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **AP** – **[inout]** device array of device pointers storing the packed version of the specified triangular portion of each Hermitian matrix A_i of at least size ((n * (n + 1)) / 2). Array is of at least size batchCount. if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of each Hermitian matrix A_i is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1)

= A(0,1) AP(2) = A(1,1), etc. Ex: (HIPBLAS_FILL_MODE_UPPER; n = 3) (1, 0) (2, 1) (4,9) (2,-1) (3, 0) (5,3) –> [(1,0), (2,1), (3,0), (4,9), (5,3), (6,0)] (4,-9) (5,-3) (6,0) if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of each Hermitian matrix A_i is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(1,0) AP(2) = A(2,1), etc. Ex: (HIPBLAS_FILL_MODE_LOWER; n = 3) (1, 0) (2, 1) (4,9) (2,-1) (3, 0) (5,3) –> [(1,0), (2,-1), (4,-9), (3,0), (5,-3), (6,0)] (4,-9) (5,-3) (6,0) Note that the imaginary part of the diagonal elements are not accessed and are assumed to be 0.

- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasChprStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, *hipblasComplex* *AP, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasZhprStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, *hipblasDoubleComplex* *AP, *hipblasStride* strideA, int batchCount)

BLAS Level 2 API.

hprStridedBatched performs the matrix-vector operations

```
A_i := A_i + alpha*x_i*x_i**H
```

where alpha is a real scalar, x_i is a vector, and A_i is an n by n symmetric matrix, supplied in packed form, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of each A_i is supplied in AP. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of each A_i is supplied in AP.
- **n** – **[in]** [int] the number of rows and columns of each matrix A_i, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device pointer pointing to the first vector (x_1).
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1).
- **AP** – **[inout]** device array of device pointers storing the packed version of the specified triangular portion of each Hermitian matrix A_i. Points to the first matrix (A_1). if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of each Hermitian matrix A_i is supplied. The matrix is compacted so that AP contains the triangular portion

column-by-column so that: AP(0) = A(0,0) AP(1) = A(0,1) AP(2) = A(1,1), etc. Ex: (HIPBLAS_FILL_MODE_UPPER; n = 3) (1, 0) (2, 1) (4,9) (2,-1) (3, 0) (5,3) –> [(1,0), (2,1), (3,0), (4,9), (5,3), (6,0)] (4,-9) (5,-3) (6,0) if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of each Hermitian matrix A_i is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(1,0) AP(2) = A(2,1), etc. Ex: (HIPBLAS_FILL_MODE_LOWER; n = 3) (1, 0) (2, 1) (4,9) (2,-1) (3, 0) (5,3) –> [(1,0), (2,-1), (4,-9), (3,0), (5,-3), (6,0)] (4,-9) (5,-3) (6,0) Note that the imaginary part of the diagonal elements are not accessed and are assumed to be 0.

- `strideA` – **[in]** [hipblasStride] stride from the start of one (A_i) and the next (A_i+1)
- `batchCount` – **[in]** [int] number of instances in the batch.

1.9.2.10 hipblasXhpr2 + Batched, StridedBatched

hipblasStatus_t **hipblasChpr2**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *x, int incx, const *hipblasComplex* *y, int incy, *hipblasComplex* *AP)

hipblasStatus_t **hipblasZhpr2**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *x, int incx, const *hipblasDoubleComplex* *y, int incy, *hipblasDoubleComplex* *AP)

BLAS Level 2 API.

hpr2 performs the matrix-vector operations

```
A := A + alpha*x*y**H + conj(alpha)*y*x**H
```

where alpha is a complex scalar, x and y are vectors, and A is an n by n Hermitian matrix, supplied in packed form.

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : c,z

Parameters

- `handle` – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- `uplo` – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of A is supplied in AP. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of A is supplied in AP.
- `n` – **[in]** [int] the number of rows and columns of matrix A, must be at least 0.
- `alpha` – **[in]** device pointer or host pointer to scalar alpha.
- `x` – **[in]** device pointer storing vector x.
- `incx` – **[in]** [int] specifies the increment for the elements of x.
- `y` – **[in]** device pointer storing vector y.
- `incy` – **[in]** [int] specifies the increment for the elements of y.

- **AP** – **[inout]** device pointer storing the packed version of the specified triangular portion of the Hermitian matrix A. Of at least size ((n * (n + 1)) / 2). if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of the Hermitian matrix A is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(0,1) AP(2) = A(1,1), etc. Ex: (HIPBLAS_FILL_MODE_UPPER; n = 3) (1, 0) (2, 1) (4,9) (2,-1) (3, 0) (5,3) –> [(1,0), (2,1), (3,0), (4,9), (5,3), (6,0)] (4,-9) (5,-3) (6,0) if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of the Hermitian matrix A is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(1,0) AP(2) = A(2,1), etc. Ex: (HIPBLAS_FILL_MODE_LOWER; n = 3) (1, 0) (2, 1) (4,9) (2,-1) (3, 0) (5,3) –> [(1,0), (2,-1), (4,-9), (3,0), (5,-3), (6,0)] (4,-9) (5,-3) (6,0) Note that the imaginary part of the diagonal elements are not accessed and are assumed to be 0.

hipblasStatus_t **hipblasChpr2Batched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *const x[], int incx, const *hipblasComplex* *const y[], int incy, *hipblasComplex* *const AP[], int batchCount)

hipblasStatus_t **hipblasZhpr2Batched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const x[], int incx, const *hipblasDoubleComplex* *const y[], int incy, *hipblasDoubleComplex* *const AP[], int batchCount)

BLAS Level 2 API.

hpr2Batched performs the matrix-vector operations

```
A_i := A_i + alpha*x_i*y_i**H + conj(alpha)*y_i*x_i**H
```

where alpha is a complex scalar, x_i and y_i are vectors, and A_i is an n by n symmetric matrix, supplied in packed form, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of each A_i is supplied in AP. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of each A_i is supplied in AP.
- **n** – **[in]** [int] the number of rows and columns of each matrix A_i, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **y** – **[in]** device array of device pointers storing each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.

- **AP** – **[inout]** device array of device pointers storing the packed version of the specified triangular portion of each Hermitian matrix A_i of at least size ((n * (n + 1)) / 2). Array is of at least size batchCount. if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of each Hermitian matrix A_i is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(0,1) AP(2) = A(1,1), etc. Ex: (HIPBLAS_FILL_MODE_UPPER; n = 3) (1, 0) (2, 1) (4,9) (2,-1) (3, 0) (5,3) –> [(1,0), (2,1), (3,0), (4,9), (5,3), (6,0)] (4,-9) (5,-3) (6,0) if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of each Hermitian matrix A_i is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(1,0) AP(2) = A(2,1), etc. Ex: (HIPBLAS_FILL_MODE_LOWER; n = 3) (1, 0) (2, 1) (4,9) (2,-1) (3, 0) (5,3) –> [(1,0), (2,-1), (4,-9), (3,0), (5,-3), (6,0)] (4,-9) (5,-3) (6,0) Note that the imaginary part of the diagonal elements are not accessed and are assumed to be 0.
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasChpr2StridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, const *hipblasComplex* *y, int incy, *hipblasStride* stridey, *hipblasComplex* *AP, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasZhpr2StridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, const *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, *hipblasDoubleComplex* *AP, *hipblasStride* strideA, int batchCount)

BLAS Level 2 API.

hpr2StridedBatched performs the matrix-vector operations

```
A_i := A_i + alpha*x_i*y_i**H + conj(alpha)*y_i*x_i**H
```

where alpha is a complex scalar, x_i and y_i are vectors, and A_i is an n by n symmetric matrix, supplied in packed form, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of each A_i is supplied in AP. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of each A_i is supplied in AP.
- **n** – **[in]** [int] the number of rows and columns of each matrix A_i, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device pointer pointing to the first vector (x_1).
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.

- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1).
- **y** – **[in]** device pointer pointing to the first vector (y_1).
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.
- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) and the next one (y_i+1).
- **AP** – **[inout]** device array of device pointers storing the packed version of the specified triangular portion of each Hermitian matrix A_i. Points to the first matrix (A_1). if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of each Hermitian matrix A_i is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(0,1) AP(2) = A(1,1), etc. Ex: (HIPBLAS_FILL_MODE_UPPER; n = 3) (1, 0) (2, 1) (4,9) (2,-1) (3, 0) (5,3) –> [(1,0), (2,1), (3,0), (4,9), (5,3), (6,0)] (4,-9) (5,-3) (6,0) if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of each Hermitian matrix A_i is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(1,0) AP(2) = A(2,1), etc. Ex: (HIPBLAS_FILL_MODE_LOWER; n = 3) (1, 0) (2, 1) (4,9) (2,-1) (3, 0) (5,3) –> [(1,0), (2,-1), (4,-9), (3,0), (5,-3), (6,0)] (4,-9) (5,-3) (6,0) Note that the imaginary part of the diagonal elements are not accessed and are assumed to be 0.
- **strideA** – **[in]** [hipblasStride] stride from the start of one (A_i) and the next (A_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.2.11 hipblasXsbmv + Batched, StridedBatched

hipblasStatus_t **hipblasSsbmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, int k, const float *alpha, const float *AP, int lda, const float *x, int incx, const float *beta, float *y, int incy)

hipblasStatus_t **hipblasDsbmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, int k, const double *alpha, const double *AP, int lda, const double *x, int incx, const double *beta, double *y, int incy)

BLAS Level 2 API.

sbmv performs the matrix-vector operation:

```
y := alpha*A*x + beta*y,
```

where alpha and beta are scalars, x and y are n element vectors and A should contain an upper or lower triangular n by n symmetric banded matrix.

- Supported precisions in rocBLAS : s,d
- Supported precisions in cuBLAS : s,d

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' if HIPBLAS_FILL_MODE_UPPER, the lower part of A is not referenced if HIPBLAS_FILL_MODE_LOWER, the upper part of A is not referenced

- **n** – **[in]** [int]
- **k** – **[in]** [int] specifies the number of sub- and super-diagonals
- **alpha** – **[in]** specifies the scalar alpha
- **AP** – **[in]** pointer storing matrix A on the GPU
- **lda** – **[in]** [int] specifies the leading dimension of matrix A
- **x** – **[in]** pointer storing vector x on the GPU
- **incx** – **[in]** [int] specifies the increment for the elements of x
- **beta** – **[in]** specifies the scalar beta
- **y** – **[out]** pointer storing vector y on the GPU
- **incy** – **[in]** [int] specifies the increment for the elements of y

hipblasStatus_t **hipblasSsbmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, int k, const float *alpha, const float *const AP[], int lda, const float *const x[], int incx, const float *beta, float *y[], int incy, int batchCount)

hipblasStatus_t **hipblasDsbmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, int k, const double *alpha, const double *const AP[], int lda, const double *const x[], int incx, const double *beta, double *y[], int incy, int batchCount)

BLAS Level 2 API.

sbmvBatched performs the matrix-vector operation:

```
y_i := alpha*A_i*x_i + beta*y_i,
```

where (A_i, x_i, y_i) is the i-th instance of the batch. alpha and beta are scalars, x_i and y_i are vectors and A_i is an n by n symmetric banded matrix, for i = 1, …, batchCount. A should contain an upper or lower triangular n by n symmetric banded matrix.

- Supported precisions in rocBLAS : s,d
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' if HIPBLAS_FILL_MODE_UPPER, the lower part of A is not referenced if HIPBLAS_FILL_MODE_LOWER, the upper part of A is not referenced
- **n** – **[in]** [int] number of rows and columns of each matrix A_i
- **k** – **[in]** [int] specifies the number of sub- and super-diagonals
- **alpha** – **[in]** device pointer or host pointer to scalar alpha
- **AP** – **[in]** device array of device pointers storing each matrix A_i
- **lda** – **[in]** [int] specifies the leading dimension of each matrix A_i
- **x** – **[in]** device array of device pointers storing each vector x_i
- **incx** – **[in]** [int] specifies the increment for the elements of each vector x_i

- **beta** – **[in]** device pointer or host pointer to scalar beta
- **y** – **[out]** device array of device pointers storing each vector y_i
- **incy** – **[in]** [int] specifies the increment for the elements of each vector y_i
- **batchCount** – **[in]** [int] number of instances in the batch

hipblasStatus_t **hipblasSsbmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, int k, const float *alpha, const float *AP, int lda, *hipblasStride* strideA, const float *x, int incx, *hipblasStride* stridex, const float *beta, float *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasDsbmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, int k, const double *alpha, const double *AP, int lda, *hipblasStride* strideA, const double *x, int incx, *hipblasStride* stridex, const double *beta, double *y, int incy, *hipblasStride* stridey, int batchCount)

BLAS Level 2 API.

sbmvStridedBatched performs the matrix-vector operation:

```
y_i := alpha*A_i*x_i + beta*y_i,
```

where (A_i, x_i, y_i) is the i-th instance of the batch. alpha and beta are scalars, x_i and y_i are vectors and A_i is an n by n symmetric banded matrix, for i = 1, . . . , batchCount. A should contain an upper or lower triangular n by n symmetric banded matrix.

- Supported precisions in rocBLAS : s,d
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' if HIPBLAS_FILL_MODE_UPPER, the lower part of A is not referenced if HIPBLAS_FILL_MODE_LOWER, the upper part of A is not referenced
- **n** – **[in]** [int] number of rows and columns of each matrix A_i
- **k** – **[in]** [int] specifies the number of sub- and super-diagonals
- **alpha** – **[in]** device pointer or host pointer to scalar alpha
- **AP** – **[in]** Device pointer to the first matrix A_1 on the GPU
- **lda** – **[in]** [int] specifies the leading dimension of each matrix A_i
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **x** – **[in]** Device pointer to the first vector x_1 on the GPU
- **incx** – **[in]** [int] specifies the increment for the elements of each vector x_i
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1). There are no restrictions placed on stridex, however the user should take care to

ensure that stridex is of appropriate size. This typically means stridex >= n * incx. stridex should be non zero.

- **beta** – **[in]** device pointer or host pointer to scalar beta
- **y** – **[out]** Device pointer to the first vector y_1 on the GPU
- **incy** – **[in]** [int] specifies the increment for the elements of each vector y_i
- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) and the next one (y_i+1). There are no restrictions placed on stridey, however the user should take care to ensure that stridey is of appropriate size. This typically means stridey >= n * incy. stridey should be non zero.
- **batchCount** – **[in]** [int] number of instances in the batch

1.9.2.12 hipblasXspmv + Batched, StridedBatched

hipblasStatus_t **hipblasSspmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *AP, const float *x, int incx, const float *beta, float *y, int incy)

hipblasStatus_t **hipblasDspmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *AP, const double *x, int incx, const double *beta, double *y, int incy)

BLAS Level 2 API.

spmv performs the matrix-vector operation:

```
y := alpha*A*x + beta*y,
```

where alpha and beta are scalars, x and y are n element vectors and A should contain an upper or lower triangular n by n packed symmetric matrix.

- Supported precisions in rocBLAS : s,d
- Supported precisions in cuBLAS : s,d

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' if HIPBLAS_FILL_MODE_UPPER, the lower part of A is not referenced if HIPBLAS_FILL_MODE_LOWER, the upper part of A is not referenced
- **n** – **[in]** [int]
- **alpha** – **[in]** specifies the scalar alpha
- **AP** – **[in]** pointer storing matrix A on the GPU
- **x** – **[in]** pointer storing vector x on the GPU
- **incx** – **[in]** [int] specifies the increment for the elements of x
- **beta** – **[in]** specifies the scalar beta
- **y** – **[out]** pointer storing vector y on the GPU
- **incy** – **[in]** [int] specifies the increment for the elements of y

hipblasStatus_t **hipblasSspmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *const AP[], const float *const x[], int incx, const float *beta, float *y[], int incy, int batchCount)

hipblasStatus_t **hipblasDspmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *const AP[], const double *const x[], int incx, const double *beta, double *y[], int incy, int batchCount)

BLAS Level 2 API.

spmvBatched performs the matrix-vector operation:

```
y_i := alpha*AP_i*x_i + beta*y_i,
```

where (A_i, x_i, y_i) is the i-th instance of the batch. alpha and beta are scalars, x_i and y_i are vectors and A_i is an n by n symmetric matrix, for i = 1, …, batchCount. A should contain an upper or lower triangular n by n packed symmetric matrix.

- Supported precisions in rocBLAS : s,d
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' if HIPBLAS_FILL_MODE_UPPER, the lower part of A is not referenced if HIPBLAS_FILL_MODE_LOWER, the upper part of A is not referenced
- **n** – **[in]** [int] number of rows and columns of each matrix A_i
- **alpha** – **[in]** device pointer or host pointer to scalar alpha
- **AP** – **[in]** device array of device pointers storing each matrix A_i
- **x** – **[in]** device array of device pointers storing each vector x_i
- **incx** – **[in]** [int] specifies the increment for the elements of each vector x_i
- **beta** – **[in]** device pointer or host pointer to scalar beta
- **y** – **[out]** device array of device pointers storing each vector y_i
- **incy** – **[in]** [int] specifies the increment for the elements of each vector y_i
- **batchCount** – **[in]** [int] number of instances in the batch

hipblasStatus_t **hipblasSspmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *AP, *hipblasStride* strideA, const float *x, int incx, *hipblasStride* stridex, const float *beta, float *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasDspmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *AP, *hipblasStride* strideA, const double *x, int incx, *hipblasStride* stridex, const double *beta, double *y, int incy, *hipblasStride* stridey, int batchCount)

BLAS Level 2 API.

spmvStridedBatched performs the matrix-vector operation:

```
y_i := alpha*A_i*x_i + beta*y_i,
```

where (A_i, x_i, y_i) is the i-th instance of the batch. alpha and beta are scalars, x_i and y_i are vectors and A_i is an n by n symmetric matrix, for i = 1, …, batchCount. A should contain an upper or lower triangular n by n packed symmetric matrix.

- Supported precisions in rocBLAS : s,d
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' if HIPBLAS_FILL_MODE_UPPER, the lower part of A is not referenced if HIPBLAS_FILL_MODE_LOWER, the upper part of A is not referenced
- **n** – **[in]** [int] number of rows and columns of each matrix A_i
- **alpha** – **[in]** device pointer or host pointer to scalar alpha
- **AP** – **[in]** Device pointer to the first matrix A_1 on the GPU
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **x** – **[in]** Device pointer to the first vector x_1 on the GPU
- **incx** – **[in]** [int] specifies the increment for the elements of each vector x_i
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1). There are no restrictions placed on stridex, however the user should take care to ensure that stridex is of appropriate size. This typically means stridex >= n * incx. stridex should be non zero.
- **beta** – **[in]** device pointer or host pointer to scalar beta
- **y** – **[out]** Device pointer to the first vector y_1 on the GPU
- **incy** – **[in]** [int] specifies the increment for the elements of each vector y_i
- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) and the next one (y_i+1). There are no restrictions placed on stridey, however the user should take care to ensure that stridey is of appropriate size. This typically means stridey >= n * incy. stridey should be non zero.
- **batchCount** – **[in]** [int] number of instances in the batch

1.9.2.13 hipblasXspr + Batched, StridedBatched

hipblasStatus_t **hipblasSspr**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *x, int incx, float *AP)

hipblasStatus_t **hipblasDspr**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *x, int incx, double *AP)

hipblasStatus_t **hipblasCspr**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *x, int incx, *hipblasComplex* *AP)

hipblasStatus_t **hipblasZspr**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *x, int incx, *hipblasDoubleComplex* *AP)

BLAS Level 2 API.

spr performs the matrix-vector operations

```
A := A + alpha*x*x**T
```

where alpha is a scalar, x is a vector, and A is an n by n symmetric matrix, supplied in packed form.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of A is supplied in AP. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of A is supplied in AP.
- **n** – **[in]** [int] the number of rows and columns of matrix A, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **AP** – **[inout]** device pointer storing the packed version of the specified triangular portion of the symmetric matrix A. Of at least size ((n * (n + 1)) / 2). if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of the symmetric matrix A is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(0,1) AP(2) = A(1,1), etc. Ex: (HIPBLAS_FILL_MODE_UPPER; n = 4) 1 2 4 7 2 3 5 8 –> [1, 2, 3, 4, 5, 6, 7, 8, 9, 0] 4 5 6 9 7 8 9 0 if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of the symmetric matrix A is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(1,0) AP(2) = A(2,1), etc. Ex: (HIPBLAS_FILL_MODE_LOWER; n = 4) 1 2 3 4 2 5 6 7 –> [1, 2, 3, 4, 5, 6, 7, 8, 9, 0] 3 6 8 9 4 7 9 0

hipblasStatus_t **hipblasSsprBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *const x[], int incx, float *const AP[], int batchCount)

hipblasStatus_t **hipblasDsprBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *const x[], int incx, double *const AP[], int batchCount)

hipblasStatus_t **hipblasCsprBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *const x[], int incx, *hipblasComplex* *const AP[], int batchCount)

hipblasStatus_t **hipblasZsprBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const x[], int incx, *hipblasDoubleComplex* *const AP[], int batchCount)

BLAS Level 2 API.

sprBatched performs the matrix-vector operations

```
A_i := A_i + alpha*x_i*x_i**T
```

where alpha is a scalar, x_i is a vector, and A_i is an n by n symmetric matrix, supplied in packed form, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of each A_i is supplied in AP. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of each A_i is supplied in AP.
- **n** – **[in]** [int] the number of rows and columns of each matrix A_i, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **AP** – **[inout]** device array of device pointers storing the packed version of the specified triangular portion of each symmetric matrix A_i of at least size ((n * (n + 1)) / 2). Array is of at least size batchCount. if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of each symmetric matrix A_i is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(0,1) AP(2) = A(1,1), etc. Ex: (HIPBLAS_FILL_MODE_UPPER; n = 4) 1 2 4 7 2 3 5 8 –> [1, 2, 3, 4, 5, 6, 7, 8, 9, 0] 4 5 6 9 7 8 9 0 if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of each symmetric matrix A_i is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(1,0) AP(2) = A(2,1), etc. Ex: (HIPBLAS_FILL_MODE_LOWER; n = 4) 1 2 3 4 2 5 6 7 –> [1, 2, 3, 4, 5, 6, 7, 8, 9, 0] 3 6 8 9 4 7 9 0
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasSsprStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *x, int incx, *hipblasStride* stridex, float *AP, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasDsprStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *x, int incx, *hipblasStride* stridex, double *AP, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasCsprStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, *hipblasComplex* *AP, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasZsprStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, *hipblasDoubleComplex* *AP, *hipblasStride* strideA, int batchCount)

BLAS Level 2 API.

sprStridedBatched performs the matrix-vector operations

```
A_i := A_i + alpha*x_i*x_i**T
```

where alpha is a scalar, x_i is a vector, and A_i is an n by n symmetric matrix, supplied in packed form, for i = 1, …, batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of each A_i is supplied in AP. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of each A_i is supplied in AP.
- **n** – **[in]** [int] the number of rows and columns of each matrix A_i, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device pointer pointing to the first vector (x_1).
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1).
- **AP** – **[inout]** device pointer storing the packed version of the specified triangular portion of each symmetric matrix A_i. Points to the first A_1. if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of each symmetric matrix A_i is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(0,1) AP(2) = A(1,1), etc. Ex: (HIPBLAS_FILL_MODE_UPPER; n = 4) 1 2 4 7 2 3 5 8 –> [1, 2, 3, 4, 5, 6, 7, 8, 9, 0] 4 5

6 9 7 8 9 0 if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of each symmetric matrix A_i is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(1,0) AP(2) = A(2,1), etc. Ex: (HIPBLAS_FILL_MODE_LOWER; n = 4) 1 2 3 4 2 5 6 7 –> [1, 2, 3, 4, 5, 6, 7, 8, 9, 0] 3 6 8 9 4 7 9 0

- **strideA** – **[in]** [hipblasStride] stride from the start of one (A_i) and the next (A_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.2.14 hipblasXspr2 + Batched, StridedBatched

hipblasStatus_t **hipblasSspr2**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *x, int incx, const float *y, int incy, float *AP)

hipblasStatus_t **hipblasDspr2**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *x, int incx, const double *y, int incy, double *AP)

BLAS Level 2 API.

spr2 performs the matrix-vector operation

```
A := A + alpha*x*y**T + alpha*y*x**T
```

where alpha is a scalar, x and y are vectors, and A is an n by n symmetric matrix, supplied in packed form.

- Supported precisions in rocBLAS : s,d
- Supported precisions in cuBLAS : s,d

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of A is supplied in AP. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of A is supplied in AP.
- **n** – **[in]** [int] the number of rows and columns of matrix A, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **y** – **[in]** device pointer storing vector y.
- **incy** – **[in]** [int] specifies the increment for the elements of y.
- **AP** – **[inout]** device pointer storing the packed version of the specified triangular portion of the symmetric matrix A. Of at least size ((n * (n + 1)) / 2). if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of the symmetric matrix A is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(0,1) AP(2) = A(1,1), etc. Ex: (HIPBLAS_FILL_MODE_UPPER; n = 4) 1 2 4 7 2 3 5 8 –> [1, 2, 3, 4, 5, 6, 7, 8, 9, 0] 4 5 6 9 7 8 9 0 if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of

the symmetric matrix A is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(1,0) AP(n) = A(2,1), etc. Ex: (HIPBLAS_FILL_MODE_LOWER; n = 4) 1 2 3 4 2 5 6 7 –> [1, 2, 3, 4, 5, 6, 7, 8, 9, 0] 3 6 8 9 4 7 9 0

hipblasStatus_t **hipblasSspr2Batched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *const x[], int incx, const float *const y[], int incy, float *const AP[], int batchCount)

hipblasStatus_t **hipblasDspr2Batched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *const x[], int incx, const double *const y[], int incy, double *const AP[], int batchCount)

BLAS Level 2 API.

spr2Batched performs the matrix-vector operation

```
A_i := A_i + alpha*x_i*y_i**T + alpha*y_i*x_i**T
```

where alpha is a scalar, x_i and y_i are vectors, and A_i is an n by n symmetric matrix, supplied in packed form, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : s,d
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of each A_i is supplied in AP. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of each A_i is supplied in AP.
- **n** – **[in]** [int] the number of rows and columns of each matrix A_i, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **y** – **[in]** device array of device pointers storing each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.
- **AP** – **[inout]** device array of device pointers storing the packed version of the specified triangular portion of each symmetric matrix A_i of at least size ((n * (n + 1)) / 2). Array is of at least size batchCount. if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of each symmetric matrix A_i is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(0,1) AP(2) = A(1,1), etc. Ex: (HIPBLAS_FILL_MODE_UPPER; n = 4) 1 2 4 7 2 3 5 8 –> [1, 2, 3, 4, 5, 6, 7, 8, 9, 0] 4 5 6 9 7 8 9 0 if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of each symmetric matrix A_i is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(1,0) AP(n) = A(2,1), etc. Ex: (HIPBLAS_FILL_MODE_LOWER; n = 4) 1 2 3 4 2 5 6 7 –> [1, 2, 3, 4, 5, 6, 7, 8, 9, 0] 3 6 8 9 4 7 9 0

- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasSspr2StridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *x, int incx, *hipblasStride* stridex, const float *y, int incy, *hipblasStride* stridey, float *AP, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasDspr2StridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *x, int incx, *hipblasStride* stridex, const double *y, int incy, *hipblasStride* stridey, double *AP, *hipblasStride* strideA, int batchCount)

BLAS Level 2 API.

spr2StridedBatched performs the matrix-vector operation

```
A_i := A_i + alpha*x_i*y_i**T + alpha*y_i*x_i**T
```

where alpha is a scalar, x_i amd y_i are vectors, and A_i is an n by n symmetric matrix, supplied in packed form, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : s,d
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' HIPBLAS_FILL_MODE_UPPER: The upper triangular part of each A_i is supplied in AP. HIPBLAS_FILL_MODE_LOWER: The lower triangular part of each A_i is supplied in AP.
- **n** – **[in]** [int] the number of rows and columns of each matrix A_i, must be at least 0.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device pointer pointing to the first vector (x_1).
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1).
- **y** – **[in]** device pointer pointing to the first vector (y_1).
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.
- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) and the next one (y_i+1).
- **AP** – **[inout]** device pointer storing the packed version of the specified triangular portion of each symmetric matrix A_i. Points to the first A_1. if uplo == HIPBLAS_FILL_MODE_UPPER: The upper triangular portion of each symmetric matrix A_i is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(0,1) AP(2) = A(1,1), etc. Ex: (HIPBLAS_FILL_MODE_UPPER; n = 4) 1 2 4 7 2 3 5 8 –> [1, 2, 3, 4, 5, 6, 7, 8, 9, 0] 4 5 6 9 7 8 9 0 if uplo == HIPBLAS_FILL_MODE_LOWER: The lower triangular portion of

each symmetric matrix A_i is supplied. The matrix is compacted so that AP contains the triangular portion column-by-column so that: AP(0) = A(0,0) AP(1) = A(1,0) AP(n) = A(2,1), etc. Ex: (HIPBLAS_FILL_MODE_LOWER; n = 4) 1 2 3 4 2 5 6 7 –> [1, 2, 3, 4, 5, 6, 7, 8, 9, 0] 3 6 8 9 4 7 9 0

- **strideA** – **[in]** [hipblasStride] stride from the start of one (A_i) and the next (A_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.2.15 hipblasXsymv + Batched, StridedBatched

hipblasStatus_t **hipblasSsymv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *AP, int lda, const float *x, int incx, const float *beta, float *y, int incy)

hipblasStatus_t **hipblasDsymv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *AP, int lda, const double *x, int incx, const double *beta, double *y, int incy)

hipblasStatus_t **hipblasCsymv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, const *hipblasComplex* *x, int incx, const *hipblasComplex* *beta, *hipblasComplex* *y, int incy)

hipblasStatus_t **hipblasZsymv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, const *hipblasDoubleComplex* *x, int incx, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *y, int incy)

BLAS Level 2 API.

symv performs the matrix-vector operation:

```
y := alpha*A*x + beta*y,
```

where alpha and beta are scalars, x and y are n element vectors and A should contain an upper or lower triangular n by n symmetric matrix.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' if HIPBLAS_FILL_MODE_UPPER, the lower part of A is not referenced if HIPBLAS_FILL_MODE_LOWER, the upper part of A is not referenced
- **n** – **[in]** [int]
- **alpha** – **[in]** specifies the scalar alpha
- **AP** – **[in]** pointer storing matrix A on the GPU
- **lda** – **[in]** [int] specifies the leading dimension of A

- **x** – **[in]** pointer storing vector x on the GPU
- **incx** – **[in]** [int] specifies the increment for the elements of x
- **beta** – **[in]** specifies the scalar beta
- **y** – **[out]** pointer storing vector y on the GPU
- **incy** – **[in]** [int] specifies the increment for the elements of y

hipblasStatus_t **hipblasSsymvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *const AP[], int lda, const float *const x[], int incx, const float *beta, float *y[], int incy, int batchCount)

hipblasStatus_t **hipblasDsymvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *const AP[], int lda, const double *const x[], int incx, const double *beta, double *y[], int incy, int batchCount)

hipblasStatus_t **hipblasCsymvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *const AP[], int lda, const *hipblasComplex* *const x[], int incx, const *hipblasComplex* *beta, *hipblasComplex* *y[], int incy, int batchCount)

hipblasStatus_t **hipblasZsymvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const AP[], int lda, const *hipblasDoubleComplex* *const x[], int incx, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *y[], int incy, int batchCount)

BLAS Level 2 API.

symvBatched performs the matrix-vector operation:

```
y_i := alpha*A_i*x_i + beta*y_i,
```

where (A_i, x_i, y_i) is the i-th instance of the batch. alpha and beta are scalars, x_i and y_i are vectors and A_i is an n by n symmetric matrix, for i = 1, …, batchCount. A a should contain an upper or lower triangular symmetric matrix and the opposing triangular part of A is not referenced

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' if HIPBLAS_FILL_MODE_UPPER, the lower part of A is not referenced if HIPBLAS_FILL_MODE_LOWER, the upper part of A is not referenced
- **n** – **[in]** [int] number of rows and columns of each matrix A_i
- **alpha** – **[in]** device pointer or host pointer to scalar alpha
- **AP** – **[in]** device array of device pointers storing each matrix A_i
- **lda** – **[in]** [int] specifies the leading dimension of each matrix A_i

- **x** – **[in]** device array of device pointers storing each vector x_i
- **incx** – **[in]** [int] specifies the increment for the elements of each vector x_i
- **beta** – **[in]** device pointer or host pointer to scalar beta
- **y** – **[out]** device array of device pointers storing each vector y_i
- **incy** – **[in]** [int] specifies the increment for the elements of each vector y_i
- **batchCount** – **[in]** [int] number of instances in the batch

hipblasStatus_t **hipblasSsymvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *AP, int lda, *hipblasStride* strideA, const float *x, int incx, *hipblasStride* stridex, const float *beta, float *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasDsymvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *AP, int lda, *hipblasStride* strideA, const double *x, int incx, *hipblasStride* stridex, const double *beta, double *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasCsymvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, const *hipblasComplex* *beta, *hipblasComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

hipblasStatus_t **hipblasZsymvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, int batchCount)

BLAS Level 2 API.

symvStridedBatched performs the matrix-vector operation:

```
y_i := alpha*A_i*x_i + beta*y_i,
```

where (A_i, x_i, y_i) is the i-th instance of the batch. alpha and beta are scalars, x_i and y_i are vectors and A_i is an n by n symmetric matrix, for i = 1, …, batchCount. A a should contain an upper or lower triangular symmetric matrix and the opposing triangular part of A is not referenced

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' if

HIPBLAS_FILL_MODE_UPPER, the lower part of A is not referenced if HIPBLAS_FILL_MODE_LOWER, the upper part of A is not referenced

- **n** – **[in]** [int] number of rows and columns of each matrix A_i
- **alpha** – **[in]** device pointer or host pointer to scalar alpha
- **AP** – **[in]** Device pointer to the first matrix A_1 on the GPU
- **lda** – **[in]** [int] specifies the leading dimension of each matrix A_i
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **x** – **[in]** Device pointer to the first vector x_1 on the GPU
- **incx** – **[in]** [int] specifies the increment for the elements of each vector x_i
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1). There are no restrictions placed on stridex, however the user should take care to ensure that stridex is of appropriate size. This typically means stridex >= n * incx. stridex should be non zero.
- **beta** – **[in]** device pointer or host pointer to scalar beta
- **y** – **[out]** Device pointer to the first vector y_1 on the GPU
- **incy** – **[in]** [int] specifies the increment for the elements of each vector y_i
- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) and the next one (y_i+1). There are no restrictions placed on stridey, however the user should take care to ensure that stridey is of appropriate size. This typically means stridey >= n * incy. stridey should be non zero.
- **batchCount** – **[in]** [int] number of instances in the batch

1.9.2.16 hipblasXsyr + Batched, StridedBatched

hipblasStatus_t **hipblasSsyr**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *x, int incx, float *AP, int lda)

hipblasStatus_t **hipblasDsyr**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *x, int incx, double *AP, int lda)

hipblasStatus_t **hipblasCsyr**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *x, int incx, *hipblasComplex* *AP, int lda)

hipblasStatus_t **hipblasZsyr**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *x, int incx, *hipblasDoubleComplex* *AP, int lda)

BLAS Level 2 API.

syr performs the matrix-vector operations

```
A := A + alpha*x*x**T
```

where alpha is a scalar, x is a vector, and A is an n by n symmetric matrix.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' if HIPBLAS_FILL_MODE_UPPER, the lower part of A is not referenced if HIPBLAS_FILL_MODE_LOWER, the upper part of A is not referenced
- **n** – **[in]** [int] the number of rows and columns of matrix A.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **AP** – **[inout]** device pointer storing matrix A.
- **lda** – **[in]** [int] specifies the leading dimension of A.

hipblasStatus_t **hipblasSsyrBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *const x[], int incx, float *const AP[], int lda, int batchCount)

hipblasStatus_t **hipblasDsyrBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *const x[], int incx, double *const AP[], int lda, int batchCount)

hipblasStatus_t **hipblasCsyrBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *const x[], int incx, *hipblasComplex* *const AP[], int lda, int batchCount)

hipblasStatus_t **hipblasZsyrBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const x[], int incx, *hipblasDoubleComplex* *const AP[], int lda, int batchCount)

BLAS Level 2 API.

syrBatched performs a batch of matrix-vector operations

```
A[i] := A[i] + alpha*x[i]*x[i]**T
```

where alpha is a scalar, x is an array of vectors, and A is an array of n by n symmetric matrices, for i = 1 , … , batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.

- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' if HIPBLAS_FILL_MODE_UPPER, the lower part of A is not referenced if HIPBLAS_FILL_MODE_LOWER, the upper part of A is not referenced
- **n** – **[in]** [int] the number of rows and columns of matrix A.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **AP** – **[inout]** device array of device pointers storing each matrix A_i.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i.
- **batchCount** – **[in]** [int] number of instances in the batch

hipblasStatus_t **hipblasSsyrStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *x, int incx, *hipblasStride* stridex, float *AP, int lda, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasDsyrStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *x, int incx, *hipblasStride* stridex, double *AP, int lda, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasCsyrStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, *hipblasComplex* *AP, int lda, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasZsyrStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, int batchCount)

BLAS Level 2 API.

syrStridedBatched performs the matrix-vector operations

```
A[i] := A[i] + alpha*x[i]*x[i]**T
```

where alpha is a scalar, vectors, and A is an array of n by n symmetric matrices, for i = 1 , … , batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' if HIPBLAS_FILL_MODE_UPPER, the lower part of A is not referenced if HIPBLAS_FILL_MODE_LOWER, the upper part of A is not referenced
- **n** – **[in]** [int] the number of rows and columns of each matrix A.

- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device pointer to the first vector x_1.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] specifies the pointer increment between vectors (x_i) and (x_i+1).
- **AP** – **[inout]** device pointer to the first matrix A_1.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i.
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch

1.9.2.17 hipblasXsyr2 + Batched, StridedBatched

hipblasStatus_t **hipblasSsyr2**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *x, int incx, const float *y, int incy, float *AP, int lda)

hipblasStatus_t **hipblasDsyr2**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *x, int incx, const double *y, int incy, double *AP, int lda)

hipblasStatus_t **hipblasCsyr2**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *x, int incx, const *hipblasComplex* *y, int incy, *hipblasComplex* *AP, int lda)

hipblasStatus_t **hipblasZsyr2**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *x, int incx, const *hipblasDoubleComplex* *y, int incy, *hipblasDoubleComplex* *AP, int lda)

BLAS Level 2 API.

syr2 performs the matrix-vector operations

```
A := A + alpha*x*y**T + alpha*y*x**T
```

where alpha is a scalar, x and y are vectors, and A is an n by n symmetric matrix.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' if HIPBLAS_FILL_MODE_UPPER, the lower part of A is not referenced if HIPBLAS_FILL_MODE_LOWER, the upper part of A is not referenced
- **n** – **[in]** [int] the number of rows and columns of matrix A.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.

- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **y** – **[in]** device pointer storing vector y.
- **incy** – **[in]** [int] specifies the increment for the elements of y.
- **AP** – **[inout]** device pointer storing matrix A.
- **lda** – **[in]** [int] specifies the leading dimension of A.

hipblasStatus_t **hipblasSsyr2Batched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *const x[], int incx, const float *const y[], int incy, float *const AP[], int lda, int batchCount)

hipblasStatus_t **hipblasDsyr2Batched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *const x[], int incx, const double *const y[], int incy, double *const AP[], int lda, int batchCount)

hipblasStatus_t **hipblasCsyr2Batched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *const x[], int incx, const *hipblasComplex* *const y[], int incy, *hipblasComplex* *const AP[], int lda, int batchCount)

hipblasStatus_t **hipblasZsyr2Batched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const x[], int incx, const *hipblasDoubleComplex* *const y[], int incy, *hipblasDoubleComplex* *const AP[], int lda, int batchCount)

BLAS Level 2 API.

syr2Batched performs a batch of matrix-vector operations

```
A[i] := A[i] + alpha*x[i]*y[i]**T + alpha*y[i]*x[i]**T
```

where alpha is a scalar, x[i] and y[i] are vectors, and A[i] is a n by n symmetric matrix, for i = 1 , … , batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' if HIPBLAS_FILL_MODE_UPPER, the lower part of A is not referenced if HIPBLAS_FILL_MODE_LOWER, the upper part of A is not referenced
- **n** – **[in]** [int] the number of rows and columns of matrix A.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **y** – **[in]** device array of device pointers storing each vector y_i.

- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.
- **AP** – **[inout]** device array of device pointers storing each matrix A_i.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i.
- **batchCount** – **[in]** [int] number of instances in the batch

hipblasStatus_t **hipblasSsyr2StridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const float *alpha, const float *x, int incx, *hipblasStride* stridex, const float *y, int incy, *hipblasStride* stridey, float *AP, int lda, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasDsyr2StridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const double *alpha, const double *x, int incx, *hipblasStride* stridex, const double *y, int incy, *hipblasStride* stridey, double *AP, int lda, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasCsyr2StridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, const *hipblasComplex* *y, int incy, *hipblasStride* stridey, *hipblasComplex* *AP, int lda, *hipblasStride* strideA, int batchCount)

hipblasStatus_t **hipblasZsyr2StridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, const *hipblasDoubleComplex* *y, int incy, *hipblasStride* stridey, *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, int batchCount)

BLAS Level 2 API.

syr2StridedBatched the matrix-vector operations

```
A[i] := A[i] + alpha*x[i]*y[i]**T + alpha*y[i]*x[i]**T
```

where alpha is a scalar, x[i] and y[i] are vectors, and A[i] is a n by n symmetric matrices, for i = 1 , … , batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' if HIPBLAS_FILL_MODE_UPPER, the lower part of A is not referenced if HIPBLAS_FILL_MODE_LOWER, the upper part of A is not referenced
- **n** – **[in]** [int] the number of rows and columns of each matrix A.
- **alpha** – **[in]** device pointer or host pointer to scalar alpha.
- **x** – **[in]** device pointer to the first vector x_1.

- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] specifies the pointer increment between vectors (x_i) and (x_i+1).
- **y** – **[in]** device pointer to the first vector y_1.
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.
- **stridey** – **[in]** [hipblasStride] specifies the pointer increment between vectors (y_i) and (y_i+1).
- **AP** – **[inout]** device pointer to the first matrix A_1.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i.
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch

1.9.2.18 hipblasXtbmv + Batched, StridedBatched

hipblasStatus_t **hipblasStbmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int k, const float *AP, int lda, float *x, int incx)

hipblasStatus_t **hipblasDtbmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int k, const double *AP, int lda, double *x, int incx)

hipblasStatus_t **hipblasCtbmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int k, const *hipblasComplex* *AP, int lda, *hipblasComplex* *x, int incx)

hipblasStatus_t **hipblasZtbmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int k, const *hipblasDoubleComplex* *AP, int lda, *hipblasDoubleComplex* *x, int incx)

BLAS Level 2 API.

tbmv performs one of the matrix-vector operations

```
x := A*x      or
x := A**T*x   or
x := A**H*x,
```

x is a vectors and A is a banded m by m matrix (see description below).

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A is an upper banded triangular matrix. HIPBLAS_FILL_MODE_LOWER: A is a lower banded triangular matrix.

- **transA** – **[in]** [hipblasOperation_t] indicates whether matrix A is tranposed (conjugated) or not.
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: The main diagonal of A is assumed to consist of only 1's and is not referenced. HIPBLAS_DIAG_NON_UNIT: No assumptions are made of A's main diagonal.
- **m** – **[in]** [int] the number of rows and columns of the matrix represented by A.
- **k** – **[in]** [int] if uplo == HIPBLAS_FILL_MODE_UPPER, k specifies the number of super-diagonals of the matrix A. if uplo == HIPBLAS_FILL_MODE_LOWER, k specifies the number of sub-diagonals of the matrix A. k must satisfy k > 0 && k < lda.
- **AP** – **[in]** device pointer storing banded triangular matrix A. if uplo == HIPBLAS_FILL_MODE_UPPER: The matrix represented is an upper banded triangular matrix with the main diagonal and k super-diagonals, everything else can be assumed to be 0. The matrix is compacted so that the main diagonal resides on the k'th row, the first super diagonal resides on the RHS of the k-1'th row, etc, with the k'th diagonal on the RHS of the 0'th row. Ex: (HIPBLAS_FILL_MODE_UPPER; m = 5; k = 2) 1 6 9 0 0 0 0 9 8 7 0 2 7 8 0 0 6 7 8 9 0 0 3 8 7 -> 1 2 3 4 5 0 0 0 4 9 0 0 0 0 0 0 0 0 0 5 0 0 0 0 0 if uplo == HIPBLAS_FILL_MODE_LOWER: The matrix represnted is a lower banded triangular matrix with the main diagonal and k sub-diagonals, everything else can be assumed to be 0. The matrix is compacted so that the main diagonal resides on the 0'th row, working up to the k'th diagonal residing on the LHS of the k'th row. Ex: (HIPBLAS_FILL_MODE_LOWER; m = 5; k = 2) 1 0 0 0 0 1 2 3 4 5 6 2 0 0 0 6 7 8 9 0 9 7 3 0 0 -> 9 8 7 0 0 0 8 8 4 0 0 0 0 0 0 0 0 7 9 5 0 0 0 0 0
- **lda** – **[in]** [int] specifies the leading dimension of A. lda must satisfy lda > k.
- **x** – **[inout]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.

hipblasStatus_t **hipblasStbmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int k, const float *const AP[], int lda, float *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasDtbmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int k, const double *const AP[], int lda, double *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasCtbmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int k, const *hipblasComplex* *const AP[], int lda, *hipblasComplex* *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasZtbmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int k, const *hipblasDoubleComplex* *const AP[], int lda, *hipblasDoubleComplex* *const x[], int incx, int batchCount)

BLAS Level 2 API.

tbmvBatched performs one of the matrix-vector operations

```
x_i := A_i*x_i      or
x_i := A_i**T*x_i   or
x_i := A_i**H*x_i,
```

where (A_i, x_i) is the i-th instance of the batch. x_i is a vector and A_i is an m by m matrix, for i = 1, …, batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: each A_i is an upper banded triangular matrix. HIPBLAS_FILL_MODE_LOWER: each A_i is a lower banded triangular matrix.
- **transA** – **[in]** [hipblasOperation_t] indicates whether each matrix A_i is tranposed (conjugated) or not.
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: The main diagonal of each A_i is assumed to consist of only 1's and is not referenced. HIPBLAS_DIAG_NON_UNIT: No assumptions are made of each A_i's main diagonal.
- **m** – **[in]** [int] the number of rows and columns of the matrix represented by each A_i.
- **k** – **[in]** [int] if uplo == HIPBLAS_FILL_MODE_UPPER, k specifies the number of super-diagonals of each matrix A_i. if uplo == HIPBLAS_FILL_MODE_LOWER, k specifies the number of sub-diagonals of each matrix A_i. k must satisfy k > 0 && k < lda.
- **AP** – **[in]** device array of device pointers storing each banded triangular matrix A_i. if uplo == HIPBLAS_FILL_MODE_UPPER: The matrix represented is an upper banded triangular matrix with the main diagonal and k super-diagonals, everything else can be assumed to be 0. The matrix is compacted so that the main diagonal resides on the k'th row, the first super diagonal resides on the RHS of the k-1'th row, etc, with the k'th diagonal on the RHS of the 0'th row. Ex: (HIPBLAS_FILL_MODE_UPPER; m = 5; k = 2) 1 6 9 0 0 0 0 9 8 7 0 2 7 8 0 0 6 7 8 9 0 0 3 8 7 -> 1 2 3 4 5 0 0 0 4 9 0 0 0 0 0 0 0 0 0 5 0 0 0 0 0 if uplo == HIPBLAS_FILL_MODE_LOWER: The matrix represnted is a lower banded triangular matrix with the main diagonal and k sub-diagonals, everything else can be assumed to be 0. The matrix is compacted so that the main diagonal resides on the 0'th row, working up to the k'th diagonal residing on the LHS of the k'th row. Ex: (HIPBLAS_FILL_MODE_LOWER; m = 5; k = 2) 1 0 0 0 0 1 2 3 4 5 6 2 0 0 0 6 7 8 9 0 9 7 3 0 0 -> 9 8 7 0 0 0 8 8 4 0 0 0 0 0 0 0 0 7 9 5 0 0 0 0 0 0
- **lda** – **[in]** [int] specifies the leading dimension of each A_i. lda must satisfy lda > k.
- **x** – **[inout]** device array of device pointer storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasStbmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int k, const float *AP, int lda, *hipblasStride* strideA, float *x, int incx, *hipblasStride* stridex, int batchCount) *hipblasStatus_t* **hipblasDtbmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int k, const double *AP, int lda, *hipblasStride* strideA, double *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasCtbmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int k, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, *hipblasComplex* *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasZtbmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int k, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, int batchCount)

BLAS Level 2 API.

tbmvStridedBatched performs one of the matrix-vector operations

```
x_i := A_i*x_i      or
x_i := A_i**T*x_i   or
x_i := A_i**H*x_i,
```

where (A_i, x_i) is the i-th instance of the batch. x_i is a vector and A_i is an m by m matrix, for i = 1, …, batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: each A_i is an upper banded triangular matrix. HIPBLAS_FILL_MODE_LOWER: each A_i is a lower banded triangular matrix.
- **transA** – **[in]** [hipblasOperation_t] indicates whether each matrix A_i is tranposed (conjugated) or not.
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: The main diagonal of each A_i is assumed to consist of only 1's and is not referenced. HIPBLAS_DIAG_NON_UNIT: No assumptions are made of each A_i's main diagonal.
- **m** – **[in]** [int] the number of rows and columns of the matrix represented by each A_i.
- **k** – **[in]** [int] if uplo == HIPBLAS_FILL_MODE_UPPER, k specifies the number of super-diagonals of each matrix A_i. if uplo == HIPBLAS_FILL_MODE_LOWER, k specifies the number of sub-diagonals of each matrix A_i. k must satisfy k > 0 && k < lda.
- **AP** – **[in]** device array to the first matrix A_i of the batch. Stores each banded triangular matrix A_i. if uplo == HIPBLAS_FILL_MODE_UPPER: The matrix represented is an upper banded triangular matrix with the main diagonal and k super-diagonals, everything else can be assumed to be 0. The matrix is compacted so that the main diagonal resides on the k'th row, the first super diagonal resides on the RHS of the k-1'th row, etc, with the k'th diagonal

on the RHS of the 0'th row. Ex: (HIPBLAS_FILL_MODE_UPPER; m = 5; k = 2) 1 6 9 0 0 0 0 9 8 7 0 2 7 8 0 0 6 7 8 9 0 0 3 8 7 -> 1 2 3 4 5 0 0 0 4 9 0 0 0 0 0 0 0 0 0 0 5 0 0 0 0 0 if uplo == HIPBLAS_FILL_MODE_LOWER: The matrix represnted is a lower banded triangular matrix with the main diagonal and k sub-diagonals, everything else can be assumed to be 0. The matrix is compacted so that the main diagonal resides on the 0'th row, working up to the k'th diagonal residing on the LHS of the k'th row. Ex: (HIPBLAS_FILL_MODE_LOWER; m = 5; k = 2) 1 0 0 0 0 1 2 3 4 5 6 2 0 0 0 6 7 8 9 0 9 7 3 0 0 -> 9 8 7 0 0 0 8 8 4 0 0 0 0 0 0 0 7 9 5 0 0 0 0 0

- **lda** – **[in]** [int] specifies the leading dimension of each A_i. lda must satisfy lda > k.
- **strideA** – **[in]** [hipblasStride] stride from the start of one A_i matrix to the next A_(i + 1).
- **x** – **[inout]** device array to the first vector x_i of the batch.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] stride from the start of one x_i matrix to the next x_(i + 1).
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.2.19 hipblasXtbsv + Batched, StridedBatched

hipblasStatus_t **hipblasStbsv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int n, int k, const float *AP, int lda, float *x, int incx)

hipblasStatus_t **hipblasDtbsv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int n, int k, const double *AP, int lda, double *x, int incx)

hipblasStatus_t **hipblasCtbsv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int n, int k, const *hipblasComplex* *AP, int lda, *hipblasComplex* *x, int incx)

hipblasStatus_t **hipblasZtbsv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int n, int k, const *hipblasDoubleComplex* *AP, int lda, *hipblasDoubleComplex* *x, int incx)

BLAS Level 2 API.

tbsv solves

```
A*x = b or A**T*x = b or A**H*x = b,
```

where x and b are vectors and A is a banded triangular matrix.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A is a lower triangular matrix.

- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_N: Solves A*x = b HIPBLAS_OP_T: Solves A**T*x = b HIPBLAS_OP_C: Solves A**H*x = b
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: A is assumed to be unit triangular (i.e. the diagonal elements of A are not used in computations). HIPBLAS_DIAG_NON_UNIT: A is not assumed to be unit triangular.
- **n** – **[in]** [int] n specifies the number of rows of b. n >= 0.
- **k** – **[in]** [int] if(uplo == HIPBLAS_FILL_MODE_UPPER) k specifies the number of super-diagonals of A. if(uplo == HIPBLAS_FILL_MODE_LOWER) k specifies the number of sub-diagonals of A. k >= 0.
- **AP** – **[in]** device pointer storing the matrix A in banded format.
- **lda** – **[in]** [int] specifies the leading dimension of A. lda >= (k + 1).
- **x** – **[inout]** device pointer storing input vector b. Overwritten by the output vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.

hipblasStatus_t **hipblasStbsvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int n, int k, const float *const AP[], int lda, float *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasDtbsvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int n, int k, const double *const AP[], int lda, double *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasCtbsvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int n, int k, const *hipblasComplex* *const AP[], int lda, *hipblasComplex* *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasZtbsvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int n, int k, const *hipblasDoubleComplex* *const AP[], int lda, *hipblasDoubleComplex* *const x[], int incx, int batchCount)

BLAS Level 2 API.

tbsvBatched solves

```
A_i*x_i = b_i or A_i**T*x_i = b_i or A_i**H*x_i = b_i,
```

where x_i and b_i are vectors and A_i is a banded triangular matrix, for i = [1, batchCount].

The input vectors b_i are overwritten by the output vectors x_i.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A_i is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A_i is a lower triangular matrix.

- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_N: Solves A_i*x_i = b_i HIPBLAS_OP_T: Solves A_i**T*x_i = b_i HIPBLAS_OP_C: Solves A_i**H*x_i = b_i
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: each A_i is assumed to be unit triangular (i.e. the diagonal elements of each A_i are not used in computations). HIPBLAS_DIAG_NON_UNIT: each A_i is not assumed to be unit triangular.
- **n** – **[in]** [int] n specifies the number of rows of each b_i. n >= 0.
- **k** – **[in]** [int] if(uplo == HIPBLAS_FILL_MODE_UPPER) k specifies the number of super-diagonals of each A_i. if(uplo == HIPBLAS_FILL_MODE_LOWER) k specifies the number of sub-diagonals of each A_i. k >= 0.
- **AP** – **[in]** device vector of device pointers storing each matrix A_i in banded format.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i. lda >= (k + 1).
- **x** – **[inout]** device vector of device pointers storing each input vector b_i. Overwritten by each output vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasStbsvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int n, int k, const float *AP, int lda, *hipblasStride* strideA, float *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasDtbsvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int n, int k, const double *AP, int lda, *hipblasStride* strideA, double *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasCtbsvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int n, int k, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, *hipblasComplex* *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasZtbsvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int n, int k, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, int batchCount)

BLAS Level 2 API.

tbsvStridedBatched solves

```
A_i*x_i = b_i or A_i**T*x_i = b_i or A_i**H*x_i = b_i,
```

where x_i and b_i are vectors and A_i is a banded triangular matrix, for i = [1, batchCount].

The input vectors b_i are overwritten by the output vectors x_i.

- Supported precisions in rocBLAS : s,d,c,z

- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A_i is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A_i is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_N: Solves A_i*x_i = b_i HIPBLAS_OP_T: Solves A_i**T*x_i = b_i HIPBLAS_OP_C: Solves A_i**H*x_i = b_i
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: each A_i is assumed to be unit triangular (i.e. the diagonal elements of each A_i are not used in computations). HIPBLAS_DIAG_NON_UNIT: each A_i is not assumed to be unit triangular.
- **n** – **[in]** [int] n specifies the number of rows of each b_i. n >= 0.
- **k** – **[in]** [int] if(uplo == HIPBLAS_FILL_MODE_UPPER) k specifies the number of super-diagonals of each A_i. if(uplo == HIPBLAS_FILL_MODE_LOWER) k specifies the number of sub-diagonals of each A_i. k >= 0.
- **AP** – **[in]** device pointer pointing to the first banded matrix A_1.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i. lda >= (k + 1).
- **strideA** – **[in]** [hipblasStride] specifies the distance between the start of one matrix (A_i) and the next (A_i+1).
- **x** – **[inout]** device pointer pointing to the first input vector b_1. Overwritten by output vectors x.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] specifies the distance between the start of one vector (x_i) and the next (x_i+1).
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.2.20 hipblasXtpmv + Batched, StridedBatched

hipblasStatus_t **hipblasStpmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const float *AP, float *x, int incx)

hipblasStatus_t **hipblasDtpmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const double *AP, double *x, int incx)

hipblasStatus_t **hipblasCtpmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasComplex* *AP, *hipblasComplex* *x, int incx)

hipblasStatus_t **hipblasZtpmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasDoubleComplex* *AP, *hipblasDoubleComplex* *x, int incx)

BLAS Level 2 API.

tpmv performs one of the matrix-vector operations

```
x = A*x or x = A**T*x,
```

where x is an n element vector and A is an n by n unit, or non-unit, upper or lower triangular matrix, supplied in the pack form.

The vector x is overwritten.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t]
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: A is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: A is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of A. m >= 0.
- **AP** – **[in]** device pointer storing matrix A, of dimension at leat (m * (m + 1) / 2). Before entry with uplo = HIPBLAS_FILL_MODE_UPPER, the array A must contain the upper triangular matrix packed sequentially, column by column, so that A[0] contains a_{0,0}, A[1] and A[2] contain a_{0,1} and a_{1, 1} respectively, and so on. Before entry with uplo = HIPBLAS_FILL_MODE_LOWER, the array A must contain the lower triangular matrix packed sequentially, column by column, so that A[0] contains a_{0,0}, A[1] and A[2] contain a_{1,0} and a_{2,0} respectively, and so on. Note that when DIAG = HIPBLAS_DIAG_UNIT, the diagonal elements of A are not referenced, but are assumed to be unity.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x. incx must not be zero.

hipblasStatus_t **hipblasStpmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const float *const AP[], float *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasDtpmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const double *const AP[], double *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasCtpmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasComplex* *const AP[], *hipblasComplex* *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasZtpmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasDoubleComplex* *const AP[], *hipblasDoubleComplex* *const x[], int incx, int batchCount)

BLAS Level 2 API.

tpmvBatched performs one of the matrix-vector operations

```
x_i = A_i*x_i or x_i = A**T*x_i, 0 \le i < batchCount
```

where x_i is an n element vector and A_i is an n by n (unit, or non-unit, upper or lower triangular matrix)

The vectors x_i are overwritten.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A_i is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A_i is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t]
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: A_i is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: A_i is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of matrices A_i. m >= 0.
- **AP** – **[in]** device pointer storing pointer of matrices A_i, of dimension (lda, m)
- **x** – **[in]** device pointer storing vectors x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of vectors x_i.
- **batchCount** – **[in]** [int] The number of batched matrices/vectors.

hipblasStatus_t **hipblasStpmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const float *AP, *hipblasStride* strideA, float *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasDtpmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const double *AP, *hipblasStride* strideA, double *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasCtpmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasComplex* *AP, *hipblasStride* strideA, *hipblasComplex* *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasZtpmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasDoubleComplex* *AP, *hipblasStride* strideA, *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, int batchCount)

BLAS Level 2 API.

tpmvStridedBatched performs one of the matrix-vector operations

```
x_i = A_i*x_i or x_i = A**T*x_i, 0 \le i < batchCount
```

where x_i is an n element vector and A_i is an n by n (unit, or non-unit, upper or lower triangular matrix) with strides specifying how to retrieve x_i (resp. A_i) from x_{i-1} (resp. A_i).

The vectors x_i are overwritten.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A_i is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A_i is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t]
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: A_i is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: A_i is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of matrices A_i. m >= 0.
- **AP** – **[in]** device pointer of the matrix A_0, of dimension (lda, m)
- **strideA** – **[in]** [hipblasStride] stride from the start of one A_i matrix to the next A_{i + 1}
- **x** – **[in]** device pointer storing the vector x_0.
- **incx** – **[in]** [int] specifies the increment for the elements of one vector x.
- **stridex** – **[in]** [hipblasStride] stride from the start of one x_i vector to the next x_{i + 1}
- **batchCount** – **[in]** [int] The number of batched matrices/vectors.

1.9.2.21 hipblasXtpsv + Batched, StridedBatched

hipblasStatus_t **hipblasStpsv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const float *AP, float *x, int incx)

hipblasStatus_t **hipblasDtpsv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const double *AP, double *x, int incx)

hipblasStatus_t **hipblasCtpsv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasComplex* *AP, *hipblasComplex* *x, int incx)

hipblasStatus_t **hipblasZtpsv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasDoubleComplex* *AP, *hipblasDoubleComplex* *x, int incx)

BLAS Level 2 API.

tpsv solves

```
A*x = b or A**T*x = b, or A**H*x = b,
```

where x and b are vectors and A is a triangular matrix stored in the packed format.

The input vector b is overwritten by the output vector x.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_N: Solves A*x = b HIPBLAS_OP_T: Solves A**T*x = b HIPBLAS_OP_C: Solves A**H*x = b
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: A is assumed to be unit triangular (i.e. the diagonal elements of A are not used in computations). HIPBLAS_DIAG_NON_UNIT: A is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of b. m >= 0.
- **AP** – **[in]** device pointer storing the packed version of matrix A, of dimension >= (n * (n + 1) / 2)
- **x** – **[inout]** device pointer storing vector b on input, overwritten by x on output.
- **incx** – **[in]** [int] specifies the increment for the elements of x.

hipblasStatus_t **hipblasStpsvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const float *const AP[], float *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasDtpsvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const double *const AP[], double *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasCtpsvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasComplex* *const AP[], *hipblasComplex* *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasZtpsvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasDoubleComplex* *const AP[], *hipblasDoubleComplex* *const x[], int incx, int batchCount)

BLAS Level 2 API.

tpsvBatched solves

```
A_i*x_i = b_i or A_i**T*x_i = b_i, or A_i**H*x_i = b_i,
```

where x_i and b_i are vectors and A_i is a triangular matrix stored in the packed format, for i in [1, batchCount].

The input vectors b_i are overwritten by the output vectors x_i.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: each A_i is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: each A_i is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_N: Solves A*x = b HIPBLAS_OP_T: Solves A**T*x = b HIPBLAS_OP_C: Solves A**H*x = b
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: each A_i is assumed to be unit triangular (i.e. the diagonal elements of each A_i are not used in computations). HIPBLAS_DIAG_NON_UNIT: each A_i is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of each b_i. m >= 0.
- **AP** – **[in]** device array of device pointers storing the packed versions of each matrix A_i, of dimension >= (n * (n + 1) / 2)
- **x** – **[inout]** device array of device pointers storing each input vector b_i, overwritten by x_i on output.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **batchCount** – **[in]** [int] specifies the number of instances in the batch.

hipblasStatus_t **hipblasStpsvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const float *AP, *hipblasStride* strideA, float *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasDtpsvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const double *AP, *hipblasStride* strideA, double *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasCtpsvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasComplex* *AP, *hipblasStride* strideA, *hipblasComplex* *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasZtpsvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasDoubleComplex* *AP, *hipblasStride* strideA, *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, int batchCount)

BLAS Level 2 API.

tpsvStridedBatched solves

```
A_i*x_i = b_i or A_i**T*x_i = b_i, or A_i**H*x_i = b_i,
```

where x_i and b_i are vectors and A_i is a triangular matrix stored in the packed format, for i in [1, batchCount].

The input vectors b_i are overwritten by the output vectors x_i.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: each A_i is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: each A_i is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_N: Solves A*x = b HIPBLAS_OP_T: Solves A**T*x = b HIPBLAS_OP_C: Solves A**H*x = b
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: each A_i is assumed to be unit triangular (i.e. the diagonal elements of each A_i are not used in computations). HIPBLAS_DIAG_NON_UNIT: each A_i is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of each b_i. m >= 0.
- **AP** – **[in]** device pointer pointing to the first packed matrix A_1, of dimension >= (n * (n + 1) / 2)
- **strideA** – **[in]** [hipblasStride] stride from the beginning of one packed matrix (AP_i) and the next (AP_i+1).
- **x** – **[inout]** device pointer pointing to the first input vector b_1. Overwritten by each x_i on output.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] stride from the beginning of one vector (x_i) and the next (x_i+1).
- **batchCount** – **[in]** [int] specifies the number of instances in the batch.

1.9.2.22 hipblasXtrmv + Batched, StridedBatched

hipblasStatus_t **hipblasStrmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const float *AP, int lda, float *x, int incx)

hipblasStatus_t **hipblasDtrmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const double *AP, int lda, double *x, int incx)

hipblasStatus_t **hipblasCtrmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasComplex* *AP, int lda, *hipblasComplex* *x, int incx)

hipblasStatus_t **hipblasZtrmv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasDoubleComplex* *AP, int lda, *hipblasDoubleComplex* *x, int incx)

BLAS Level 2 API.

trmv performs one of the matrix-vector operations

```
x = A*x or x = A**T*x,
```

where x is an n element vector and A is an n by n unit, or non-unit, upper or lower triangular matrix.

The vector x is overwritten.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t]
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: A is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: A is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of A. m >= 0.
- **AP** – **[in]** device pointer storing matrix A, of dimension (lda, m)
- **lda** – **[in]** [int] specifies the leading dimension of A. lda = max(1, m).
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.

hipblasStatus_t **hipblasStrmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const float *const AP[], int lda, float *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasDtrmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const double *const AP[], int lda, double *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasCtrmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasComplex* *const AP[], int lda, *hipblasComplex* *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasZtrmvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasDoubleComplex* *const AP[], int lda, *hipblasDoubleComplex* *const x[], int incx, int batchCount)

BLAS Level 2 API.

trmvBatched performs one of the matrix-vector operations

```
x_i = A_i*x_i or x_i = A**T*x_i, 0 \le i < batchCount
```

where x_i is an n element vector and A_i is an n by n (unit, or non-unit, upper or lower triangular matrix)

The vectors x_i are overwritten.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A_i is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A_i is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t]
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: A_i is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: A_i is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of matrices A_i. m >= 0.
- **AP** – **[in]** device pointer storing pointer of matrices A_i, of dimension (lda, m)
- **lda** – **[in]** [int] specifies the leading dimension of A_i. lda >= max(1, m).
- **x** – **[in]** device pointer storing vectors x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of vectors x_i.
- **batchCount** – **[in]** [int] The number of batched matrices/vectors.

hipblasStatus_t **hipblasStrmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const float *AP, int lda, *hipblasStride* strideA, float *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasDtrmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const double *AP, int lda, *hipblasStride* strideA, double *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasCtrmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, *hipblasComplex* *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasZtrmvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, int batchCount)

BLAS Level 2 API.

trmvStridedBatched performs one of the matrix-vector operations

```
x_i = A_i*x_i or x_i = A**T*x_i, 0 \le i < batchCount
```

where x_i is an n element vector and A_i is an n by n (unit, or non-unit, upper or lower triangular matrix) with strides specifying how to retrieve x_i (resp. A_i) from x_{i-1} (resp. A_i).

The vectors x_i are overwritten.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A_i is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A_i is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t]
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: A_i is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: A_i is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of matrices A_i. m >= 0.
- **AP** – **[in]** device pointer of the matrix A_0, of dimension (lda, m)
- **lda** – **[in]** [int] specifies the leading dimension of A_i. lda >= max(1, m).
- **strideA** – **[in]** [hipblasStride] stride from the start of one A_i matrix to the next A_{i + 1}
- **x** – **[in]** device pointer storing the vector x_0.
- **incx** – **[in]** [int] specifies the increment for the elements of one vector x.
- **stridex** – **[in]** [hipblasStride] stride from the start of one x_i vector to the next x_{i + 1}
- **batchCount** – **[in]** [int] The number of batched matrices/vectors.

1.9.2.23 hipblasXtrsv + Batched, StridedBatched

hipblasStatus_t **hipblasStrsv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const float *AP, int lda, float *x, int incx)

hipblasStatus_t **hipblasDtrsv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const double *AP, int lda, double *x, int incx)

hipblasStatus_t **hipblasCtrsv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasComplex* *AP, int lda, *hipblasComplex* *x, int incx)

hipblasStatus_t **hipblasZtrsv**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasDoubleComplex* *AP, int lda, *hipblasDoubleComplex* *x, int incx)

BLAS Level 2 API.

trsv solves

```
A*x = b or A**T*x = b,
```

where x and b are vectors and A is a triangular matrix.

The vector x is overwritten on b.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t]
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: A is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: A is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of b. m >= 0.
- **AP** – **[in]** device pointer storing matrix A, of dimension (lda, m)
- **lda** – **[in]** [int] specifies the leading dimension of A. lda = max(1, m).
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.

hipblasStatus_t **hipblasStrsvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const float *const AP[], int lda, float *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasDtrsvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const double *const AP[], int lda, double *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasCtrsvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasComplex* *const AP[], int lda, *hipblasComplex* *const x[], int incx, int batchCount)

hipblasStatus_t **hipblasZtrsvBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasDoubleComplex* *const AP[], int lda, *hipblasDoubleComplex* *const x[], int incx, int batchCount)

BLAS Level 2 API.

trsvBatched solves

```
A_i*x_i = b_i or A_i**T*x_i = b_i,
```

where (A_i, x_i, b_i) is the i-th instance of the batch. x_i and b_i are vectors and A_i is an m by m triangular matrix.

The vector x is overwritten on b.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t]
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: A is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: A is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of b. m >= 0.
- **AP** – **[in]** device array of device pointers storing each matrix A_i.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i. lda = max(1, m)
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **batchCount** – **[in]** [int] number of instances in the batch

hipblasStatus_t **hipblasStrsvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const float *AP, int lda, *hipblasStride* strideA, float *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasDtrsvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const double *AP, int lda, *hipblasStride* strideA, double *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasCtrsvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, *hipblasComplex* *x, int incx, *hipblasStride* stridex, int batchCount)

hipblasStatus_t **hipblasZtrsvStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, int batchCount)

BLAS Level 2 API.

trsvStridedBatched solves

```
A_i*x_i = b_i or A_i**T*x_i = b_i,
```

where (A_i, x_i, b_i) is the i-th instance of the batch. x_i and b_i are vectors and A_i is an m by m triangular matrix, for i = 1, . . . , batchCount.

The vector x is overwritten on b.

- Supported precisions in rocBLAS : s,d,c,z

- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t]
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: A is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: A is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of each b_i. m >= 0.
- **AP** – **[in]** device pointer to the first matrix (A_1) in the batch, of dimension (lda, m)
- **strideA** – **[in]** [hipblasStride] stride from the start of one A_i matrix to the next A_(i + 1)
- **lda** – **[in]** [int] specifies the leading dimension of each A_i. lda = max(1, m).
- **x** – **[inout]** device pointer to the first vector (x_1) in the batch.
- **stridex** – **[in]** [hipblasStride] stride from the start of one x_i vector to the next x_(i + 1)
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **batchCount** – **[in]** [int] number of instances in the batch

1.9.3 Level 3 BLAS

List of Level-3 BLAS Functions

1.9.3.1 hipblasXgemm + Batched, StridedBatched

hipblasStatus_t **hipblasHgemm**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const *hipblasHalf* *alpha, const *hipblasHalf* *AP, int lda, const *hipblasHalf* *BP, int ldb, const *hipblasHalf* *beta, *hipblasHalf* *CP, int ldc)

hipblasStatus_t **hipblasSgemm**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const float *alpha, const float *AP, int lda, const float *BP, int ldb, const float *beta, float *CP, int ldc)

hipblasStatus_t **hipblasDgemm**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const double *alpha, const double *AP, int lda, const double *BP, int ldb, const double *beta, double *CP, int ldc)

hipblasStatus_t **hipblasCgemm**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, const *hipblasComplex* *BP, int ldb, const *hipblasComplex* *beta, *hipblasComplex* *CP, int ldc)

hipblasStatus_t **hipblasZgemm**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, const *hipblasDoubleComplex* *BP, int ldb, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *CP, int ldc)

BLAS Level 3 API.

gemm performs one of the matrix-matrix operations

```
C = alpha*op( A )*op( B ) + beta*C,
```

where op(X) is one of

```
op( X ) = X      or
op( X ) = X**T   or
op( X ) = X**H,
```

alpha and beta are scalars, and A, B and C are matrices, with op(A) an m by k matrix, op(B) a k by n matrix and C an m by n matrix.

- Supported precisions in rocBLAS : h,s,d,c,z
- Supported precisions in cuBLAS : h,s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t]

```
        .
```

- **transA** – **[in]** [hipblasOperation_t] specifies the form of op(A)
- **transB** – **[in]** [hipblasOperation_t] specifies the form of op(B)
- **m** – **[in]** [int] number or rows of matrices op(A) and C

- **n** – **[in]** [int] number of columns of matrices op(B) and C
- **k** – **[in]** [int] number of columns of matrix op(A) and number of rows of matrix op(B)
- **alpha** – **[in]** device pointer or host pointer specifying the scalar alpha.
- **AP** – **[in]** device pointer storing matrix A.
- **lda** – **[in]** [int] specifies the leading dimension of A.
- **BP** – **[in]** device pointer storing matrix B.
- **ldb** – **[in]** [int] specifies the leading dimension of B.
- **beta** – **[in]** device pointer or host pointer specifying the scalar beta.
- **CP** – **[inout]** device pointer storing matrix C on the GPU.
- **ldc** – **[in]** [int] specifies the leading dimension of C.

hipblasStatus_t **hipblasHgemmBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const *hipblasHalf* *alpha, const *hipblasHalf* *const AP[], int lda, const *hipblasHalf* *const BP[], int ldb, const *hipblasHalf* *beta, *hipblasHalf* *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasSgemmBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const float *alpha, const float *const AP[], int lda, const float *const BP[], int ldb, const float *beta, float *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasDgemmBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const double *alpha, const double *const AP[], int lda, const double *const BP[], int ldb, const double *beta, double *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasCgemmBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *const AP[], int lda, const *hipblasComplex* *const BP[], int ldb, const *hipblasComplex* *beta, *hipblasComplex* *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasZgemmBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const AP[], int lda, const *hipblasDoubleComplex* *const BP[], int ldb, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *const CP[], int ldc, int batchCount)

BLAS Level 3 API.

gemmBatched performs one of the batched matrix-matrix operations C_i = alpha*op(A_i)*op(B_i) + beta*C_i, for i = 1, . . . , batchCount. where op(X) is one of op(X) = X or op(X) = X**T or op(X) = X**H, alpha and beta are scalars, and A, B and C are strided batched matrices, with op(A) an m by k by batchCount strided_batched matrix, op(B) an k by n by batchCount strided_batched matrix and C an m by n by batchCount strided_batched matrix.

- Supported precisions in rocBLAS : h,s,d,c,z

- Supported precisions in cuBLAS : h,s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **transA** – **[in]** [hipblasOperation_t] specifies the form of op(A)
- **transB** – **[in]** [hipblasOperation_t] specifies the form of op(B)
- **m** – **[in]** [int] matrix dimention m.
- **n** – **[in]** [int] matrix dimention n.
- **k** – **[in]** [int] matrix dimention k.
- **alpha** – **[in]** device pointer or host pointer specifying the scalar alpha.
- **AP** – **[in]** device array of device pointers storing each matrix A_i.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i.
- **BP** – **[in]** device array of device pointers storing each matrix B_i.
- **ldb** – **[in]** [int] specifies the leading dimension of each B_i.
- **beta** – **[in]** device pointer or host pointer specifying the scalar beta.
- **CP** – **[inout]** device array of device pointers storing each matrix C_i.
- **ldc** – **[in]** [int] specifies the leading dimension of each C_i.
- **batchCount** – **[in]** [int] number of gemm operations in the batch

hipblasStatus_t **hipblasHgemmStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const *hipblasHalf* *alpha, const *hipblasHalf* *AP, int lda, long long strideA, const *hipblasHalf* *BP, int ldb, long long strideB, const *hipblasHalf* *beta, *hipblasHalf* *CP, int ldc, long long strideC, int batchCount)

hipblasStatus_t **hipblasSgemmStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const float *alpha, const float *AP, int lda, long long strideA, const float *BP, int ldb, long long strideB, const float *beta, float *CP, int ldc, long long strideC, int batchCount)

hipblasStatus_t **hipblasDgemmStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const double *alpha, const double *AP, int lda, long long strideA, const double *BP, int ldb, long long strideB, const double *beta, double *CP, int ldc, long long strideC, int batchCount)

hipblasStatus_t **hipblasCgemmStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, long long strideA, const *hipblasComplex* *BP, int ldb, long long strideB, const *hipblasComplex* *beta, *hipblasComplex* *CP, int ldc, long long strideC, int batchCount) *hipblasStatus_t* **hipblasZgemmStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, long long strideA, const *hipblasDoubleComplex* *BP, int ldb, long long strideB, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *CP, int ldc, long long strideC, int batchCount)

BLAS Level 3 API.

gemmStridedBatched performs one of the strided batched matrix-matrix operations

```
C_i = alpha*op( A_i )*op( B_i ) + beta*C_i, for i = 1, ..., batchCount.
```

where op(X) is one of

```
op( X ) = X      or
op( X ) = X**T   or
op( X ) = X**H,
```

alpha and beta are scalars, and A, B and C are strided batched matrices, with op(A) an m by k by batchCount strided_batched matrix, op(B) an k by n by batchCount strided_batched matrix and C an m by n by batchCount strided_batched matrix.

- Supported precisions in rocBLAS : h,s,d,c,z
- Supported precisions in cuBLAS : h,s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **transA** – **[in]** [hipblasOperation_t] specifies the form of op(A)
- **transB** – **[in]** [hipblasOperation_t] specifies the form of op(B)
- **m** – **[in]** [int] matrix dimention m.
- **n** – **[in]** [int] matrix dimention n.
- **k** – **[in]** [int] matrix dimention k.
- **alpha** – **[in]** device pointer or host pointer specifying the scalar alpha.
- **AP** – **[in]** device pointer pointing to the first matrix A_1.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i.
- **strideA** – **[in]** [hipblasStride] stride from the start of one A_i matrix to the next A_(i + 1).
- **BP** – **[in]** device pointer pointing to the first matrix B_1.
- **ldb** – **[in]** [int] specifies the leading dimension of each B_i.
- **strideB** – **[in]** [hipblasStride] stride from the start of one B_i matrix to the next B_(i + 1).
- **beta** – **[in]** device pointer or host pointer specifying the scalar beta.
- **CP** – **[inout]** device pointer pointing to the first matrix C_1.
- **ldc** – **[in]** [int] specifies the leading dimension of each C_i.
- **strideC** – **[in]** [hipblasStride] stride from the start of one C_i matrix to the next C_(i + 1).

- **batchCount** – **[in]** [int] number of gemm operatons in the batch

1.9.3.2 hipblasXherk + Batched, StridedBatched

hipblasStatus_t **hipblasCherk**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const float *alpha, const *hipblasComplex* *AP, int lda, const float *beta, *hipblasComplex* *CP, int ldc)

hipblasStatus_t **hipblasZherk**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const double *alpha, const *hipblasDoubleComplex* *AP, int lda, const double *beta, *hipblasDoubleComplex* *CP, int ldc)

BLAS Level 3 API.

herk performs one of the matrix-matrix operations for a Hermitian rank-k update

C := alpha*op(A)*op(A)^H + beta*C

where alpha and beta are scalars, op(A) is an n by k matrix, and C is a n x n Hermitian matrix stored as either upper or lower.

```
op( A ) = A,  and A is n by k if transA == HIPBLAS_OP_N
op( A ) = A^H and A is k by n if transA == HIPBLAS_OP_C
```

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_C: op(A) = A^H HIPBLAS_ON_N: op(A) = A
- **n** – **[in]** [int] n specifies the number of rows and columns of C. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** pointer storing matrix A on the GPU. Martrix dimension is (lda, k) when if transA = HIPBLAS_OP_N, otherwise (lda, n) only the upper/lower triangular part is accessed.
- **lda** – **[in]** [int] lda specifies the first dimension of A. if transA = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** pointer storing matrix C on the GPU. The imaginary component of the diagonal elements are not used but are set to zero unless quick return.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).

hipblasStatus_t **hipblasCherkBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const float *alpha, const *hipblasComplex* *const AP[], int lda, const float *beta, *hipblasComplex* *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasZherkBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const double *alpha, const *hipblasDoubleComplex* *const AP[], int lda, const double *beta, *hipblasDoubleComplex* *const CP[], int ldc, int batchCount)

BLAS Level 3 API.

herkBatched performs a batch of the matrix-matrix operations for a Hermitian rank-k update

C_i := alpha*op(A_i)*op(A_i)^H + beta*C_i

where alpha and beta are scalars, op(A) is an n by k matrix, and C_i is a n x n Hermitian matrix stored as either upper or lower.

```
op( A_i ) = A_i, and A_i is n by k if transA == HIPBLAS_OP_N
op( A_i ) = A_i^H and A_i is k by n if transA == HIPBLAS_OP_C
```

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C_i is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C_i is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_C: op(A) = A^H HIPBLAS_OP_N: op(A) = A
- **n** – **[in]** [int] n specifies the number of rows and columns of C_i. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** device array of device pointers storing each matrix_i A of dimension (lda, k) when transA is HIPBLAS_OP_N, otherwise of dimension (lda, n)
- **lda** – **[in]** [int] lda specifies the first dimension of A_i. if transA = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** device array of device pointers storing each matrix C_i on the GPU. The imaginary component of the diagonal elements are not used but are set to zero unless quick return.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasCherkStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const float *alpha, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, const float *beta, *hipblasComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasZherkStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const double *alpha, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, const double *beta, *hipblasDoubleComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

BLAS Level 3 API.

herkStridedBatched performs a batch of the matrix-matrix operations for a Hermitian rank-k update

C_i := alpha*op(A_i)*op(A_i)^H + beta*C_i

where alpha and beta are scalars, op(A) is an n by k matrix, and C_i is a n x n Hermitian matrix stored as either upper or lower.

```
op( A_i ) = A_i, and A_i is n by k if transA == HIPBLAS_OP_N
op( A_i ) = A_i^H and A_i is k by n if transA == HIPBLAS_OP_C
```

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C_i is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C_i is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_C: op(A) = A^H HIPBLAS_OP_N: op(A) = A
- **n** – **[in]** [int] n specifies the number of rows and columns of C_i. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** Device pointer to the first matrix A_1 on the GPU of dimension (lda, k) when transA is HIPBLAS_OP_N, otherwise of dimension (lda, n)
- **lda** – **[in]** [int] lda specifies the first dimension of A_i. if transA = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** Device pointer to the first matrix C_1 on the GPU. The imaginary component of the diagonal elements are not used but are set to zero unless quick return.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).

- **strideC** – **[inout]** [hipblasStride] stride from the start of one matrix (C_i) and the next one (C_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.3.3 hipblasXherkx + Batched, StridedBatched

hipblasStatus_t **hipblasCherkx**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, const *hipblasComplex* *BP, int ldb, const float *beta, *hipblasComplex* *CP, int ldc)

hipblasStatus_t **hipblasZherkx**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, const *hipblasDoubleComplex* *BP, int ldb, const double *beta, *hipblasDoubleComplex* *CP, int ldc)

BLAS Level 3 API.

herkx performs one of the matrix-matrix operations for a Hermitian rank-k update

C := alpha*op(A)*op(B)^H + beta*C

where alpha and beta are scalars, op(A) and op(B) are n by k matrices, and C is a n x n Hermitian matrix stored as either upper or lower. This routine should only be used when the caller can guarantee that the result of op(A)*op(B)^T will be Hermitian.

```
op( A ) = A, op( B ) = B, and A and B are n by k if trans == HIPBLAS_OP_N
op( A ) = A^H, op( B ) = B^H,  and A and B are k by n if trans == HIPBLAS_OP_C
```

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_C: op(A) = A^H, op(B) = B^H HIPBLAS_OP_N: op(A) = A, op(B) = B
- **n** – **[in]** [int] n specifies the number of rows and columns of C. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** pointer storing matrix A on the GPU. Martrix dimension is (lda, k) when if trans = HIPBLAS_OP_N, otherwise (lda, n) only the upper/lower triangular part is accessed.
- **lda** – **[in]** [int] lda specifies the first dimension of A. if trans = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **BP** – **[in]** pointer storing matrix B on the GPU. Martrix dimension is (ldb, k) when if trans = HIPBLAS_OP_N, otherwise (ldb, n) only the upper/lower triangular part is accessed.

- **ldb** – **[in]** [int] ldb specifies the first dimension of B. if trans = HIPBLAS_OP_N, ldb >= max(1, n), otherwise ldb >= max(1, k).
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** pointer storing matrix C on the GPU. The imaginary component of the diagonal elements are not used but are set to zero unless quick return.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).

hipblasStatus_t **hipblasCherkxBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *const AP[], int lda, const *hipblasComplex* *const BP[], int ldb, const float *beta, *hipblasComplex* *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasZherkxBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const AP[], int lda, const *hipblasDoubleComplex* *const BP[], int ldb, const double *beta, *hipblasDoubleComplex* *const CP[], int ldc, int batchCount)

BLAS Level 3 API.

herkxBatched performs a batch of the matrix-matrix operations for a Hermitian rank-k update

C_i := alpha*op(A_i)*op(B_i)^H + beta*C_i

where alpha and beta are scalars, op(A_i) and op(B_i) are n by k matrices, and C_i is a n x n Hermitian matrix stored as either upper or lower. This routine should only be used when the caller can guarantee that the result of op(A)*op(B)^T will be Hermitian.

```
op( A_i ) = A_i, op( B_i ) = B_i, and A_i and B_i are n by k if trans == HIPBLAS_OP_
↪N
op( A_i ) = A_i^H, op( B_i ) = B_i^H,  and A_i and B_i are k by n if trans ==␣
↪HIPBLAS_OP_C
```

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C_i is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C_i is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_C: op(A) = A^H HIPBLAS_OP_N: op(A) = A
- **n** – **[in]** [int] n specifies the number of rows and columns of C_i. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** device array of device pointers storing each matrix_i A of dimension (lda, k) when trans is HIPBLAS_OP_N, otherwise of dimension (lda, n)

- **lda** – **[in]** [int] lda specifies the first dimension of A_i. if trans = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **BP** – **[in]** device array of device pointers storing each matrix_i B of dimension (ldb, k) when trans is HIPBLAS_OP_N, otherwise of dimension (ldb, n)
- **ldb** – **[in]** [int] ldb specifies the first dimension of B_i. if trans = HIPBLAS_OP_N, ldb >= max(1, n), otherwise ldb >= max(1, k).
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** device array of device pointers storing each matrix C_i on the GPU. The imaginary component of the diagonal elements are not used but are set to zero unless quick return.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasCherkxStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasComplex* *BP, int ldb, *hipblasStride* strideB, const float *beta, *hipblasComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasZherkxStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasDoubleComplex* *BP, int ldb, *hipblasStride* strideB, const double *beta, *hipblasDoubleComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

BLAS Level 3 API.

herkxStridedBatched performs a batch of the matrix-matrix operations for a Hermitian rank-k update

C_i := alpha*op(A_i)*op(B_i)^H + beta*C_i

where alpha and beta are scalars, op(A_i) and op(B_i) are n by k matrices, and C_i is a n x n Hermitian matrix stored as either upper or lower. This routine should only be used when the caller can guarantee that the result of op(A)*op(B)^T will be Hermitian.

```
op( A_i ) = A_i, op( B_i ) = B_i, and A_i and B_i are n by k if trans == HIPBLAS_OP_
↪N
op( A_i ) = A_i^H, op( B_i ) = B_i^H,  and A_i and B_i are k by n if trans ==␣
↪HIPBLAS_OP_C
```

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C_i is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C_i is a lower triangular matrix

- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_C: op(A_i) = A_i^H, op(B_i) = B_i^H HIPBLAS_OP_N: op(A_i) = A_i, op(B_i) = B_i
- **n** – **[in]** [int] n specifies the number of rows and columns of C_i. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** Device pointer to the first matrix A_1 on the GPU of dimension (lda, k) when trans is HIPBLAS_OP_N, otherwise of dimension (lda, n)
- **lda** – **[in]** [int] lda specifies the first dimension of A_i. if trans = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **BP** – **[in]** Device pointer to the first matrix B_1 on the GPU of dimension (ldb, k) when trans is HIPBLAS_OP_N, otherwise of dimension (ldb, n)
- **ldb** – **[in]** [int] ldb specifies the first dimension of B_i. if trans = HIPBLAS_OP_N, ldb >= max(1, n), otherwise ldb >= max(1, k).
- **strideB** – **[in]** [hipblasStride] stride from the start of one matrix (B_i) and the next one (B_i+1)
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** Device pointer to the first matrix C_1 on the GPU. The imaginary component of the diagonal elements are not used but are set to zero unless quick return.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).
- **strideC** – **[inout]** [hipblasStride] stride from the start of one matrix (C_i) and the next one (C_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.3.4 hipblasXher2k + Batched, StridedBatched

hipblasStatus_t **hipblasCher2k**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, const *hipblasComplex* *BP, int ldb, const float *beta, *hipblasComplex* *CP, int ldc)

hipblasStatus_t **hipblasZher2k**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, const *hipblasDoubleComplex* *BP, int ldb, const double *beta, *hipblasDoubleComplex* *CP, int ldc)

BLAS Level 3 API.

her2k performs one of the matrix-matrix operations for a Hermitian rank-2k update

C := alpha*op(A)*op(B)^H + conj(alpha)*op(B)*op(A)^H + beta*C

where alpha and beta are scalars, op(A) and op(B) are n by k matrices, and C is a n x n Hermitian matrix stored as either upper or lower.

```
op( A ) = A, op( B ) = B, and A and B are n by k if trans == HIPBLAS_OP_N
op( A ) = A^H, op( B ) = B^H,  and A and B are k by n if trans == HIPBLAS_OP_C
```

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_C: op(A) = A^H, op(B) = B^H HIPBLAS_OP_N: op(A) = A, op(B) = B
- **n** – **[in]** [int] n specifies the number of rows and columns of C. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** pointer storing matrix A on the GPU. Martrix dimension is (lda, k) when if trans = HIPBLAS_OP_N, otherwise (lda, n) only the upper/lower triangular part is accessed.
- **lda** – **[in]** [int] lda specifies the first dimension of A. if trans = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **BP** – **[in]** pointer storing matrix B on the GPU. Martrix dimension is (ldb, k) when if trans = HIPBLAS_OP_N, otherwise (ldb, n) only the upper/lower triangular part is accessed.
- **ldb** – **[in]** [int] ldb specifies the first dimension of B. if trans = HIPBLAS_OP_N, ldb >= max(1, n), otherwise ldb >= max(1, k).
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** pointer storing matrix C on the GPU. The imaginary component of the diagonal elements are not used but are set to zero unless quick return.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).

hipblasStatus_t **hipblasCher2kBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *const AP[], int lda, const *hipblasComplex* *const BP[], int ldb, const float *beta, *hipblasComplex* *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasZher2kBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const AP[], int lda, const *hipblasDoubleComplex* *const BP[], int ldb, const double *beta, *hipblasDoubleComplex* *const CP[], int ldc, int batchCount)

BLAS Level 3 API.

her2kBatched performs a batch of the matrix-matrix operations for a Hermitian rank-2k update

C_i := alpha*op(A_i)*op(B_i)^H + conj(alpha)*op(B_i)*op(A_i)^H + beta*C_i where alpha and beta are scalars, op(A_i) and op(B_i) are n by k matrices, and C_i is a n x n Hermitian matrix stored as either upper or lower.

```
op( A_i ) = A_i, op( B_i ) = B_i, and A_i and B_i are n by k if trans == HIPBLAS_OP_
↪N
op( A_i ) = A_i^H, op( B_i ) = B_i^H,  and A_i and B_i are k by n if trans ==␣
↪HIPBLAS_OP_C
```

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C_i is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C_i is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_C: op(A) = A^H HIPBLAS_OP_N: op(A) = A
- **n** – **[in]** [int] n specifies the number of rows and columns of C_i. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** device array of device pointers storing each matrix_i A of dimension (lda, k) when trans is HIPBLAS_OP_N, otherwise of dimension (lda, n)
- **lda** – **[in]** [int] lda specifies the first dimension of A_i. if trans = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **BP** – **[in]** device array of device pointers storing each matrix_i B of dimension (ldb, k) when trans is HIPBLAS_OP_N, otherwise of dimension (ldb, n)
- **ldb** – **[in]** [int] ldb specifies the first dimension of B_i. if trans = HIPBLAS_OP_N, ldb >= max(1, n), otherwise ldb >= max(1, k).
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** device array of device pointers storing each matrix C_i on the GPU. The imaginary component of the diagonal elements are not used but are set to zero unless quick return.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasCher2kStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasComplex* *BP, int ldb, *hipblasStride* strideB, const float *beta, *hipblasComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount) *hipblasStatus_t* **hipblasZher2kStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasDoubleComplex* *BP, int ldb, *hipblasStride* strideB, const double *beta, *hipblasDoubleComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

BLAS Level 3 API.

her2kStridedBatched performs a batch of the matrix-matrix operations for a Hermitian rank-2k update

C_i := alpha*op(A_i)*op(B_i)^H + conj(alpha)*op(B_i)*op(A_i)^H + beta*C_i

where alpha and beta are scalars, op(A_i) and op(B_i) are n by k matrices, and C_i is a n x n Hermitian matrix stored as either upper or lower.

```
op( A_i ) = A_i, op( B_i ) = B_i, and A_i and B_i are n by k if trans == HIPBLAS_OP_
→N
op( A_i ) = A_i^H, op( B_i ) = B_i^H,  and A_i and B_i are k by n if trans ==␣
→HIPBLAS_OP_C
```

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C_i is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C_i is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_C: op(A_i) = A_i^H, op(B_i) = B_i^H HIPBLAS_OP_N: op(A_i) = A_i, op(B_i) = B_i
- **n** – **[in]** [int] n specifies the number of rows and columns of C_i. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** Device pointer to the first matrix A_1 on the GPU of dimension (lda, k) when trans is HIPBLAS_OP_N, otherwise of dimension (lda, n)
- **lda** – **[in]** [int] lda specifies the first dimension of A_i. if trans = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **BP** – **[in]** Device pointer to the first matrix B_1 on the GPU of dimension (ldb, k) when trans is HIPBLAS_OP_N, otherwise of dimension (ldb, n)
- **ldb** – **[in]** [int] ldb specifies the first dimension of B_i. if trans = HIPBLAS_OP_N, ldb >= max(1, n), otherwise ldb >= max(1, k).
- **strideB** – **[in]** [hipblasStride] stride from the start of one matrix (B_i) and the next one (B_i+1)

- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** Device pointer to the first matrix C_1 on the GPU. The imaginary component of the diagonal elements are not used but are set to zero unless quick return.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).
- **strideC** – **[inout]** [hipblasStride] stride from the start of one matrix (C_i) and the next one (C_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.3.5 hipblasXsymm + Batched, StridedBatched

hipblasStatus_t **hipblasSsymm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int m, int n, const float *alpha, const float *AP, int lda, const float *BP, int ldb, const float *beta, float *CP, int ldc)

hipblasStatus_t **hipblasDsymm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int m, int n, const double *alpha, const double *AP, int lda, const double *BP, int ldb, const double *beta, double *CP, int ldc)

hipblasStatus_t **hipblasCsymm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, const *hipblasComplex* *BP, int ldb, const *hipblasComplex* *beta, *hipblasComplex* *CP, int ldc)

hipblasStatus_t **hipblasZsymm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, const *hipblasDoubleComplex* *BP, int ldb, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *CP, int ldc)

BLAS Level 3 API.

symm performs one of the matrix-matrix operations:

C := alpha*A*B + beta*C if side == HIPBLAS_SIDE_LEFT, C := alpha*B*A + beta*C if side == HIPBLAS_SIDE_RIGHT,

where alpha and beta are scalars, B and C are m by n matrices, and A is a symmetric matrix stored as either upper or lower.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **side** – **[in]** [hipblasSideMode_t] HIPBLAS_SIDE_LEFT: C := alpha*A*B + beta*C HIPBLAS_SIDE_RIGHT: C := alpha*B*A + beta*C
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: A is a lower triangular matrix
- **m** – **[in]** [int] m specifies the number of rows of B and C. m >= 0.

- **n** – **[in]** [int] n specifies the number of columns of B and C. n >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A and B are not referenced.
- **AP** – **[in]** pointer storing matrix A on the GPU. A is m by m if side == HIPBLAS_SIDE_LEFT A is n by n if side == HIPBLAS_SIDE_RIGHT only the upper/lower triangular part is accessed.
- **lda** – **[in]** [int] lda specifies the first dimension of A. if side = HIPBLAS_SIDE_LEFT, lda >= max(1, m), otherwise lda >= max(1, n).
- **BP** – **[in]** pointer storing matrix B on the GPU. Matrix dimension is m by n
- **ldb** – **[in]** [int] ldb specifies the first dimension of B. ldb >= max(1, m)
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** pointer storing matrix C on the GPU. Matrix dimension is m by n
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, m)

hipblasStatus_t **hipblasSsymmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int m, int n, const float *alpha, const float *const AP[], int lda, const float *const BP[], int ldb, const float *beta, float *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasDsymmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int m, int n, const double *alpha, const double *const AP[], int lda, const double *const BP[], int ldb, const double *beta, double *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasCsymmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *const AP[], int lda, const *hipblasComplex* *const BP[], int ldb, const *hipblasComplex* *beta, *hipblasComplex* *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasZsymmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const AP[], int lda, const *hipblasDoubleComplex* *const BP[], int ldb, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *const CP[], int ldc, int batchCount)

BLAS Level 3 API.

symmBatched performs a batch of the matrix-matrix operations:

C_i := alpha*A_i*B_i + beta*C_i if side == HIPBLAS_SIDE_LEFT, C_i := alpha*B_i*A_i + beta*C_i if side == HIPBLAS_SIDE_RIGHT,

where alpha and beta are scalars, B_i and C_i are m by n matrices, and A_i is a symmetric matrix stored as either upper or lower.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **side** – **[in]** [hipblasSideMode_t] HIPBLAS_SIDE_LEFT: C_i := alpha*A_i*B_i + beta*C_i HIPBLAS_SIDE_RIGHT: C_i := alpha*B_i*A_i + beta*C_i
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A_i is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: A_i is a lower triangular matrix
- **m** – **[in]** [int] m specifies the number of rows of B_i and C_i. m >= 0.
- **n** – **[in]** [int] n specifies the number of columns of B_i and C_i. n >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A_i and B_i are not referenced.
- **AP** – **[in]** device array of device pointers storing each matrix A_i on the GPU. A_i is m by m if side == HIPBLAS_SIDE_LEFT A_i is n by n if side == HIPBLAS_SIDE_RIGHT only the upper/lower triangular part is accessed.
- **lda** – **[in]** [int] lda specifies the first dimension of A_i. if side = HIPBLAS_SIDE_LEFT, lda >= max(1, m), otherwise lda >= max(1, n).
- **BP** – **[in]** device array of device pointers storing each matrix B_i on the GPU. Matrix dimension is m by n
- **ldb** – **[in]** [int] ldb specifies the first dimension of B_i. ldb >= max(1, m)
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C_i need not be set before entry.
- **CP** – **[in]** device array of device pointers storing each matrix C_i on the GPU. Matrix dimension is m by n
- **ldc** – **[in]** [int] ldc specifies the first dimension of C_i. ldc >= max(1, m)
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasSsymmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int m, int n, const float *alpha, const float *AP, int lda, *hipblasStride* strideA, const float *BP, int ldb, *hipblasStride* strideB, const float *beta, float *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasDsymmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int m, int n, const double *alpha, const double *AP, int lda, *hipblasStride* strideA, const double *BP, int ldb, *hipblasStride* strideB, const double *beta, double *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasCsymmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasComplex* *BP, int ldb, *hipblasStride* strideB, const *hipblasComplex* *beta, *hipblasComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount) *hipblasStatus_t* **hipblasZsymmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasDoubleComplex* *BP, int ldb, *hipblasStride* strideB, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

BLAS Level 3 API.

symmStridedBatched performs a batch of the matrix-matrix operations:

C_i := alpha*A_i*B_i + beta*C_i if side == HIPBLAS_SIDE_LEFT, C_i := alpha*B_i*A_i + beta*C_i if side == HIPBLAS_SIDE_RIGHT,

where alpha and beta are scalars, B_i and C_i are m by n matrices, and A_i is a symmetric matrix stored as either upper or lower.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **side** – **[in]** [hipblasSideMode_t] HIPBLAS_SIDE_LEFT: C_i := alpha*A_i*B_i + beta*C_i HIPBLAS_SIDE_RIGHT: C_i := alpha*B_i*A_i + beta*C_i
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A_i is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: A_i is a lower triangular matrix
- **m** – **[in]** [int] m specifies the number of rows of B_i and C_i. m >= 0.
- **n** – **[in]** [int] n specifies the number of columns of B_i and C_i. n >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A_i and B_i are not referenced.
- **AP** – **[in]** device pointer to first matrix A_1 A_i is m by m if side == HIPBLAS_SIDE_LEFT A_i is n by n if side == HIPBLAS_SIDE_RIGHT only the upper/lower triangular part is accessed.
- **lda** – **[in]** [int] lda specifies the first dimension of A_i. if side = HIPBLAS_SIDE_LEFT, lda >= max(1, m), otherwise lda >= max(1, n).
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **BP** – **[in]** device pointer to first matrix B_1 of dimension (ldb, n) on the GPU.
- **ldb** – **[in]** [int] ldb specifies the first dimension of B_i. ldb >= max(1, m)
- **strideB** – **[in]** [hipblasStride] stride from the start of one matrix (B_i) and the next one (B_i+1)
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** device pointer to first matrix C_1 of dimension (ldc, n) on the GPU.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, m).

- **strideC** – **[inout]** [hipblasStride] stride from the start of one matrix (C_i) and the next one (C_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.3.6 hipblasXsyrk + Batched, StridedBatched

hipblasStatus_t **hipblasSsyrk**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const float *alpha, const float *AP, int lda, const float *beta, float *CP, int ldc)

hipblasStatus_t **hipblasDsyrk**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const double *alpha, const double *AP, int lda, const double *beta, double *CP, int ldc)

hipblasStatus_t **hipblasCsyrk**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, const *hipblasComplex* *beta, *hipblasComplex* *CP, int ldc)

hipblasStatus_t **hipblasZsyrk**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *CP, int ldc)

BLAS Level 3 API.

syrk performs one of the matrix-matrix operations for a symmetric rank-k update

C := alpha*op(A)*op(A)^T + beta*C

where alpha and beta are scalars, op(A) is an n by k matrix, and C is a symmetric n x n matrix stored as either upper or lower.

```
op( A ) = A, and A is n by k if transA == HIPBLAS_OP_N
op( A ) = A^T and A is k by n if transA == HIPBLAS_OP_T
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

HIPBLAS_OP_C is not supported for complex types, see cherk and zherk.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_T: op(A) = A^T HIPBLAS_OP_N: op(A) = A HIPBLAS_OP_C: op(A) = A^T
- **n** – **[in]** [int] n specifies the number of rows and columns of C. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.

- **AP** – **[in]** pointer storing matrix A on the GPU. Martrix dimension is (lda, k) when if transA = HIPBLAS_OP_N, otherwise (lda, n) only the upper/lower triangular part is accessed.
- **lda** – **[in]** [int] lda specifies the first dimension of A. if transA = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** pointer storing matrix C on the GPU.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).

hipblasStatus_t **hipblasSsyrkBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const float *alpha, const float *const AP[], int lda, const float *beta, float *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasDsyrkBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const double *alpha, const double *const AP[], int lda, const double *beta, double *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasCsyrkBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *const AP[], int lda, const *hipblasComplex* *beta, *hipblasComplex* *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasZsyrkBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const AP[], int lda, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *const CP[], int ldc, int batchCount)

BLAS Level 3 API.

syrkBatched performs a batch of the matrix-matrix operations for a symmetric rank-k update

C_i := alpha*op(A_i)*op(A_i)^T + beta*C_i

where alpha and beta are scalars, op(A_i) is an n by k matrix, and C_i is a symmetric n x n matrix stored as either upper or lower.

```
op( A_i ) = A_i, and A_i is n by k if transA == HIPBLAS_OP_N
op( A_i ) = A_i^T and A_i is k by n if transA == HIPBLAS_OP_T
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

HIPBLAS_OP_C is not supported for complex types, see cherk and zherk.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C_i is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C_i is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_T: op(A) = A^T HIPBLAS_OP_N: op(A) = A HIPBLAS_OP_C: op(A) = A^T

- **n** – **[in]** [int] n specifies the number of rows and columns of C_i. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** device array of device pointers storing each matrix_i A of dimension (lda, k) when transA is HIPBLAS_OP_N, otherwise of dimension (lda, n)
- **lda** – **[in]** [int] lda specifies the first dimension of A_i. if transA = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** device array of device pointers storing each matrix C_i on the GPU.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasSsyrkStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const float *alpha, const float *AP, int lda, *hipblasStride* strideA, const float *beta, float *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasDsyrkStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const double *alpha, const double *AP, int lda, *hipblasStride* strideA, const double *beta, double *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasCsyrkStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasComplex* *beta, *hipblasComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasZsyrkStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

BLAS Level 3 API.

syrkStridedBatched performs a batch of the matrix-matrix operations for a symmetric rank-k update

C_i := alpha*op(A_i)*op(A_i)^T + beta*C_i

where alpha and beta are scalars, op(A_i) is an n by k matrix, and C_i is a symmetric n x n matrix stored as either upper or lower.

```
op( A_i ) = A_i, and A_i is n by k if transA == HIPBLAS_OP_N
op( A_i ) = A_i^T and A_i is k by n if transA == HIPBLAS_OP_T
```

- Supported precisions in rocBLAS : s,d,c,z

- Supported precisions in cuBLAS : No support

HIPBLAS_OP_C is not supported for complex types, see cherk and zherk.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C_i is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C_i is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_T: op(A) = A^T HIPBLAS_OP_N: op(A) = A HIPBLAS_OP_C: op(A) = A^T
- **n** – **[in]** [int] n specifies the number of rows and columns of C_i. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** Device pointer to the first matrix A_1 on the GPU of dimension (lda, k) when transA is HIPBLAS_OP_N, otherwise of dimension (lda, n)
- **lda** – **[in]** [int] lda specifies the first dimension of A_i. if transA = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** Device pointer to the first matrix C_1 on the GPU. on the GPU.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).
- **strideC** – **[inout]** [hipblasStride] stride from the start of one matrix (C_i) and the next one (C_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.3.7 hipblasXsyr2k + Batched, StridedBatched

hipblasStatus_t **hipblasSsyr2k**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const float *alpha, const float *AP, int lda, const float *BP, int ldb, const float *beta, float *CP, int ldc)

hipblasStatus_t **hipblasDsyr2k**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const double *alpha, const double *AP, int lda, const double *BP, int ldb, const double *beta, double *CP, int ldc)

hipblasStatus_t **hipblasCsyr2k**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, const *hipblasComplex* *BP, int ldb, const *hipblasComplex* *beta, *hipblasComplex* *CP, int ldc) *hipblasStatus_t* **hipblasZsyr2k**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, const *hipblasDoubleComplex* *BP, int ldb, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *CP, int ldc)

BLAS Level 3 API.

syr2k performs one of the matrix-matrix operations for a symmetric rank-2k update

C := alpha*(op(A)*op(B)^T + op(B)*op(A)^T) + beta*C

where alpha and beta are scalars, op(A) and op(B) are n by k matrix, and C is a symmetric n x n matrix stored as either upper or lower.

```
op( A ) = A, op( B ) = B, and A and B are n by k if trans == HIPBLAS_OP_N
op( A ) = A^T, op( B ) = B^T,  and A and B are k by n if trans == HIPBLAS_OP_T
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_T: op(A) = A^T, op(B) = B^T HIPBLAS_OP_N: op(A) = A, op(B) = B
- **n** – **[in]** [int] n specifies the number of rows and columns of C. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A) and op(B). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** pointer storing matrix A on the GPU. Martrix dimension is (lda, k) when if trans = HIPBLAS_OP_N, otherwise (lda, n) only the upper/lower triangular part is accessed.
- **lda** – **[in]** [int] lda specifies the first dimension of A. if trans = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **BP** – **[in]** pointer storing matrix B on the GPU. Martrix dimension is (ldb, k) when if trans = HIPBLAS_OP_N, otherwise (ldb, n) only the upper/lower triangular part is accessed.
- **ldb** – **[in]** [int] ldb specifies the first dimension of B. if trans = HIPBLAS_OP_N, ldb >= max(1, n), otherwise ldb >= max(1, k).
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** pointer storing matrix C on the GPU.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).

hipblasStatus_t **hipblasSsyr2kBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const float *alpha, const float *const AP[], int lda, const float *const BP[], int ldb, const float *beta, float *const CP[], int ldc, int batchCount) *hipblasStatus_t* **hipblasDsyr2kBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const double *alpha, const double *const AP[], int lda, const double *const BP[], int ldb, const double *beta, double *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasCsyr2kBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *const AP[], int lda, const *hipblasComplex* *const BP[], int ldb, const *hipblasComplex* *beta, *hipblasComplex* *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasZsyr2kBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const AP[], int lda, const *hipblasDoubleComplex* *const BP[], int ldb, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *const CP[], int ldc, int batchCount)

BLAS Level 3 API.

syr2kBatched performs a batch of the matrix-matrix operations for a symmetric rank-2k update

C_i := alpha*(op(A_i)*op(B_i)^T + op(B_i)*op(A_i)^T) + beta*C_i

where alpha and beta are scalars, op(A_i) and op(B_i) are n by k matrix, and C_i is a symmetric n x n matrix stored as either upper or lower.

```
op( A_i ) = A_i, op( B_i ) = B_i, and A_i and B_i are n by k if trans == HIPBLAS_OP_
↪N
op( A_i ) = A_i^T, op( B_i ) = B_i^T,  and A_i and B_i are k by n if trans ==␣
↪HIPBLAS_OP_T
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C_i is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C_i is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_T: op(A_i) = A_i^T, op(B_i) = B_i^T HIPBLAS_OP_N: op(A_i) = A_i, op(B_i) = B_i
- **n** – **[in]** [int] n specifies the number of rows and columns of C_i. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** device array of device pointers storing each matrix_i A of dimension (lda, k) when trans is HIPBLAS_OP_N, otherwise of dimension (lda, n)
- **lda** – **[in]** [int] lda specifies the first dimension of A_i. if trans = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).

- **BP** – **[in]** device array of device pointers storing each matrix_i B of dimension (ldb, k) when trans is HIPBLAS_OP_N, otherwise of dimension (ldb, n)
- **ldb** – **[in]** [int] ldb specifies the first dimension of B. if trans = HIPBLAS_OP_N, ldb >= max(1, n), otherwise ldb >= max(1, k).
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** device array of device pointers storing each matrix C_i on the GPU.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasSsyr2kStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const float *alpha, const float *AP, int lda, *hipblasStride* strideA, const float *BP, int ldb, *hipblasStride* strideB, const float *beta, float *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasDsyr2kStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const double *alpha, const double *AP, int lda, *hipblasStride* strideA, const double *BP, int ldb, *hipblasStride* strideB, const double *beta, double *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasCsyr2kStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasComplex* *BP, int ldb, *hipblasStride* strideB, const *hipblasComplex* *beta, *hipblasComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasZsyr2kStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasDoubleComplex* *BP, int ldb, *hipblasStride* strideB, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

BLAS Level 3 API.

syr2kStridedBatched performs a batch of the matrix-matrix operations for a symmetric rank-2k update

C_i := alpha*(op(A_i)*op(B_i)^T + op(B_i)*op(A_i)^T) + beta*C_i

where alpha and beta are scalars, op(A_i) and op(B_i) are n by k matrix, and C_i is a symmetric n x n matrix stored as either upper or lower.

```
op( A_i ) = A_i, op( B_i ) = B_i, and A_i and B_i are n by k if trans == HIPBLAS_OP_
↪N
op( A_i ) = A_i^T, op( B_i ) = B_i^T,  and A_i and B_i are k by n if trans ==␣
↪HIPBLAS_OP_T
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C_i is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C_i is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_T: op(A_i) = A_i^T, op(B_i) = B_i^T HIPBLAS_OP_N: op(A_i) = A_i, op(B_i) = B_i
- **n** – **[in]** [int] n specifies the number of rows and columns of C_i. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** Device pointer to the first matrix A_1 on the GPU of dimension (lda, k) when trans is HIPBLAS_OP_N, otherwise of dimension (lda, n)
- **lda** – **[in]** [int] lda specifies the first dimension of A_i. if trans = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **BP** – **[in]** Device pointer to the first matrix B_1 on the GPU of dimension (ldb, k) when trans is HIPBLAS_OP_N, otherwise of dimension (ldb, n)
- **ldb** – **[in]** [int] ldb specifies the first dimension of B_i. if trans = HIPBLAS_OP_N, ldb >= max(1, n), otherwise ldb >= max(1, k).
- **strideB** – **[in]** [hipblasStride] stride from the start of one matrix (B_i) and the next one (B_i+1)
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** Device pointer to the first matrix C_1 on the GPU.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).
- **strideC** – **[inout]** [hipblasStride] stride from the start of one matrix (C_i) and the next one (C_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.3.8 hipblasXsyrkx + Batched, StridedBatched

hipblasStatus_t **hipblasSsyrkx**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const float *alpha, const float *AP, int lda, const float *BP, int ldb, const float *beta, float *CP, int ldc)

hipblasStatus_t **hipblasDsyrkx**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const double *alpha, const double *AP, int lda, const double *BP, int ldb, const double *beta, double *CP, int ldc) *hipblasStatus_t* **hipblasCsyrkx**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, const *hipblasComplex* *BP, int ldb, const *hipblasComplex* *beta, *hipblasComplex* *CP, int ldc)

hipblasStatus_t **hipblasZsyrkx**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, const *hipblasDoubleComplex* *BP, int ldb, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *CP, int ldc)

BLAS Level 3 API.

syrkx performs one of the matrix-matrix operations for a symmetric rank-k update

C := alpha*op(A)*op(B)^T + beta*C

where alpha and beta are scalars, op(A) and op(B) are n by k matrix, and C is a symmetric n x n matrix stored as either upper or lower. This routine should only be used when the caller can guarantee that the result of op(A)*op(B)^T will be symmetric.

```
op( A ) = A, op( B ) = B, and A and B are n by k if trans == HIPBLAS_OP_N
op( A ) = A^T, op( B ) = B^T,  and A and B are k by n if trans == HIPBLAS_OP_T
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_T: op(A) = A^T, op(B) = B^T HIPBLAS_OP_N: op(A) = A, op(B) = B
- **n** – **[in]** [int] n specifies the number of rows and columns of C. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A) and op(B). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** pointer storing matrix A on the GPU. Martrix dimension is (lda, k) when if trans = HIPBLAS_OP_N, otherwise (lda, n) only the upper/lower triangular part is accessed.
- **lda** – **[in]** [int] lda specifies the first dimension of A. if trans = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **BP** – **[in]** pointer storing matrix B on the GPU. Martrix dimension is (ldb, k) when if trans = HIPBLAS_OP_N, otherwise (ldb, n) only the upper/lower triangular part is accessed.
- **ldb** – **[in]** [int] ldb specifies the first dimension of B. if trans = HIPBLAS_OP_N, ldb >= max(1, n), otherwise ldb >= max(1, k).
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** pointer storing matrix C on the GPU.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).

hipblasStatus_t **hipblasSsyrkxBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const float *alpha, const float *const AP[], int lda, const float *const BP[], int ldb, const float *beta, float *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasDsyrkxBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const double *alpha, const double *const AP[], int lda, const double *const BP[], int ldb, const double *beta, double *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasCsyrkxBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *const AP[], int lda, const *hipblasComplex* *const BP[], int ldb, const *hipblasComplex* *beta, *hipblasComplex* *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasZsyrkxBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const AP[], int lda, const *hipblasDoubleComplex* *const BP[], int ldb, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *const CP[], int ldc, int batchCount)

BLAS Level 3 API.

syrkxBatched performs a batch of the matrix-matrix operations for a symmetric rank-k update

C_i := alpha*op(A_i)*op(B_i)^T + beta*C_i

where alpha and beta are scalars, op(A_i) and op(B_i) are n by k matrix, and C_i is a symmetric n x n matrix stored as either upper or lower. This routine should only be used when the caller can guarantee that the result of op(A_i)*op(B_i)^T will be symmetric.

```
op( A_i ) = A_i, op( B_i ) = B_i, and A_i and B_i are n by k if trans == HIPBLAS_OP_
↪N
op( A_i ) = A_i^T, op( B_i ) = B_i^T,  and A_i and B_i are k by n if trans ==␣
↪HIPBLAS_OP_T
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C_i is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C_i is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_T: op(A_i) = A_i^T, op(B_i) = B_i^T HIPBLAS_OP_N: op(A_i) = A_i, op(B_i) = B_i
- **n** – **[in]** [int] n specifies the number of rows and columns of C_i. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A). k >= 0.

- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** device array of device pointers storing each matrix_i A of dimension (lda, k) when trans is HIPBLAS_OP_N, otherwise of dimension (lda, n)
- **lda** – **[in]** [int] lda specifies the first dimension of A_i. if trans = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **BP** – **[in]** device array of device pointers storing each matrix_i B of dimension (ldb, k) when trans is HIPBLAS_OP_N, otherwise of dimension (ldb, n)
- **ldb** – **[in]** [int] ldb specifies the first dimension of B. if trans = HIPBLAS_OP_N, ldb >= max(1, n), otherwise ldb >= max(1, k).
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** device array of device pointers storing each matrix C_i on the GPU.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasSsyrkxStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const float *alpha, const float *AP, int lda, *hipblasStride* strideA, const float *BP, int ldb, *hipblasStride* strideB, const float *beta, float *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasDsyrkxStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const double *alpha, const double *AP, int lda, *hipblasStride* strideA, const double *BP, int ldb, *hipblasStride* strideB, const double *beta, double *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasCsyrkxStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasComplex* *BP, int ldb, *hipblasStride* strideB, const *hipblasComplex* *beta, *hipblasComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasZsyrkxStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasDoubleComplex* *BP, int ldb, *hipblasStride* strideB, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

BLAS Level 3 API.

syrkxStridedBatched performs a batch of the matrix-matrix operations for a symmetric rank-k update

C_i := alpha*op(A_i)*op(B_i)^T + beta*C_i

where alpha and beta are scalars, op(A_i) and op(B_i) are n by k matrix, and C_i is a symmetric n x n matrix stored as either upper or lower. This routine should only be used when the caller can guarantee that the result of op(A_i)*op(B_i)^T will be symmetric.

```
op( A_i ) = A_i, op( B_i ) = B_i, and A_i and B_i are n by k if trans == HIPBLAS_OP_
↪N
op( A_i ) = A_i^T, op( B_i ) = B_i^T,  and A_i and B_i are k by n if trans ==␣
↪HIPBLAS_OP_T
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: C_i is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: C_i is a lower triangular matrix
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_T: op(A_i) = A_i^T, op(B_i) = B_i^T HIPBLAS_OP_N: op(A_i) = A_i, op(B_i) = B_i
- **n** – **[in]** [int] n specifies the number of rows and columns of C_i. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of op(A). k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and A need not be set before entry.
- **AP** – **[in]** Device pointer to the first matrix A_1 on the GPU of dimension (lda, k) when trans is HIPBLAS_OP_N, otherwise of dimension (lda, n)
- **lda** – **[in]** [int] lda specifies the first dimension of A_i. if trans = HIPBLAS_OP_N, lda >= max(1, n), otherwise lda >= max(1, k).
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **BP** – **[in]** Device pointer to the first matrix B_1 on the GPU of dimension (ldb, k) when trans is HIPBLAS_OP_N, otherwise of dimension (ldb, n)
- **ldb** – **[in]** [int] ldb specifies the first dimension of B_i. if trans = HIPBLAS_OP_N, ldb >= max(1, n), otherwise ldb >= max(1, k).
- **strideB** – **[in]** [hipblasStride] stride from the start of one matrix (B_i) and the next one (B_i+1)
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** Device pointer to the first matrix C_1 on the GPU.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, n).
- **strideC** – **[inout]** [hipblasStride] stride from the start of one matrix (C_i) and the next one (C_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch.

1.9.3.9 hipblasXgeam + Batched, StridedBatched

hipblasStatus_t **hipblasSgeam**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, const float *alpha, const float *AP, int lda, const float *beta, const float *BP, int ldb, float *CP, int ldc)

hipblasStatus_t **hipblasDgeam**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, const double *alpha, const double *AP, int lda, const double *beta, const double *BP, int ldb, double *CP, int ldc)

hipblasStatus_t **hipblasCgeam**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, const *hipblasComplex* *beta, const *hipblasComplex* *BP, int ldb, *hipblasComplex* *CP, int ldc)

hipblasStatus_t **hipblasZgeam**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, const *hipblasDoubleComplex* *beta, const *hipblasDoubleComplex* *BP, int ldb, *hipblasDoubleComplex* *CP, int ldc)

BLAS Level 3 API.

geam performs one of the matrix-matrix operations

```
C = alpha*op( A ) + beta*op( B ),
```

where op(X) is one of

```
op( X ) = X      or
op( X ) = X**T   or
op( X ) = X**H,
```

alpha and beta are scalars, and A, B and C are matrices, with op(A) an m by n matrix, op(B) an m by n matrix, and C an m by n matrix.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **transA** – **[in]** [hipblasOperation_t] specifies the form of op(A)
- **transB** – **[in]** [hipblasOperation_t] specifies the form of op(B)
- **m** – **[in]** [int] matrix dimension m.
- **n** – **[in]** [int] matrix dimension n.
- **alpha** – **[in]** device pointer or host pointer specifying the scalar alpha.
- **AP** – **[in]** device pointer storing matrix A.
- **lda** – **[in]** [int] specifies the leading dimension of A.
- **beta** – **[in]** device pointer or host pointer specifying the scalar beta.

- **BP** – **[in]** device pointer storing matrix B.
- **ldb** – **[in]** [int] specifies the leading dimension of B.
- **CP** – **[inout]** device pointer storing matrix C.
- **ldc** – **[in]** [int] specifies the leading dimension of C.

hipblasStatus_t **hipblasSgeamBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, const float *alpha, const float *const AP[], int lda, const float *beta, const float *const BP[], int ldb, float *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasDgeamBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, const double *alpha, const double *const AP[], int lda, const double *beta, const double *const BP[], int ldb, double *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasCgeamBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *const AP[], int lda, const *hipblasComplex* *beta, const *hipblasComplex* *const BP[], int ldb, *hipblasComplex* *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasZgeamBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const AP[], int lda, const *hipblasDoubleComplex* *beta, const *hipblasDoubleComplex* *const BP[], int ldb, *hipblasDoubleComplex* *const CP[], int ldc, int batchCount)

BLAS Level 3 API.

geamBatched performs one of the batched matrix-matrix operations

```
C_i = alpha*op( A_i ) + beta*op( B_i )  for i = 0, 1, ... batchCount - 1
```

where alpha and beta are scalars, and op(A_i), op(B_i) and C_i are m by n matrices and op(X) is one of

```
op( X ) = X      or
op( X ) = X**T
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **transA** – **[in]** [hipblasOperation_t] specifies the form of op(A)
- **transB** – **[in]** [hipblasOperation_t] specifies the form of op(B)
- **m** – **[in]** [int] matrix dimension m.
- **n** – **[in]** [int] matrix dimension n.
- **alpha** – **[in]** device pointer or host pointer specifying the scalar alpha.

- **AP** – **[in]** device array of device pointers storing each matrix A_i on the GPU. Each A_i is of dimension (lda, k), where k is m when transA == HIPBLAS_OP_N and is n when transA == HIPBLAS_OP_T.
- **lda** – **[in]** [int] specifies the leading dimension of A.
- **beta** – **[in]** device pointer or host pointer specifying the scalar beta.
- **BP** – **[in]** device array of device pointers storing each matrix B_i on the GPU. Each B_i is of dimension (ldb, k), where k is m when transB == HIPBLAS_OP_N and is n when transB == HIPBLAS_OP_T.
- **ldb** – **[in]** [int] specifies the leading dimension of B.
- **CP** – **[inout]** device array of device pointers storing each matrix C_i on the GPU. Each C_i is of dimension (ldc, n).
- **ldc** – **[in]** [int] specifies the leading dimension of C.
- **batchCount** – **[in]** [int] number of instances i in the batch.

hipblasStatus_t **hipblasSgeamStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, const float *alpha, const float *AP, int lda, *hipblasStride* strideA, const float *beta, const float *BP, int ldb, *hipblasStride* strideB, float *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasDgeamStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, const double *alpha, const double *AP, int lda, *hipblasStride* strideA, const double *beta, const double *BP, int ldb, *hipblasStride* strideB, double *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasCgeamStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasComplex* *beta, const *hipblasComplex* *BP, int ldb, *hipblasStride* strideB, *hipblasComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasZgeamStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasDoubleComplex* *beta, const *hipblasDoubleComplex* *BP, int ldb, *hipblasStride* strideB, *hipblasDoubleComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

BLAS Level 3 API.

geamStridedBatched performs one of the batched matrix-matrix operations

```
C_i = alpha*op( A_i ) + beta*op( B_i )  for i = 0, 1, ... batchCount - 1
```

where alpha and beta are scalars, and op(A_i), op(B_i) and C_i are m by n matrices and op(X) is one of

```
op( X ) = X      or
op( X ) = X**T
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **transA** – **[in]** [hipblasOperation_t] specifies the form of op(A)
- **transB** – **[in]** [hipblasOperation_t] specifies the form of op(B)
- **m** – **[in]** [int] matrix dimension m.
- **n** – **[in]** [int] matrix dimension n.
- **alpha** – **[in]** device pointer or host pointer specifying the scalar alpha.
- **AP** – **[in]** device pointer to the first matrix A_0 on the GPU. Each A_i is of dimension (lda, k), where k is m when transA == HIPBLAS_OP_N and is n when transA == HIPBLAS_OP_T.
- **lda** – **[in]** [int] specifies the leading dimension of A.
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **beta** – **[in]** device pointer or host pointer specifying the scalar beta.
- **BP** – **[in]** pointer to the first matrix B_0 on the GPU. Each B_i is of dimension (ldb, k), where k is m when transB == HIPBLAS_OP_N and is n when transB == HIPBLAS_OP_T.
- **ldb** – **[in]** [int] specifies the leading dimension of B.
- **strideB** – **[in]** [hipblasStride] stride from the start of one matrix (B_i) and the next one (B_i+1)
- **CP** – **[inout]** pointer to the first matrix C_0 on the GPU. Each C_i is of dimension (ldc, n).
- **ldc** – **[in]** [int] specifies the leading dimension of C.
- **strideC** – **[in]** [hipblasStride] stride from the start of one matrix (C_i) and the next one (C_i+1)
- **batchCount** – **[in]** [int] number of instances i in the batch.

1.9.3.10 hipblasXhemm + Batched, StridedBatched

hipblasStatus_t **hipblasChemm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, const *hipblasComplex* *BP, int ldb, const *hipblasComplex* *beta, *hipblasComplex* *CP, int ldc)

hipblasStatus_t **hipblasZhemm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, const *hipblasDoubleComplex* *BP, int ldb, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *CP, int ldc)

BLAS Level 3 API.

hemm performs one of the matrix-matrix operations:

C := alpha*A*B + beta*C if side == HIPBLAS_SIDE_LEFT, C := alpha*B*A + beta*C if side == HIPBLAS_SIDE_RIGHT,

where alpha and beta are scalars, B and C are m by n matrices, and A is a Hermitian matrix stored as either upper or lower.

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **side** – **[in]** [hipblasSideMode_t] HIPBLAS_SIDE_LEFT: C := alpha*A*B + beta*C HIPBLAS_SIDE_RIGHT: C := alpha*B*A + beta*C
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: A is a lower triangular matrix
- **n** – **[in]** [int] n specifies the number of rows of B and C. n >= 0.
- **k** – **[in]** [int] n specifies the number of columns of B and C. k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A and B are not referenced.
- **AP** – **[in]** pointer storing matrix A on the GPU. A is m by m if side == HIPBLAS_SIDE_LEFT A is n by n if side == HIPBLAS_SIDE_RIGHT Only the upper/lower triangular part is accessed. The imaginary component of the diagonal elements is not used.
- **lda** – **[in]** [int] lda specifies the first dimension of A. if side = HIPBLAS_SIDE_LEFT, lda >= max(1, m), otherwise lda >= max(1, n).
- **BP** – **[in]** pointer storing matrix B on the GPU. Matrix dimension is m by n
- **ldb** – **[in]** [int] ldb specifies the first dimension of B. ldb >= max(1, m)
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** pointer storing matrix C on the GPU. Matrix dimension is m by n
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, m)

hipblasStatus_t **hipblasChemmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *const AP[], int lda, const *hipblasComplex* *const BP[], int ldb, const *hipblasComplex* *beta, *hipblasComplex* *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasZhemmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const AP[], int lda, const *hipblasDoubleComplex* *const BP[], int ldb, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *const CP[], int ldc, int batchCount)

BLAS Level 3 API.

hemmBatched performs a batch of the matrix-matrix operations:

C_i := alpha*A_i*B_i + beta*C_i if side == HIPBLAS_SIDE_LEFT, C_i := alpha*B_i*A_i + beta*C_i if side == HIPBLAS_SIDE_RIGHT,

where alpha and beta are scalars, B_i and C_i are m by n matrices, and A_i is a Hermitian matrix stored as either upper or lower.

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **side** – **[in]** [hipblasSideMode_t] HIPBLAS_SIDE_LEFT: C_i := alpha*A_i*B_i + beta*C_i HIPBLAS_SIDE_RIGHT: C_i := alpha*B_i*A_i + beta*C_i
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A_i is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: A_i is a lower triangular matrix
- **n** – **[in]** [int] n specifies the number of rows of B_i and C_i. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of B_i and C_i. k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A_i and B_i are not referenced.
- **AP** – **[in]** device array of device pointers storing each matrix A_i on the GPU. A_i is m by m if side == HIPBLAS_SIDE_LEFT A_i is n by n if side == HIPBLAS_SIDE_RIGHT Only the upper/lower triangular part is accessed. The imaginary component of the diagonal elements is not used.
- **lda** – **[in]** [int] lda specifies the first dimension of A_i. if side = HIPBLAS_SIDE_LEFT, lda >= max(1, m), otherwise lda >= max(1, n).
- **BP** – **[in]** device array of device pointers storing each matrix B_i on the GPU. Matrix dimension is m by n
- **ldb** – **[in]** [int] ldb specifies the first dimension of B_i. ldb >= max(1, m)
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C_i need not be set before entry.
- **CP** – **[in]** device array of device pointers storing each matrix C_i on the GPU. Matrix dimension is m by n
- **ldc** – **[in]** [int] ldc specifies the first dimension of C_i. ldc >= max(1, m)
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasChemmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int n, int k, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasComplex* *BP, int ldb, *hipblasStride* strideB, const *hipblasComplex* *beta, *hipblasComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount) *hipblasStatus_t* **hipblasZhemmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, int n, int k, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasDoubleComplex* *BP, int ldb, *hipblasStride* strideB, const *hipblasDoubleComplex* *beta, *hipblasDoubleComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

BLAS Level 3 API.

hemmStridedBatched performs a batch of the matrix-matrix operations:

C_i := alpha*A_i*B_i + beta*C_i if side == HIPBLAS_SIDE_LEFT, C_i := alpha*B_i*A_i + beta*C_i if side == HIPBLAS_SIDE_RIGHT,

where alpha and beta are scalars, B_i and C_i are m by n matrices, and A_i is a Hermitian matrix stored as either upper or lower.

- Supported precisions in rocBLAS : c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **side** – **[in]** [hipblasSideMode_t] HIPBLAS_SIDE_LEFT: C_i := alpha*A_i*B_i + beta*C_i HIPBLAS_SIDE_RIGHT: C_i := alpha*B_i*A_i + beta*C_i
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A_i is an upper triangular matrix HIPBLAS_FILL_MODE_LOWER: A_i is a lower triangular matrix
- **n** – **[in]** [int] n specifies the number of rows of B_i and C_i. n >= 0.
- **k** – **[in]** [int] k specifies the number of columns of B_i and C_i. k >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A_i and B_i are not referenced.
- **AP** – **[in]** device pointer to first matrix A_1 A_i is m by m if side == HIPBLAS_SIDE_LEFT A_i is n by n if side == HIPBLAS_SIDE_RIGHT Only the upper/lower triangular part is accessed. The imaginary component of the diagonal elements is not used.
- **lda** – **[in]** [int] lda specifies the first dimension of A_i. if side = HIPBLAS_SIDE_LEFT, lda >= max(1, m), otherwise lda >= max(1, n).
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **BP** – **[in]** device pointer to first matrix B_1 of dimension (ldb, n) on the GPU
- **ldb** – **[in]** [int] ldb specifies the first dimension of B_i. if side = HIPBLAS_OP_N, ldb >= max(1, m), otherwise ldb >= max(1, n).
- **strideB** – **[in]** [hipblasStride] stride from the start of one matrix (B_i) and the next one (B_i+1)
- **beta** – **[in]** beta specifies the scalar beta. When beta is zero then C need not be set before entry.
- **CP** – **[in]** device pointer to first matrix C_1 of dimension (ldc, n) on the GPU.
- **ldc** – **[in]** [int] ldc specifies the first dimension of C. ldc >= max(1, m)

- **strideC** – **[inout]** [hipblasStride] stride from the start of one matrix (C_i) and the next one (C_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch

1.9.3.11 hipblasXtrmm + Batched, StridedBatched

hipblasStatus_t **hipblasStrmm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const float *alpha, const float *AP, int lda, float *BP, int ldb)

hipblasStatus_t **hipblasDtrmm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const double *alpha, const double *AP, int lda, double *BP, int ldb)

hipblasStatus_t **hipblasCtrmm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, *hipblasComplex* *BP, int ldb)

hipblasStatus_t **hipblasZtrmm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, *hipblasDoubleComplex* *BP, int ldb)

BLAS Level 3 API.

trmm performs one of the matrix-matrix operations

B := alpha*op(A)*B, or B := alpha*B*op(A)

where alpha is a scalar, B is an m by n matrix, A is a unit, or non-unit, upper or lower triangular matrix and op(A) is one of

```
op( A ) = A   or   op( A ) = A^T   or   op( A ) = A^H.
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

When uplo == HIPBLAS_FILL_MODE_UPPER the leading k by k upper triangular part of the array A must contain the upper triangular matrix and the strictly lower triangular part of A is not referenced.

When uplo == HIPBLAS_FILL_MODE_LOWER the leading k by k lower triangular part of the array A must contain the lower triangular matrix and the strictly upper triangular part of A is not referenced.

Note that when diag == HIPBLAS_DIAG_UNIT the diagonal elements of A are not referenced either, but are assumed to be unity.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.

- **side** – **[in]** [hipblasSideMode_t] Specifies whether op(A) multiplies B from the left or right as follows: HIPBLAS_SIDE_LEFT: B := alpha*op(A)*B. HIPBLAS_SIDE_RIGHT: B := alpha*B*op(A).
- **uplo** – **[in]** [hipblasFillMode_t] Specifies whether the matrix A is an upper or lower triangular matrix as follows: HIPBLAS_FILL_MODE_UPPER: A is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t] Specifies the form of op(A) to be used in the matrix multiplication as follows: HIPBLAS_OP_N: op(A) = A. HIPBLAS_OP_T: op(A) = A^T. HIPBLAS_OP_C: op(A) = A^H.
- **diag** – **[in]** [hipblasDiagType_t] Specifies whether or not A is unit triangular as follows: HIPBLAS_DIAG_UNIT: A is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: A is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of B. m >= 0.
- **n** – **[in]** [int] n specifies the number of columns of B. n >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A is not referenced and B need not be set before entry.
- **AP** – **[in]** Device pointer to matrix A on the GPU. A has dimension (lda, k), where k is m when side == HIPBLAS_SIDE_LEFT and is n when side == HIPBLAS_SIDE_RIGHT.
- **lda** – **[in]** [int] lda specifies the first dimension of A. if side == HIPBLAS_SIDE_LEFT, lda >= max(1, m), if side == HIPBLAS_SIDE_RIGHT, lda >= max(1, n).
- **BP** – **[inout]** Device pointer to the first matrix B_0 on the GPU. On entry, the leading m by n part of the array B must contain the matrix B, and on exit is overwritten by the transformed matrix.
- **ldb** – **[in]** [int] ldb specifies the first dimension of B. ldb >= max(1, m).

hipblasStatus_t **hipblasStrmmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const float *alpha, const float *const AP[], int lda, float *const BP[], int ldb, int batchCount)

hipblasStatus_t **hipblasDtrmmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const double *alpha, const double *const AP[], int lda, double *const BP[], int ldb, int batchCount)

hipblasStatus_t **hipblasCtrmmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *const AP[], int lda, *hipblasComplex* *const BP[], int ldb, int batchCount)

hipblasStatus_t **hipblasZtrmmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *const AP[], int lda, *hipblasDoubleComplex* *const BP[], int ldb, int batchCount)

BLAS Level 3 API.

trmmBatched performs one of the batched matrix-matrix operations

B_i := alpha*op(A_i)*B_i, or B_i := alpha*B_i*op(A_i) for i = 0, 1, … batchCount -1 where alpha is a scalar, B_i is an m by n matrix, A_i is a unit, or non-unit, upper or lower triangular matrix and op(A_i) is one of

```
op( A_i ) = A_i   or   op( A_i ) = A_i^T   or   op( A_i ) = A_i^H.
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

When uplo == HIPBLAS_FILL_MODE_UPPER the leading k by k upper triangular part of the array A must contain the upper triangular matrix and the strictly lower triangular part of A is not referenced.

When uplo == HIPBLAS_FILL_MODE_LOWER the leading k by k lower triangular part of the array A must contain the lower triangular matrix and the strictly upper triangular part of A is not referenced.

Note that when diag == HIPBLAS_DIAG_UNIT the diagonal elements of A_i are not referenced either, but are assumed to be unity.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **side** – **[in]** [hipblasSideMode_t] Specifies whether op(A_i) multiplies B_i from the left or right as follows: HIPBLAS_SIDE_LEFT: B_i := alpha*op(A_i)*B_i. HIPBLAS_SIDE_RIGHT: B_i := alpha*B_i*op(A_i).
- **uplo** – **[in]** [hipblasFillMode_t] Specifies whether the matrix A is an upper or lower triangular matrix as follows: HIPBLAS_FILL_MODE_UPPER: A is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t] Specifies the form of op(A_i) to be used in the matrix multiplication as follows: HIPBLAS_OP_N: op(A_i) = A_i. HIPBLAS_OP_T: op(A_i) = A_i^T. HIPBLAS_OP_C: op(A_i) = A_i^H.
- **diag** – **[in]** [hipblasDiagType_t] Specifies whether or not A_i is unit triangular as follows: HIPBLAS_DIAG_UNIT: A_i is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: A_i is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of B_i. m >= 0.
- **n** – **[in]** [int] n specifies the number of columns of B_i. n >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A_i is not referenced and B_i need not be set before entry.
- **AP** – **[in]** Device array of device pointers storing each matrix A_i on the GPU. Each A_i is of dimension (lda, k), where k is m when side == HIPBLAS_SIDE_LEFT and is n when side == HIPBLAS_SIDE_RIGHT.
- **lda** – **[in]** [int] lda specifies the first dimension of A. if side == HIPBLAS_SIDE_LEFT, lda >= max(1, m), if side == HIPBLAS_SIDE_RIGHT, lda >= max(1, n).
- **BP** – **[inout]** device array of device pointers storing each matrix B_i on the GPU. On entry, the leading m by n part of the array B_i must contain the matrix B_i, and on exit is overwritten by the transformed matrix.
- **ldb** – **[in]** [int] ldb specifies the first dimension of B_i. ldb >= max(1, m).
- **batchCount** – **[in]** [int] number of instances i in the batch.

hipblasStatus_t **hipblasStrmmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const float *alpha, const float *AP, int lda, *hipblasStride* strideA, float *BP, int ldb, *hipblasStride* strideB, int batchCount)

hipblasStatus_t **hipblasDtrmmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const double *alpha, const double *AP, int lda, *hipblasStride* strideA, double *BP, int ldb, *hipblasStride* strideB, int batchCount)

hipblasStatus_t **hipblasCtrmmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const *hipblasComplex* *alpha, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, *hipblasComplex* *BP, int ldb, *hipblasStride* strideB, int batchCount)

hipblasStatus_t **hipblasZtrmmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const *hipblasDoubleComplex* *alpha, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, *hipblasDoubleComplex* *BP, int ldb, *hipblasStride* strideB, int batchCount)

BLAS Level 3 API.

trmmStridedBatched performs one of the strided_batched matrix-matrix operations

B_i := alpha*op(A_i)*B_i, or B_i := alpha*B_i*op(A_i) for i = 0, 1, … batchCount -1

where alpha is a scalar, B_i is an m by n matrix, A_i is a unit, or non-unit, upper or lower triangular matrix and op(A_i) is one of

```
op( A_i ) = A_i   or   op( A_i ) = A_i^T   or   op( A_i ) = A_i^H.
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

When uplo == HIPBLAS_FILL_MODE_UPPER the leading k by k upper triangular part of the array A must contain the upper triangular matrix and the strictly lower triangular part of A is not referenced.

When uplo == HIPBLAS_FILL_MODE_LOWER the leading k by k lower triangular part of the array A must contain the lower triangular matrix and the strictly upper triangular part of A is not referenced.

Note that when diag == HIPBLAS_DIAG_UNIT the diagonal elements of A_i are not referenced either, but are assumed to be unity.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.

- **side** – **[in]** [hipblasSideMode_t] Specifies whether op(A_i) multiplies B_i from the left or right as follows: HIPBLAS_SIDE_LEFT: B_i := alpha*op(A_i)*B_i. HIPBLAS_SIDE_RIGHT: B_i := alpha*B_i*op(A_i).
- **uplo** – **[in]** [hipblasFillMode_t] Specifies whether the matrix A is an upper or lower triangular matrix as follows: HIPBLAS_FILL_MODE_UPPER: A is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t] Specifies the form of op(A_i) to be used in the matrix multiplication as follows: HIPBLAS_OP_N: op(A_i) = A_i. HIPBLAS_OP_T: op(A_i) = A_i^T. HIPBLAS_OP_C: op(A_i) = A_i^H.
- **diag** – **[in]** [hipblasDiagType_t] Specifies whether or not A_i is unit triangular as follows: HIPBLAS_DIAG_UNIT: A_i is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: A_i is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of B_i. m >= 0.
- **n** – **[in]** [int] n specifies the number of columns of B_i. n >= 0.
- **alpha** – **[in]** alpha specifies the scalar alpha. When alpha is zero then A_i is not referenced and B_i need not be set before entry.
- **AP** – **[in]** Device pointer to the first matrix A_0 on the GPU. Each A_i is of dimension (lda, k), where k is m when side == HIPBLAS_SIDE_LEFT and is n when side == HIPBLAS_SIDE_RIGHT.
- **lda** – **[in]** [int] lda specifies the first dimension of A. if side == HIPBLAS_SIDE_LEFT, lda >= max(1, m), if side == HIPBLAS_SIDE_RIGHT, lda >= max(1, n).
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **BP** – **[inout]** Device pointer to the first matrix B_0 on the GPU. On entry, the leading m by n part of the array B_i must contain the matrix B_i, and on exit is overwritten by the transformed matrix.
- **ldb** – **[in]** [int] ldb specifies the first dimension of B_i. ldb >= max(1, m).
- **strideB** – **[in]** [hipblasStride] stride from the start of one matrix (B_i) and the next one (B_i+1)
- **batchCount** – **[in]** [int] number of instances i in the batch.

1.9.3.12 hipblasXtrsm + Batched, StridedBatched

hipblasStatus_t **hipblasStrsm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const float *alpha, float *AP, int lda, float *BP, int ldb)

hipblasStatus_t **hipblasDtrsm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const double *alpha, double *AP, int lda, double *BP, int ldb)

hipblasStatus_t **hipblasCtrsm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const *hipblasComplex* *alpha, *hipblasComplex* *AP, int lda, *hipblasComplex* *BP, int ldb) *hipblasStatus_t* **hipblasZtrsm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const *hipblasDoubleComplex* *alpha, *hipblasDoubleComplex* *AP, int lda, *hipblasDoubleComplex* *BP, int ldb)

BLAS Level 3 API.

trsm solves

```
op(A)*X = alpha*B or  X*op(A) = alpha*B,
```

where alpha is a scalar, X and B are m by n matrices, A is triangular matrix and op(A) is one of

```
op( A ) = A   or   op( A ) = A^T   or   op( A ) = A^H.
```

The matrix X is overwritten on B.

Note about memory allocation: When trsm is launched with a k evenly divisible by the internal block size of 128, and is no larger than 10 of these blocks, the API takes advantage of utilizing pre-allocated memory found in the handle to increase overall performance. This memory can be managed by using the environment variable WORKBUF_TRSM_B_CHNK. When this variable is not set the device memory used for temporary storage will default to 1 MB and may result in chunking, which in turn may reduce performance. Under these circumstances it is recommended that WORKBUF_TRSM_B_CHNK be set to the desired chunk of right hand sides to be used at a time.

(where k is m when HIPBLAS_SIDE_LEFT and is n when HIPBLAS_SIDE_RIGHT)

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **side** – **[in]** [hipblasSideMode_t] HIPBLAS_SIDE_LEFT: op(A)*X = alpha*B. HIPBLAS_SIDE_RIGHT: X*op(A) = alpha*B.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_N: op(A) = A. HIPBLAS_OP_T: op(A) = A^T. HIPBLAS_OP_C: op(A) = A^H.
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: A is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: A is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of B. m >= 0.
- **n** – **[in]** [int] n specifies the number of columns of B. n >= 0.
- **alpha** – **[in]** device pointer or host pointer specifying the scalar alpha. When alpha is &zero then A is not referenced and B need not be set before entry.
- **AP** – **[in]** device pointer storing matrix A. of dimension (lda, k), where k is m when HIPBLAS_SIDE_LEFT and is n when HIPBLAS_SIDE_RIGHT only the upper/lower triangular part is accessed.
- **lda** – **[in]** [int] lda specifies the first dimension of A. if side = HIPBLAS_SIDE_LEFT, lda >= max(1, m), if side = HIPBLAS_SIDE_RIGHT, lda >= max(1, n).
- **BP** – **[inout]** device pointer storing matrix B.

- **ldb** – **[in]** [int] ldb specifies the first dimension of B. ldb >= max(1, m).

hipblasStatus_t **hipblasStrsmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const float *alpha, float *const AP[], int lda, float *BP[], int ldb, int batchCount)

hipblasStatus_t **hipblasDtrsmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const double *alpha, double *const AP[], int lda, double *BP[], int ldb, int batchCount)

hipblasStatus_t **hipblasCtrsmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const *hipblasComplex* *alpha, *hipblasComplex* *const AP[], int lda, *hipblasComplex* *BP[], int ldb, int batchCount)

hipblasStatus_t **hipblasZtrsmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const *hipblasDoubleComplex* *alpha, *hipblasDoubleComplex* *const AP[], int lda, *hipblasDoubleComplex* *BP[], int ldb, int batchCount)

BLAS Level 3 API.

trsmBatched performs the following batched operation:

```
op(A_i)*X_i = alpha*B_i or  X_i*op(A_i) = alpha*B_i, for i = 1, ..., batchCount.
```

where alpha is a scalar, X and B are batched m by n matrices, A is triangular batched matrix and op(A) is one of

```
op( A ) = A   or   op( A ) = A^T   or   op( A ) = A^H.
```

Each matrix X_i is overwritten on B_i for i = 1, . . . , batchCount.

Note about memory allocation: When trsm is launched with a k evenly divisible by the internal block size of 128, and is no larger than 10 of these blocks, the API takes advantage of utilizing pre-allocated memory found in the handle to increase overall performance. This memory can be managed by using the environment variable WORKBUF_TRSM_B_CHNK. When this variable is not set the device memory used for temporary storage will default to 1 MB and may result in chunking, which in turn may reduce performance. Under these circumstances it is recommended that WORKBUF_TRSM_B_CHNK be set to the desired chunk of right hand sides to be used at a time. (where k is m when HIPBLAS_SIDE_LEFT and is n when HIPBLAS_SIDE_RIGHT)

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **side** – **[in]** [hipblasSideMode_t] HIPBLAS_SIDE_LEFT: op(A)*X = alpha*B. HIPBLAS_SIDE_RIGHT: X*op(A) = alpha*B.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: each A_i is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: each A_i is a lower triangular matrix.

- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_N: op(A) = A. HIPBLAS_OP_T: op(A) = A^T. HIPBLAS_OP_C: op(A) = A^H.
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: each A_i is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: each A_i is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of each B_i. m >= 0.
- **n** – **[in]** [int] n specifies the number of columns of each B_i. n >= 0.
- **alpha** – **[in]** device pointer or host pointer specifying the scalar alpha. When alpha is &zero then A is not referenced and B need not be set before entry.
- **AP** – **[in]** device array of device pointers storing each matrix A_i on the GPU. Matricies are of dimension (lda, k), where k is m when HIPBLAS_SIDE_LEFT and is n when HIPBLAS_SIDE_RIGHT only the upper/lower triangular part is accessed.
- **lda** – **[in]** [int] lda specifies the first dimension of each A_i. if side = HIPBLAS_SIDE_LEFT, lda >= max(1, m), if side = HIPBLAS_SIDE_RIGHT, lda >= max(1, n).
- **BP** – **[inout]** device array of device pointers storing each matrix B_i on the GPU.
- **ldb** – **[in]** [int] ldb specifies the first dimension of each B_i. ldb >= max(1, m).
- **batchCount** – **[in]** [int] number of trsm operatons in the batch.

hipblasStatus_t **hipblasStrsmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const float *alpha, float *AP, int lda, *hipblasStride* strideA, float *BP, int ldb, *hipblasStride* strideB, int batchCount)

hipblasStatus_t **hipblasDtrsmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const double *alpha, double *AP, int lda, *hipblasStride* strideA, double *BP, int ldb, *hipblasStride* strideB, int batchCount)

hipblasStatus_t **hipblasCtrsmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const *hipblasComplex* *alpha, *hipblasComplex* *AP, int lda, *hipblasStride* strideA, *hipblasComplex* *BP, int ldb, *hipblasStride* strideB, int batchCount)

hipblasStatus_t **hipblasZtrsmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const *hipblasDoubleComplex* *alpha, *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, *hipblasDoubleComplex* *BP, int ldb, *hipblasStride* strideB, int batchCount)

BLAS Level 3 API.

trsmSridedBatched performs the following strided batched operation:

```
op(A_i)*X_i = alpha*B_i or  X_i*op(A_i) = alpha*B_i, for i = 1, ..., batchCount.
```

where alpha is a scalar, X and B are strided batched m by n matrices, A is triangular strided batched matrix and op(A) is one of

```
op( A ) = A   or   op( A ) = A^T   or   op( A ) = A^H.
```

Each matrix X_i is overwritten on B_i for i = 1, . . . , batchCount.

Note about memory allocation: When trsm is launched with a k evenly divisible by the internal block size of 128, and is no larger than 10 of these blocks, the API takes advantage of utilizing pre-allocated memory found in the handle to increase overall performance. This memory can be managed by using the environment variable WORKBUF_TRSM_B_CHNK. When this variable is not set the device memory used for temporary storage will default to 1 MB and may result in chunking, which in turn may reduce performance. Under these circumstances it is recommended that WORKBUF_TRSM_B_CHNK be set to the desired chunk of right hand sides to be used at a time. (where k is m when HIPBLAS_SIDE_LEFT and is n when HIPBLAS_SIDE_RIGHT)

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **side** – **[in]** [hipblasSideMode_t] HIPBLAS_SIDE_LEFT: op(A)*X = alpha*B. HIPBLAS_SIDE_RIGHT: X*op(A) = alpha*B.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: each A_i is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: each A_i is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_N: op(A) = A. HIPBLAS_OP_T: op(A) = A^T. HIPBLAS_OP_C: op(A) = A^H.
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: each A_i is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: each A_i is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of each B_i. m >= 0.
- **n** – **[in]** [int] n specifies the number of columns of each B_i. n >= 0.
- **alpha** – **[in]** device pointer or host pointer specifying the scalar alpha. When alpha is &zero then A is not referenced and B need not be set before entry.
- **AP** – **[in]** device pointer pointing to the first matrix A_1. of dimension (lda, k), where k is m when HIPBLAS_SIDE_LEFT and is n when HIPBLAS_SIDE_RIGHT only the upper/lower triangular part is accessed.
- **lda** – **[in]** [int] lda specifies the first dimension of each A_i. if side = HIPBLAS_SIDE_LEFT, lda >= max(1, m), if side = HIPBLAS_SIDE_RIGHT, lda >= max(1, n).
- **strideA** – **[in]** [hipblasStride] stride from the start of one A_i matrix to the next A_(i + 1).
- **BP** – **[inout]** device pointer pointing to the first matrix B_1.
- **ldb** – **[in]** [int] ldb specifies the first dimension of each B_i. ldb >= max(1, m).
- **strideB** – **[in]** [hipblasStride] stride from the start of one B_i matrix to the next B_(i + 1).
- **batchCount** – **[in]** [int] number of trsm operatons in the batch.

1.9.3.13 hipblasXtrtri + Batched, StridedBatched

hipblasStatus_t **hipblasStrtri**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasDiagType_t* diag, int n, const float *AP, int lda, float *invA, int ldinvA)

hipblasStatus_t **hipblasDtrtri**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasDiagType_t* diag, int n, const double *AP, int lda, double *invA, int ldinvA)

hipblasStatus_t **hipblasCtrtri**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasDiagType_t* diag, int n, const *hipblasComplex* *AP, int lda, *hipblasComplex* *invA, int ldinvA)

hipblasStatus_t **hipblasZtrtri**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasDiagType_t* diag, int n, const *hipblasDoubleComplex* *AP, int lda, *hipblasDoubleComplex* *invA, int ldinvA)

BLAS Level 3 API.

trtri compute the inverse of a matrix A, namely, invA

```
and write the result into invA;
```

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER' if HIPBLAS_FILL_MODE_UPPER, the lower part of A is not referenced if HIPBLAS_FILL_MODE_LOWER, the upper part of A is not referenced
- **diag** – **[in]** [hipblasDiagType_t] = 'HIPBLAS_DIAG_NON_UNIT', A is non-unit triangular; = 'HIPBLAS_DIAG_UNIT', A is unit triangular;
- **n** – **[in]** [int] size of matrix A and invA
- **AP** – **[in]** device pointer storing matrix A.
- **lda** – **[in]** [int] specifies the leading dimension of A.
- **invA** – **[out]** device pointer storing matrix invA.
- **ldinvA** – **[in]** [int] specifies the leading dimension of invA.

hipblasStatus_t **hipblasStrtriBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasDiagType_t* diag, int n, const float *const AP[], int lda, float *invA[], int ldinvA, int batchCount)

hipblasStatus_t **hipblasDtrtriBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasDiagType_t* diag, int n, const double *const AP[], int lda, double *invA[], int ldinvA, int batchCount) *hipblasStatus_t* **hipblasCtrtriBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasDiagType_t* diag, int n, const *hipblasComplex* *const AP[], int lda, *hipblasComplex* *invA[], int ldinvA, int batchCount)

hipblasStatus_t **hipblasZtrtriBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasDiagType_t* diag, int n, const *hipblasDoubleComplex* *const AP[], int lda, *hipblasDoubleComplex* *invA[], int ldinvA, int batchCount)

BLAS Level 3 API.

trtriBatched compute the inverse of A_i and write into invA_i where A_i and invA_i are the i-th matrices in the batch, for i = 1, . . . , batchCount.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER'
- **diag** – **[in]** [hipblasDiagType_t] = 'HIPBLAS_DIAG_NON_UNIT', A is non-unit triangular; = 'HIPBLAS_DIAG_UNIT', A is unit triangular;
- **n** – **[in]** [int]
- **AP** – **[in]** device array of device pointers storing each matrix A_i.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i.
- **invA** – **[out]** device array of device pointers storing the inverse of each matrix A_i. Partial inplace operation is supported, see below. If UPLO = 'U', the leading N-by-N upper triangular part of the invA will store the inverse of the upper triangular matrix, and the strictly lower triangular part of invA is cleared. If UPLO = 'L', the leading N-by-N lower triangular part of the invA will store the inverse of the lower triangular matrix, and the strictly upper triangular part of invA is cleared.
- **ldinvA** – **[in]** [int] specifies the leading dimension of each invA_i.
- **batchCount** – **[in]** [int] numbers of matrices in the batch

hipblasStatus_t **hipblasStrtriStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasDiagType_t* diag, int n, const float *AP, int lda, *hipblasStride* strideA, float *invA, int ldinvA, *hipblasStride* stride_invA, int batchCount)

hipblasStatus_t **hipblasDtrtriStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasDiagType_t* diag, int n, const double *AP, int lda, *hipblasStride* strideA, double *invA, int ldinvA, *hipblasStride* stride_invA, int batchCount) *hipblasStatus_t* **hipblasCtrtriStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasDiagType_t* diag, int n, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, *hipblasComplex* *invA, int ldinvA, *hipblasStride* stride_invA, int batchCount)

hipblasStatus_t **hipblasZtrtriStridedBatched**(*hipblasHandle_t* handle, *hipblasFillMode_t* uplo, *hipblasDiagType_t* diag, int n, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, *hipblasDoubleComplex* *invA, int ldinvA, *hipblasStride* stride_invA, int batchCount)

BLAS Level 3 API.

trtriStridedBatched compute the inverse of A_i and write into invA_i where A_i and invA_i are the i-th matrices in the batch, for i = 1, . . . , batchCount

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **uplo** – **[in]** [hipblasFillMode_t] specifies whether the upper 'HIPBLAS_FILL_MODE_UPPER' or lower 'HIPBLAS_FILL_MODE_LOWER'
- **diag** – **[in]** [hipblasDiagType_t] = 'HIPBLAS_DIAG_NON_UNIT', A is non-unit triangular; = 'HIPBLAS_DIAG_UNIT', A is unit triangular;
- **n** – **[in]** [int]
- **AP** – **[in]** device pointer pointing to address of first matrix A_1.
- **lda** – **[in]** [int] specifies the leading dimension of each A.
- **strideA** – **[in]** [hipblasStride] "batch stride a": stride from the start of one A_i matrix to the next A_(i + 1).
- **invA** – **[out]** device pointer storing the inverses of each matrix A_i. Partial inplace operation is supported, see below. If UPLO = 'U', the leading N-by-N upper triangular part of the invA will store the inverse of the upper triangular matrix, and the strictly lower triangular part of invA is cleared. If UPLO = 'L', the leading N-by-N lower triangular part of the invA will store the inverse of the lower triangular matrix, and the strictly upper triangular part of invA is cleared.
- **ldinvA** – **[in]** [int] specifies the leading dimension of each invA_i.
- **stride_invA** – **[in]** [hipblasStride] "batch stride invA": stride from the start of one invA_i matrix to the next invA_(i + 1).
- **batchCount** – **[in]** [int] numbers of matrices in the batch

1.9.3.14 hipblasXdgmm + Batched, StridedBatched

hipblasStatus_t **hipblasSdgmm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, int m, int n, const float *AP, int lda, const float *x, int incx, float *CP, int ldc)

hipblasStatus_t **hipblasDdgmm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, int m, int n, const double *AP, int lda, const double *x, int incx, double *CP, int ldc)

hipblasStatus_t **hipblasCdgmm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, int m, int n, const *hipblasComplex* *AP, int lda, const *hipblasComplex* *x, int incx, *hipblasComplex* *CP, int ldc)

hipblasStatus_t **hipblasZdgmm**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, int m, int n, const *hipblasDoubleComplex* *AP, int lda, const *hipblasDoubleComplex* *x, int incx, *hipblasDoubleComplex* *CP, int ldc)

BLAS Level 3 API.

dgmm performs one of the matrix-matrix operations

```
C = A * diag(x) if side == HIPBLAS_SIDE_RIGHT
C = diag(x) * A if side == HIPBLAS_SIDE_LEFT
```

where C and A are m by n dimensional matrices. diag(x) is a diagonal matrix and x is vector of dimension n if side == HIPBLAS_SIDE_RIGHT and dimension m if side == HIPBLAS_SIDE_LEFT.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **side** – **[in]** [hipblasSideMode_t] specifies the side of diag(x)
- **m** – **[in]** [int] matrix dimension m.
- **n** – **[in]** [int] matrix dimension n.
- **AP** – **[in]** device pointer storing matrix A.
- **lda** – **[in]** [int] specifies the leading dimension of A.
- **x** – **[in]** device pointer storing vector x.
- **incx** – **[in]** [int] specifies the increment between values of x
- **CP** – **[inout]** device pointer storing matrix C.
- **ldc** – **[in]** [int] specifies the leading dimension of C.

hipblasStatus_t **hipblasSdgmmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, int m, int n, const float *const AP[], int lda, const float *const x[], int incx, float *const CP[], int ldc, int batchCount) *hipblasStatus_t* **hipblasDdgmmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, int m, int n, const double *const AP[], int lda, const double *const x[], int incx, double *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasCdgmmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, int m, int n, const *hipblasComplex* *const AP[], int lda, const *hipblasComplex* *const x[], int incx, *hipblasComplex* *const CP[], int ldc, int batchCount)

hipblasStatus_t **hipblasZdgmmBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, int m, int n, const *hipblasDoubleComplex* *const AP[], int lda, const *hipblasDoubleComplex* *const x[], int incx, *hipblasDoubleComplex* *const CP[], int ldc, int batchCount)

BLAS Level 3 API.

dgmmBatched performs one of the batched matrix-matrix operations

```
C_i = A_i * diag(x_i) for i = 0, 1, ... batchCount-1 if side == HIPBLAS_SIDE_RIGHT
C_i = diag(x_i) * A_i for i = 0, 1, ... batchCount-1 if side == HIPBLAS_SIDE_LEFT
```

where C_i and A_i are m by n dimensional matrices. diag(x_i) is a diagonal matrix and x_i is vector of dimension n if side == HIPBLAS_SIDE_RIGHT and dimension m if side == HIPBLAS_SIDE_LEFT.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **side** – **[in]** [hipblasSideMode_t] specifies the side of diag(x)
- **m** – **[in]** [int] matrix dimension m.
- **n** – **[in]** [int] matrix dimension n.
- **AP** – **[in]** device array of device pointers storing each matrix A_i on the GPU. Each A_i is of dimension (lda, n)
- **lda** – **[in]** [int] specifies the leading dimension of A_i.
- **x** – **[in]** device array of device pointers storing each vector x_i on the GPU. Each x_i is of dimension n if side == HIPBLAS_SIDE_RIGHT and dimension m if side == HIPBLAS_SIDE_LEFT
- **incx** – **[in]** [int] specifies the increment between values of x_i
- **CP** – **[inout]** device array of device pointers storing each matrix C_i on the GPU. Each C_i is of dimension (ldc, n).
- **ldc** – **[in]** [int] specifies the leading dimension of C_i.
- **batchCount** – **[in]** [int] number of instances in the batch.

hipblasStatus_t **hipblasSdgmmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, int m, int n, const float *AP, int lda, *hipblasStride* strideA, const float *x, int incx, *hipblasStride* stridex, float *CP, int ldc, *hipblasStride* strideC, int batchCount) *hipblasStatus_t* **hipblasDdgmmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, int m, int n, const double *AP, int lda, *hipblasStride* strideA, const double *x, int incx, *hipblasStride* stridex, double *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasCdgmmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, int m, int n, const *hipblasComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasComplex* *x, int incx, *hipblasStride* stridex, *hipblasComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

hipblasStatus_t **hipblasZdgmmStridedBatched**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, int m, int n, const *hipblasDoubleComplex* *AP, int lda, *hipblasStride* strideA, const *hipblasDoubleComplex* *x, int incx, *hipblasStride* stridex, *hipblasDoubleComplex* *CP, int ldc, *hipblasStride* strideC, int batchCount)

BLAS Level 3 API.

dgmmStridedBatched performs one of the batched matrix-matrix operations

```
C_i = A_i * diag(x_i)   if side == HIPBLAS_SIDE_RIGHT   for i = 0, 1, ...
↪batchCount-1
C_i = diag(x_i) * A_i   if side == HIPBLAS_SIDE_LEFT    for i = 0, 1, ...
↪batchCount-1
```

where C_i and A_i are m by n dimensional matrices. diag(x_i) is a diagonal matrix and x_i is vector of dimension n if side == HIPBLAS_SIDE_RIGHT and dimension m if side == HIPBLAS_SIDE_LEFT.

- Supported precisions in rocBLAS : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **side** – **[in]** [hipblasSideMode_t] specifies the side of diag(x)
- **m** – **[in]** [int] matrix dimension m.
- **n** – **[in]** [int] matrix dimension n.
- **AP** – **[in]** device pointer to the first matrix A_0 on the GPU. Each A_i is of dimension (lda, n)
- **lda** – **[in]** [int] specifies the leading dimension of A.
- **strideA** – **[in]** [hipblasStride] stride from the start of one matrix (A_i) and the next one (A_i+1)
- **x** – **[in]** pointer to the first vector x_0 on the GPU. Each x_i is of dimension n if side == HIPBLAS_SIDE_RIGHT and dimension m if side == HIPBLAS_SIDE_LEFT
- **incx** – **[in]** [int] specifies the increment between values of x
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector(x_i) and the next one (x_i+1)

- **CP** – **[inout]** device pointer to the first matrix C_0 on the GPU. Each C_i is of dimension (ldc, n).
- **ldc** – **[in]** [int] specifies the leading dimension of C.
- **strideC** – **[in]** [hipblasStride] stride from the start of one matrix (C_i) and the next one (C_i+1)
- **batchCount** – **[in]** [int] number of instances i in the batch.

1.9.4 SOLVER API

List of SOLVER APIs

1.9.4.1 hipblasXgetrf + Batched, stridedBatched

hipblasStatus_t **hipblasSgetrf**(*hipblasHandle_t* handle, const int n, float *A, const int lda, int *ipiv, int *info)

hipblasStatus_t **hipblasDgetrf**(*hipblasHandle_t* handle, const int n, double *A, const int lda, int *ipiv, int *info)

hipblasStatus_t **hipblasCgetrf**(*hipblasHandle_t* handle, const int n, *hipblasComplex* *A, const int lda, int *ipiv, int *info)

hipblasStatus_t **hipblasZgetrf**(*hipblasHandle_t* handle, const int n, *hipblasDoubleComplex* *A, const int lda, int *ipiv, int *info)

SOLVER API.

getrf computes the LU factorization of a general n-by-n matrix A using partial pivoting with row interchanges. The LU factorization can be done without pivoting if ipiv is passed as a nullptr.

In the case that ipiv is not null, the factorization has the form:

$$A = PLU$$

where P is a permutation matrix, L is lower triangular with unit diagonal elements, and U is upper triangular.

In the case that ipiv is null, the factorization is done without pivoting:

$$A = LU$$

- Supported precisions in rocSOLVER : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** hipblasHandle_t.
- **n** – **[in]** int. n >= 0.

  The number of columns and rows of the matrix A.
- **A** – **[inout]** pointer to type. Array on the GPU of dimension lda*n.

  On entry, the n-by-n matrix A to be factored. On exit, the factors L and U from the factorization. The unit diagonal elements of L are not stored.
- **lda** – **[in]** int. lda >= n.

  Specifies the leading dimension of A.
- **ipiv** – **[out]** pointer to int. Array on the GPU of dimension n.

  The vector of pivot indices. Elements of ipiv are 1-based indices. For 1 <= i <= n, the row i of the matrix was interchanged with row ipiv[i]. Matrix P of the factorization can be derived from ipiv. The factorization here can be done without pivoting if ipiv is passed in as a nullptr.
- **info** – **[out]** pointer to a int on the GPU.

  If info = 0, successful exit. If info = j > 0, U is singular. U[j,j] is the first zero pivot.

hipblasStatus_t **hipblasSgetrfBatched**(*hipblasHandle_t* handle, const int n, float *const A[], const int lda, int *ipiv, int *info, const int batchCount)

hipblasStatus_t **hipblasDgetrfBatched**(*hipblasHandle_t* handle, const int n, double *const A[], const int lda, int *ipiv, int *info, const int batchCount)

hipblasStatus_t **hipblasCgetrfBatched**(*hipblasHandle_t* handle, const int n, *hipblasComplex* *const A[], const int lda, int *ipiv, int *info, const int batchCount)

hipblasStatus_t **hipblasZgetrfBatched**(*hipblasHandle_t* handle, const int n, *hipblasDoubleComplex* *const A[], const int lda, int *ipiv, int *info, const int batchCount)

SOLVER API.

getrfBatched computes the LU factorization of a batch of general n-by-n matrices using partial pivoting with row interchanges. The LU factorization can be done without pivoting if ipiv is passed as a nullptr.

In the case that ipiv is not null, the factorization of matrix A_i in the batch has the form:

$$A_i = P_i L_i U_i$$

where P_i is a permutation matrix, L_i is lower triangular with unit diagonal elements, and U_i is upper triangular.

In the case that ipiv is null, the factorization is done without pivoting:

$$A_i = L_i U_i$$

- Supported precisions in rocSOLVER : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** hipblasHandle_t.
- **n** – **[in]** int. n >= 0.

  The number of columns and rows of all matrices A_i in the batch.
- **A** – **[inout]** array of pointers to type. Each pointer points to an array on the GPU of dimension lda*n.

  On entry, the n-by-n matrices A_i to be factored. On exit, the factors L_i and U_i from the factorizations. The unit diagonal elements of L_i are not stored.
- **lda** – **[in]** int. lda >= n.

  Specifies the leading dimension of matrices A_i.
- **ipiv** – **[out]** pointer to int. Array on the GPU.

  Contains the vectors of pivot indices ipiv_i (corresponding to A_i). Dimension of ipiv_i is n. Elements of ipiv_i are 1-based indices. For each instance A_i in the batch and for 1 <= j <= n, the row j of the matrix A_i was interchanged with row ipiv_i[j]. Matrix P_i of the factorization can be derived from ipiv_i. The factorization here can be done without pivoting if ipiv is passed in as a nullptr.
- **info** – **[out]** pointer to int. Array of batchCount integers on the GPU.

  If info[i] = 0, successful exit for factorization of A_i. If info[i] = j > 0, U_i is singular. U_i[j,j] is the first zero pivot.
- **batchCount** – **[in]** int. batchCount >= 0.

  Number of matrices in the batch.

hipblasStatus_t **hipblasSgetrfStridedBatched**(*hipblasHandle_t* handle, const int n, float *A, const int lda, const *hipblasStride* strideA, int *ipiv, const *hipblasStride* strideP, int *info, const int batchCount)

hipblasStatus_t **hipblasDgetrfStridedBatched**(*hipblasHandle_t* handle, const int n, double *A, const int lda, const *hipblasStride* strideA, int *ipiv, const *hipblasStride* strideP, int *info, const int batchCount)

hipblasStatus_t **hipblasCgetrfStridedBatched**(*hipblasHandle_t* handle, const int n, *hipblasComplex* *A, const int lda, const *hipblasStride* strideA, int *ipiv, const *hipblasStride* strideP, int *info, const int batchCount)

hipblasStatus_t **hipblasZgetrfStridedBatched**(*hipblasHandle_t* handle, const int n, *hipblasDoubleComplex* *A, const int lda, const *hipblasStride* strideA, int *ipiv, const *hipblasStride* strideP, int *info, const int batchCount)

SOLVER API.

getrfStridedBatched computes the LU factorization of a batch of general n-by-n matrices using partial pivoting with row interchanges. The LU factorization can be done without pivoting if ipiv is passed as a nullptr.

In the case that ipiv is not null, the factorization of matrix A_i in the batch has the form:

$$A_i = P_i L_i U_i$$

where P_i is a permutation matrix, L_i is lower triangular with unit diagonal elements, and U_i is upper triangular.

In the case that ipiv is null, the factorization is done without pivoting:

$$A_i = L_i U_i$$

- Supported precisions in rocSOLVER : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** hipblasHandle_t.
- **n** – **[in]** int. n >= 0.

  The number of columns and rows of all matrices A_i in the batch.
- **A** – **[inout]** pointer to type. Array on the GPU (the size depends on the value of strideA).

  On entry, the n-by-n matrices A_i to be factored. On exit, the factors L_i and U_i from the factorization. The unit diagonal elements of L_i are not stored.
- **lda** – **[in]** int. lda >= n.

  Specifies the leading dimension of matrices A_i.
- **strideA** – **[in]** hipblasStride.

  Stride from the start of one matrix A_i to the next one A_(i+1). There is no restriction for the value of strideA. Normal use case is strideA >= lda*n
- **ipiv** – **[out]** pointer to int. Array on the GPU (the size depends on the value of strideP).

  Contains the vectors of pivots indices ipiv_i (corresponding to A_i). Dimension of ipiv_i is n. Elements of ipiv_i are 1-based indices. For each instance A_i in the batch and for 1 <= j <= n, the row j of the matrix A_i was interchanged with row ipiv_i[j]. Matrix P_i of the factorization can be derived from ipiv_i. The factorization here can be done without pivoting if ipiv is passed in as a nullptr.
- **strideP** – **[in]** hipblasStride.

  Stride from the start of one vector ipiv_i to the next one ipiv_(i+1). There is no restriction for the value of strideP. Normal use case is strideP >= n.
- **info** – **[out]** pointer to int. Array of batchCount integers on the GPU.

  If info[i] = 0, successful exit for factorization of A_i. If info[i] = j > 0, U_i is singular. U_i[j,j] is the first zero pivot.
- **batchCount** – **[in]** int. batchCount >= 0.

  Number of matrices in the batch.

1.9.4.2 hipblasXgetrs + Batched, stridedBatched

hipblasStatus_t **hipblasSgetrs**(*hipblasHandle_t* handle, const *hipblasOperation_t* trans, const int n, const int nrhs, float *A, const int lda, const int *ipiv, float *B, const int ldb, int *info)

hipblasStatus_t **hipblasDgetrs**(*hipblasHandle_t* handle, const *hipblasOperation_t* trans, const int n, const int nrhs, double *A, const int lda, const int *ipiv, double *B, const int ldb, int *info)

hipblasStatus_t **hipblasCgetrs**(*hipblasHandle_t* handle, const *hipblasOperation_t* trans, const int n, const int nrhs, *hipblasComplex* *A, const int lda, const int *ipiv, *hipblasComplex* *B, const int ldb, int *info)

hipblasStatus_t **hipblasZgetrs**(*hipblasHandle_t* handle, const *hipblasOperation_t* trans, const int n, const int nrhs, *hipblasDoubleComplex* *A, const int lda, const int *ipiv, *hipblasDoubleComplex* *B, const int ldb, int *info)

SOLVER API.

getrs solves a system of n linear equations on n variables in its factorized form.

It solves one of the following systems, depending on the value of trans:

$$\begin{array}{cl} AX = B & \text{not transposed,} \\ A^T X = B & \text{transposed, or} \\ A^H X = B & \text{conjugate transposed.} \end{array}$$

Matrix A is defined by its triangular factors as returned by *getrf*.

- Supported precisions in rocSOLVER : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** hipblasHandle_t.
- **trans** – **[in]** hipblasOperation_t.

  Specifies the form of the system of equations.
- **n** – **[in]** int. n >= 0.

  The order of the system, i.e. the number of columns and rows of A.
- **nrhs** – **[in]** int. nrhs >= 0.

  The number of right hand sides, i.e., the number of columns of the matrix B.
- **A** – **[in]** pointer to type. Array on the GPU of dimension lda*n.

  The factors L and U of the factorization A = P*L*U returned by *getrf*.
- **lda** – **[in]** int. lda >= n.

  The leading dimension of A.
- **ipiv** – **[in]** pointer to int. Array on the GPU of dimension n.

  The pivot indices returned by *getrf*.

- **B** – **[inout]** pointer to type. Array on the GPU of dimension ldb*nrhs.

  On entry, the right hand side matrix B. On exit, the solution matrix X.

- **ldb** – **[in]** int. ldb >= n.

  The leading dimension of B.

- **info** – **[out]** pointer to a int on the host.

  If info = 0, successful exit. If info = j < 0, the argument at position -j is invalid.

hipblasStatus_t **hipblasSgetrsBatched**(*hipblasHandle_t* handle, const *hipblasOperation_t* trans, const int n, const int nrhs, float *const A[], const int lda, const int *ipiv, float *const B[], const int ldb, int *info, const int batchCount)

hipblasStatus_t **hipblasDgetrsBatched**(*hipblasHandle_t* handle, const *hipblasOperation_t* trans, const int n, const int nrhs, double *const A[], const int lda, const int *ipiv, double *const B[], const int ldb, int *info, const int batchCount)

hipblasStatus_t **hipblasCgetrsBatched**(*hipblasHandle_t* handle, const *hipblasOperation_t* trans, const int n, const int nrhs, *hipblasComplex* *const A[], const int lda, const int *ipiv, *hipblasComplex* *const B[], const int ldb, int *info, const int batchCount)

hipblasStatus_t **hipblasZgetrsBatched**(*hipblasHandle_t* handle, const *hipblasOperation_t* trans, const int n, const int nrhs, *hipblasDoubleComplex* *const A[], const int lda, const int *ipiv, *hipblasDoubleComplex* *const B[], const int ldb, int *info, const int batchCount)

SOLVER API.

getrsBatched solves a batch of systems of n linear equations on n variables in its factorized forms.

For each instance i in the batch, it solves one of the following systems, depending on the value of trans:

$$\begin{array}{cl} A_i X_i = B_i & \text{not transposed,} \\ A_i^T X_i = B_i & \text{transposed, or} \\ A_i^H X_i = B_i & \text{conjugate transposed.} \end{array}$$

Matrix A_i is defined by its triangular factors as returned by *getrfBatched*.

- Supported precisions in rocSOLVER : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** hipblasHandle_t.
- **trans** – **[in]** hipblasOperation_t.

  Specifies the form of the system of equations of each instance in the batch.

- **n** – **[in]** int. n >= 0.

  The order of the system, i.e. the number of columns and rows of all A_i matrices.

- **nrhs** – **[in]** int. nrhs >= 0.

  The number of right hand sides, i.e., the number of columns of all the matrices B_i.
- **A** – **[in]** Array of pointers to type. Each pointer points to an array on the GPU of dimension lda*n.

  The factors L_i and U_i of the factorization A_i = P_i*L_i*U_i returned by *getrfBatched*.
- **lda** – **[in]** int. lda >= n.

  The leading dimension of matrices A_i.
- **ipiv** – **[in]** pointer to int. Array on the GPU.

  Contains the vectors ipiv_i of pivot indices returned by *getrfBatched*.
- **B** – **[inout]** Array of pointers to type. Each pointer points to an array on the GPU of dimension ldb*nrhs.

  On entry, the right hand side matrices B_i. On exit, the solution matrix X_i of each system in the batch.
- **ldb** – **[in]** int. ldb >= n.

  The leading dimension of matrices B_i.
- **info** – **[out]** pointer to a int on the host.

  If info = 0, successful exit. If info = j < 0, the argument at position -j is invalid.
- **batchCount** – **[in]** int. batchCount >= 0.

  Number of instances (systems) in the batch.

hipblasStatus_t **hipblasSgetrsStridedBatched**(*hipblasHandle_t* handle, const *hipblasOperation_t* trans, const int n, const int nrhs, float *A, const int lda, const *hipblasStride* strideA, const int *ipiv, const *hipblasStride* strideP, float *B, const int ldb, const *hipblasStride* strideB, int *info, const int batchCount)

hipblasStatus_t **hipblasDgetrsStridedBatched**(*hipblasHandle_t* handle, const *hipblasOperation_t* trans, const int n, const int nrhs, double *A, const int lda, const *hipblasStride* strideA, const int *ipiv, const *hipblasStride* strideP, double *B, const int ldb, const *hipblasStride* strideB, int *info, const int batchCount)

hipblasStatus_t **hipblasCgetrsStridedBatched**(*hipblasHandle_t* handle, const *hipblasOperation_t* trans, const int n, const int nrhs, *hipblasComplex* *A, const int lda, const *hipblasStride* strideA, const int *ipiv, const *hipblasStride* strideP, *hipblasComplex* *B, const int ldb, const *hipblasStride* strideB, int *info, const int batchCount)

hipblasStatus_t **hipblasZgetrsStridedBatched**(*hipblasHandle_t* handle, const *hipblasOperation_t* trans, const int n, const int nrhs, *hipblasDoubleComplex* *A, const int lda, const *hipblasStride* strideA, const int *ipiv, const *hipblasStride* strideP, *hipblasDoubleComplex* *B, const int ldb, const *hipblasStride* strideB, int *info, const int batchCount)

SOLVER API.

getrsStridedBatched solves a batch of systems of n linear equations on n variables in its factorized forms.

For each instance i in the batch, it solves one of the following systems, depending on the value of trans:

$$\begin{array}{cl} A_i X_i = B_i & \text{not transposed,} \\ A_i^T X_i = B_i & \text{transposed, or} \\ A_i^H X_i = B_i & \text{conjugate transposed.} \end{array}$$

Matrix A_i is defined by its triangular factors as returned by *getrfStridedBatched*.

- Supported precisions in rocSOLVER : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** hipblasHandle_t.
- **trans** – **[in]** hipblasOperation_t.

  Specifies the form of the system of equations of each instance in the batch.
- **n** – **[in]** int. n >= 0.

  The order of the system, i.e. the number of columns and rows of all A_i matrices.
- **nrhs** – **[in]** int. nrhs >= 0.

  The number of right hand sides, i.e., the number of columns of all the matrices B_i.
- **A** – **[in]** pointer to type. Array on the GPU (the size depends on the value of strideA).

  The factors L_i and U_i of the factorization A_i = P_i*L_i*U_i returned by *getrfStrided-Batched*.
- **lda** – **[in]** int. lda >= n.

  The leading dimension of matrices A_i.
- **strideA** – **[in]** hipblasStride.

  Stride from the start of one matrix A_i to the next one A_(i+1). There is no restriction for the value of strideA. Normal use case is strideA >= lda*n.
- **ipiv** – **[in]** pointer to int. Array on the GPU (the size depends on the value of strideP).

  Contains the vectors ipiv_i of pivot indices returned by *getrfStridedBatched*.
- **strideP** – **[in]** hipblasStride.

  Stride from the start of one vector ipiv_i to the next one ipiv_(i+1). There is no restriction for the value of strideP. Normal use case is strideP >= n.
- **B** – **[inout]** pointer to type. Array on the GPU (size depends on the value of strideB).

  On entry, the right hand side matrices B_i. On exit, the solution matrix X_i of each system in the batch.
- **ldb** – **[in]** int. ldb >= n.

  The leading dimension of matrices B_i.

- **strideB** – **[in]** hipblasStride.

  Stride from the start of one matrix B_i to the next one B_(i+1). There is no restriction for the value of strideB. Normal use case is strideB >= ldb*nrhs.

- **info** – **[out]** pointer to a int on the host.

  If info = 0, successful exit. If info = j < 0, the argument at position -j is invalid.

- **batchCount** – **[in]** int. batchCount >= 0.

  Number of instances (systems) in the batch.

1.9.4.3 hipblasXgetri + Batched, stridedBatched

hipblasStatus_t **hipblasSgetriBatched**(*hipblasHandle_t* handle, const int n, float *const A[], const int lda, int *ipiv, float *const C[], const int ldc, int *info, const int batchCount)

hipblasStatus_t **hipblasDgetriBatched**(*hipblasHandle_t* handle, const int n, double *const A[], const int lda, int *ipiv, double *const C[], const int ldc, int *info, const int batchCount)

hipblasStatus_t **hipblasCgetriBatched**(*hipblasHandle_t* handle, const int n, *hipblasComplex* *const A[], const int lda, int *ipiv, *hipblasComplex* *const C[], const int ldc, int *info, const int batchCount)

hipblasStatus_t **hipblasZgetriBatched**(*hipblasHandle_t* handle, const int n, *hipblasDoubleComplex* *const A[], const int lda, int *ipiv, *hipblasDoubleComplex* *const C[], const int ldc, int *info, const int batchCount)

SOLVER API.

getriBatched computes the inverse $C_i = A_i^{-1}$ of a batch of general n-by-n matrices A_i.

The inverse is computed by solving the linear system

$$A_i C_i = I$$

where I is the identity matrix, and A_i is factorized as $A_i = P_i L_i U_i$ as given by *getrfBatched*.

- Supported precisions in rocSOLVER : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** hipblasHandle_t.
- **n** – **[in]** int. n >= 0.

  The number of rows and columns of all matrices A_i in the batch.

- **A** – **[in]** array of pointers to type. Each pointer points to an array on the GPU of dimension lda*n.

  The factors L_i and U_i of the factorization A_i = P_i*L_i*U_i returned by *getrfBatched*.

- **lda** – **[in]** int. lda >= n.

  Specifies the leading dimension of matrices A_i.

- **ipiv** – **[in]** pointer to int. Array on the GPU (the size depends on the value of strideP).

  The pivot indices returned by *getrfBatched*. ipiv can be passed in as a nullptr, this will assume that getrfBatched was called without partial pivoting.

- **C** – **[out]** array of pointers to type. Each pointer points to an array on the GPU of dimension ldc*n.

  If info[i] = 0, the inverse of matrices A_i. Otherwise, undefined.

- **ldc** – **[in]** int. ldc >= n.

  Specifies the leading dimension of C_i.

- **info** – **[out]** pointer to int. Array of batchCount integers on the GPU.

  If info[i] = 0, successful exit for inversion of A_i. If info[i] = j > 0, U_i is singular. U_i[j,j] is the first zero pivot.

- **batchCount** – **[in]** int. batchCount >= 0.

  Number of matrices in the batch.

1.9.4.4 hipblasXgeqrf + Batched, stridedBatched

hipblasStatus_t **hipblasSgeqrf**(*hipblasHandle_t* handle, const int m, const int n, float *A, const int lda, float *ipiv, int *info)

hipblasStatus_t **hipblasDgeqrf**(*hipblasHandle_t* handle, const int m, const int n, double *A, const int lda, double *ipiv, int *info)

hipblasStatus_t **hipblasCgeqrf**(*hipblasHandle_t* handle, const int m, const int n, *hipblasComplex* *A, const int lda, *hipblasComplex* *ipiv, int *info)

hipblasStatus_t **hipblasZgeqrf**(*hipblasHandle_t* handle, const int m, const int n, *hipblasDoubleComplex* *A, const int lda, *hipblasDoubleComplex* *ipiv, int *info)

SOLVER API.

geqrf computes a QR factorization of a general m-by-n matrix A.

The factorization has the form

$$A = Q \begin{bmatrix} R \\ 0 \end{bmatrix}$$

where R is upper triangular (upper trapezoidal if m < n), and Q is a m-by-m orthogonal/unitary matrix represented as the product of Householder matrices

$$Q = H_1 H_2 \cdots H_k, \quad \text{with } k = \text{min}(m, n)$$

Each Householder matrix H_i is given by

$$H_i = I - \text{ipiv}[i] \cdot v_i v_i'$$

where the first i-1 elements of the Householder vector v_i are zero, and $v_i[i] = 1$.

- Supported precisions in rocSOLVER : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** hipblasHandle_t.
- **m** – **[in]** int. m >= 0.

  The number of rows of the matrix A.
- **n** – **[in]** int. n >= 0.

  The number of columns of the matrix A.
- **A** – **[inout]** pointer to type. Array on the GPU of dimension lda*n.

  On entry, the m-by-n matrix to be factored. On exit, the elements on and above the diagonal contain the factor R; the elements below the diagonal are the last m - i elements of Householder vector v_i.
- **lda** – **[in]** int. lda >= m.

  Specifies the leading dimension of A.
- **ipiv** – **[out]** pointer to type. Array on the GPU of dimension min(m,n).

  The Householder scalars.
- **info** – **[out]** pointer to a int on the host.

  If info = 0, successful exit. If info = j < 0, the argument at position -j is invalid.

hipblasStatus_t **hipblasSgeqrfBatched**(*hipblasHandle_t* handle, const int m, const int n, float *const A[], const int lda, float *const ipiv[], int *info, const int batchCount)

hipblasStatus_t **hipblasDgeqrfBatched**(*hipblasHandle_t* handle, const int m, const int n, double *const A[], const int lda, double *const ipiv[], int *info, const int batchCount)

hipblasStatus_t **hipblasCgeqrfBatched**(*hipblasHandle_t* handle, const int m, const int n, *hipblasComplex* *const A[], const int lda, *hipblasComplex* *const ipiv[], int *info, const int batchCount)

hipblasStatus_t **hipblasZgeqrfBatched**(*hipblasHandle_t* handle, const int m, const int n, *hipblasDoubleComplex* *const A[], const int lda, *hipblasDoubleComplex* *const ipiv[], int *info, const int batchCount)

SOLVER API.

geqrfBatched computes the QR factorization of a batch of general m-by-n matrices.

The factorization of matrix A_i in the batch has the form

$$A_i = Q_i \begin{bmatrix} R_i \\ 0 \end{bmatrix}$$

where R_i is upper triangular (upper trapezoidal if m < n), and Q_i is a m-by-m orthogonal/unitary matrix represented as the product of Householder matrices

$$Q_i = H_{i_1} H_{i_2} \cdots H_{i_k}, \quad \text{with } k = \text{min}(m, n)$$

Each Householder matrix H_{i_j} is given by

$$H_{i_j} = I - \text{ipiv}_i[j] \cdot v_{i_j} v_{i_j}'$$

where the first j-1 elements of Householder vector v_{i_j} are zero, and $v_{i_j}[j] = 1$.

- Supported precisions in rocSOLVER : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z

Parameters

- **handle** – **[in]** hipblasHandle_t.
- **m** – **[in]** int. m >= 0.

  The number of rows of all the matrices A_i in the batch.
- **n** – **[in]** int. n >= 0.

  The number of columns of all the matrices A_i in the batch.
- **A** – **[inout]** Array of pointers to type. Each pointer points to an array on the GPU of dimension lda*n.

  On entry, the m-by-n matrices A_i to be factored. On exit, the elements on and above the diagonal contain the factor R_i. The elements below the diagonal are the last m - j elements of Householder vector v_(i_j).
- **lda** – **[in]** int. lda >= m.

  Specifies the leading dimension of matrices A_i.
- **ipiv** – **[out]** array of pointers to type. Each pointer points to an array on the GPU of dimension min(m, n).

  Contains the vectors ipiv_i of corresponding Householder scalars.
- **info** – **[out]** pointer to a int on the host.

  If info = 0, successful exit. If info = j < 0, the argument at position -j is invalid.
- **batchCount** – **[in]** int. batchCount >= 0.

  Number of matrices in the batch.

hipblasStatus_t **hipblasSgeqrfStridedBatched**(*hipblasHandle_t* handle, const int m, const int n, float *A, const int lda, const *hipblasStride* strideA, float *ipiv, const *hipblasStride* strideP, int *info, const int batchCount)

hipblasStatus_t **hipblasDgeqrfStridedBatched**(*hipblasHandle_t* handle, const int m, const int n, double *A, const int lda, const *hipblasStride* strideA, double *ipiv, const *hipblasStride* strideP, int *info, const int batchCount)

hipblasStatus_t **hipblasCgeqrfStridedBatched**(*hipblasHandle_t* handle, const int m, const int n, *hipblasComplex* *A, const int lda, const *hipblasStride* strideA, *hipblasComplex* *ipiv, const *hipblasStride* strideP, int *info, const int batchCount)

hipblasStatus_t **hipblasZgeqrfStridedBatched**(*hipblasHandle_t* handle, const int m, const int n, *hipblasDoubleComplex* *A, const int lda, const *hipblasStride* strideA, *hipblasDoubleComplex* *ipiv, const *hipblasStride* strideP, int *info, const int batchCount)

SOLVER API.

geqrfStridedBatched computes the QR factorization of a batch of general m-by-n matrices.

The factorization of matrix A_i in the batch has the form

$$A_i = Q_i \begin{bmatrix} R_i \\ 0 \end{bmatrix}$$

where R_i is upper triangular (upper trapezoidal if m < n), and Q_i is a m-by-m orthogonal/unitary matrix represented as the product of Householder matrices

$$Q_i = H_{i_1} H_{i_2} \cdots H_{i_k}, \quad \text{with } k = \text{min}(m, n)$$

Each Householder matrix H_{i_j} is given by

$$H_{i_j} = I - \text{ipiv}_j[j] \cdot v_{i_j} v_{i_j}'$$

where the first j-1 elements of Householder vector v_{i_j} are zero, and $v_{i_j}[j] = 1$.

- Supported precisions in rocSOLVER : s,d,c,z
- Supported precisions in cuBLAS : No support

Parameters

- **handle** – **[in]** hipblasHandle_t.
- **m** – **[in]** int. m >= 0.

  The number of rows of all the matrices A_i in the batch.

- **n** – **[in]** int. n >= 0.

  The number of columns of all the matrices A_i in the batch.

- **A** – **[inout]** pointer to type. Array on the GPU (the size depends on the value of strideA).

  On entry, the m-by-n matrices A_i to be factored. On exit, the elements on and above the diagonal contain the factor R_i. The elements below the diagonal are the last m - j elements of Householder vector v_(i_j).

- **lda** – **[in]** int. lda >= m.

  Specifies the leading dimension of matrices A_i.

- **strideA** – **[in]** hipblasStride.

  Stride from the start of one matrix A_i to the next one A_(i+1). There is no restriction for the value of strideA. Normal use case is strideA >= lda*n.

- **ipiv** – **[out]** pointer to type. Array on the GPU (the size depends on the value of strideP).

  Contains the vectors ipiv_i of corresponding Householder scalars.

- **strideP** – **[in]** hipblasStride.

  Stride from the start of one vector ipiv_i to the next one ipiv_(i+1). There is no restriction for the value of strideP. Normal use is strideP >= min(m,n).

- **info** – **[out]** pointer to a int on the host.

  If info = 0, successful exit. If info = j < 0, the argument at position -j is invalid.

- **batchCount** – **[in]** int. batchCount >= 0.

  Number of matrices in the batch.

1.9.4.5 hipblasXgels + Batched, StridedBatched

hipblasStatus_t **hipblasSgels**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, const int m, const int n, const int nrhs, float *A, const int lda, float *B, const int ldb, int *info, int *deviceInfo)

hipblasStatus_t **hipblasDgels**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, const int m, const int n, const int nrhs, double *A, const int lda, double *B, const int ldb, int *info, int *deviceInfo)

hipblasStatus_t **hipblasCgels**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, const int m, const int n, const int nrhs, *hipblasComplex* *A, const int lda, *hipblasComplex* *B, const int ldb, int *info, int *deviceInfo)

hipblasStatus_t **hipblasZgels**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, const int m, const int n, const int nrhs, *hipblasDoubleComplex* *A, const int lda, *hipblasDoubleComplex* *B, const int ldb, int *info, int *deviceInfo)

GELS solves an overdetermined (or underdetermined) linear system defined by an m-by-n matrix A, and a corresponding matrix B, using the QR factorization computed by *GEQRF* (or the LQ factorization computed by "GELQF").

Depending on the value of trans, the problem solved by this function is either of the form

$$\begin{array}{ll} AX = B & \text{not transposed, or} \\ A'X = B & \text{transposed if real, or conjugate transposed if complex} \end{array}$$

If m >= n (or m < n in the case of transpose/conjugate transpose), the system is overdetermined and a least-squares solution approximating X is found by minimizing

$$||B - AX|| \quad \text{(or } ||B - A'X||\text{)}$$

If m < n (or m >= n in the case of transpose/conjugate transpose), the system is underdetermined and a unique solution for X is chosen such that $||X||$ is minimal.

- Supported precisions in rocSOLVER : s,d,c,z
- Supported precisions in cuBLAS : currently unsupported

Parameters

- **`handle`** – **[in]** hipblasHandle_t.
- **`trans`** – **[in]** hipblasOperation_t.

  Specifies the form of the system of equations.
- **`m`** – **[in]** int. m >= 0.

  The number of rows of matrix A.
- **`n`** – **[in]** int. n >= 0.

  The number of columns of matrix A.
- **`nrhs`** – **[in]** int. nrhs >= 0.

  The number of columns of matrices B and X; i.e., the columns on the right hand side.
- **`A`** – **[inout]** pointer to type. Array on the GPU of dimension lda*n.

  On entry, the matrix A. On exit, the QR (or LQ) factorization of A as returned by "GEQRF" (or "GELQF").
- **`lda`** – **[in]** int. lda >= m.

  Specifies the leading dimension of matrix A.
- **`B`** – **[inout]** pointer to type. Array on the GPU of dimension ldb*nrhs.

  On entry, the matrix B. On exit, when info = 0, B is overwritten by the solution vectors (and the residuals in the overdetermined cases) stored as columns.
- **`ldb`** – **[in]** int. ldb >= max(m,n).

  Specifies the leading dimension of matrix B.
- **`info`** – **[out]** pointer to an int on the host.

  If info = 0, successful exit. If info = j < 0, the argument at position -j is invalid.
- **`deviceInfo`** – **[out]** pointer to int on the GPU.

  If info = 0, successful exit. If info = i > 0, the solution could not be computed because input matrix A is rank deficient; the i-th diagonal element of its triangular factor is zero.

hipblasStatus_t **`hipblasSgelsBatched`**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, const int m, const int n, const int nrhs, float *const A[], const int lda, float *const B[], const int ldb, int *info, int *deviceInfo, const int batchCount) *hipblasStatus_t* **hipblasDgelsBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, const int m, const int n, const int nrhs, double *const A[], const int lda, double *const B[], const int ldb, int *info, int *deviceInfo, const int batchCount)

hipblasStatus_t **hipblasCgelsBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, const int m, const int n, const int nrhs, *hipblasComplex* *const A[], const int lda, *hipblasComplex* *const B[], const int ldb, int *info, int *deviceInfo, const int batchCount)

hipblasStatus_t **hipblasZgelsBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, const int m, const int n, const int nrhs, *hipblasDoubleComplex* *const A[], const int lda, *hipblasDoubleComplex* *const B[], const int ldb, int *info, int *deviceInfo, const int batchCount)

gelsBatched solves a batch of overdetermined (or underdetermined) linear systems defined by a set of m-by-n matrices A_j, and corresponding matrices B_j, using the QR factorizations computed by "GEQRF_BATCHED" (or the LQ factorizations computed by "GELQF_BATCHED").

For each instance in the batch, depending on the value of trans, the problem solved by this function is either of the form

$$\begin{array}{ll} A_j X_j = B_j & \text{not transposed, or} \\ A_j' X_j = B_j & \text{transposed if real, or conjugate transposed if complex} \end{array}$$

If m >= n (or m < n in the case of transpose/conjugate transpose), the system is overdetermined and a least-squares solution approximating X_j is found by minimizing

$$||B_j - A_j X_j|| \quad \text{(or } ||B_j - A_j' X_j||\text{)}$$

If m < n (or m >= n in the case of transpose/conjugate transpose), the system is underdetermined and a unique solution for X_j is chosen such that $||X_j||$ is minimal.

- Supported precisions in rocSOLVER : s,d,c,z
- Supported precisions in cuBLAS : s,d,c,z Note that cuBLAS backend supports only the non-transpose operation and only solves over-determined systems (m >= n).

Parameters

- **handle** – **[in]** hipblasHandle_t.
- **trans** – **[in]** hipblasOperation_t.

  Specifies the form of the system of equations.
- **m** – **[in]** int. m >= 0.

  The number of rows of all matrices A_j in the batch.
- **n** – **[in]** int. n >= 0.

  The number of columns of all matrices A_j in the batch.
- **nrhs** – **[in]** int. nrhs >= 0.

  The number of columns of all matrices B_j and X_j in the batch; i.e., the columns on the right hand side.

- **A** – **[inout]** array of pointer to type. Each pointer points to an array on the GPU of dimension lda*n.

  On entry, the matrices A_j. On exit, the QR (or LQ) factorizations of A_j as returned by "GEQRF_BATCHED" (or "GELQF_BATCHED").

- **lda** – **[in]** int. lda >= m.

  Specifies the leading dimension of matrices A_j.

- **B** – **[inout]** array of pointer to type. Each pointer points to an array on the GPU of dimension ldb*nrhs.

  On entry, the matrices B_j. On exit, when info[j] = 0, B_j is overwritten by the solution vectors (and the residuals in the overdetermined cases) stored as columns.

- **ldb** – **[in]** int. ldb >= max(m,n).

  Specifies the leading dimension of matrices B_j.

- **info** – **[out]** pointer to an int on the host.

  If info = 0, successful exit. If info = j < 0, the argument at position -j is invalid.

- **deviceInfo** – **[out]** pointer to int. Array of batchCount integers on the GPU.

  If deviceInfo[j] = 0, successful exit for solution of A_j. If deviceInfo[j] = i > 0, the solution of A_j could not be computed because input matrix A_j is rank deficient; the i-th diagonal element of its triangular factor is zero.

- **batchCount** – **[in]** int. batchCount >= 0.

  Number of matrices in the batch.

hipblasStatus_t **hipblasSgelsStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, const int m, const int n, const int nrhs, float *A, const int lda, const *hipblasStride* strideA, float *B, const int ldb, const *hipblasStride* strideB, int *info, int *deviceInfo, const int batch_count)

hipblasStatus_t **hipblasDgelsStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, const int m, const int n, const int nrhs, double *A, const int lda, const *hipblasStride* strideA, double *B, const int ldb, const *hipblasStride* strideB, int *info, int *deviceInfo, const int batch_count)

hipblasStatus_t **hipblasCgelsStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, const int m, const int n, const int nrhs, *hipblasComplex* *A, const int lda, const *hipblasStride* strideA, *hipblasComplex* *B, const int ldb, const *hipblasStride* strideB, int *info, int *deviceInfo, const int batch_count)

hipblasStatus_t **hipblasZgelsStridedBatched**(*hipblasHandle_t* handle, *hipblasOperation_t* trans, const int m, const int n, const int nrhs, *hipblasDoubleComplex* *A, const int lda, const *hipblasStride* strideA, *hipblasDoubleComplex* *B, const int ldb, const *hipblasStride* strideB, int *info, int *deviceInfo, const int batch_count)

gelsStridedBatched solves a batch of overdetermined (or underdetermined) linear systems defined by a set of m-by-n matrices A_j, and corresponding matrices B_j, using the QR factorizations computed by "GEQRF_STRIDED_BATCHED" (or the LQ factorizations computed by "GELQF_STRIDED_BATCHED").

For each instance in the batch, depending on the value of trans, the problem solved by this function is either of the form

$$\begin{array}{ll} A_j X_j = B_j & \text{not transposed, or} \\ A_j' X_j = B_j & \text{transposed if real, or conjugate transposed if complex} \end{array}$$

If m >= n (or m < n in the case of transpose/conjugate transpose), the system is overdetermined and a least-squares solution approximating X_j is found by minimizing

$$||B_j - A_j X_j|| \quad \text{(or } ||B_j - A_j' X_j||\text{)}$$

If m < n (or m >= n in the case of transpose/conjugate transpose), the system is underdetermined and a unique solution for X_j is chosen such that $||X_j||$ is minimal.

- Supported precisions in rocSOLVER : s,d,c,z
- Supported precisions in cuBLAS : currently unsupported

Parameters

- `handle` – **[in]** hipblasHandle_t.
- `trans` – **[in]** hipblasOperation_t.

  Specifies the form of the system of equations.
- `m` – **[in]** int. m >= 0.

  The number of rows of all matrices A_j in the batch.
- `n` – **[in]** int. n >= 0.

  The number of columns of all matrices A_j in the batch.
- `nrhs` – **[in]** int. nrhs >= 0.

  The number of columns of all matrices B_j and X_j in the batch; i.e., the columns on the right hand side.
- `A` – **[inout]** pointer to type. Array on the GPU (the size depends on the value of strideA).

  On entry, the matrices A_j. On exit, the QR (or LQ) factorizations of A_j as returned by "GEQRF_STRIDED_BATCHED" (or "GELQF_STRIDED_BATCHED").
- `lda` – **[in]** int. lda >= m.

  Specifies the leading dimension of matrices A_j.
- `strideA` – **[in]** hipblasStride.

  Stride from the start of one matrix A_j to the next one A_(j+1). There is no restriction for the value of strideA. Normal use case is strideA >= lda*n
- `B` – **[inout]** pointer to type. Array on the GPU (the size depends on the value of strideB).

  On entry, the matrices B_j. On exit, when info[j] = 0, each B_j is overwritten by the solution vectors (and the residuals in the overdetermined cases) stored as columns.

- **ldb** – **[in]** int. ldb >= max(m,n).

  Specifies the leading dimension of matrices B_j.

- **strideB** – **[in]** hipblasStride.

  Stride from the start of one matrix B_j to the next one B_(j+1). There is no restriction for the value of strideB. Normal use case is strideB >= ldb*nrhs

- **info** – **[out]** pointer to an int on the host.

  If info = 0, successful exit. If info = j < 0, the argument at position -j is invalid.

- **deviceInfo** – **[out]** pointer to int. Array of batchCount integers on the GPU.

  If deviceInfo[j] = 0, successful exit for solution of A_j. If deviceInfo[j] = i > 0, the solution of A_j could not be computed because input matrix A_j is rank deficient; the i-th diagonal element of its triangular factor is zero.

- **batchCount** – **[in]** int. batchCount >= 0.

  Number of matrices in the batch.

1.9.5 BLAS Extensions

List of BLAS Extension Functions

- *hipblasGemmEx + Batched, StridedBatched*
- *hipblasTrsmEx + Batched, StridedBatched*
- *hipblasAxpyEx + Batched, StridedBatched*
- *hipblasDotEx + Batched, StridedBatched*
- *hipblasDotcEx + Batched, StridedBatched*
- *hipblasNrm2Ex + Batched, StridedBatched*
- *hipblasRotEx + Batched, StridedBatched*
- *hipblasScalEx + Batched, StridedBatched*

1.9.5.1 hipblasGemmEx + Batched, StridedBatched

hipblasStatus_t **hipblasGemmEx**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const void *alpha, const void *A, *hipblasDatatype_t* aType, int lda, const void *B, *hipblasDatatype_t* bType, int ldb, const void *beta, void *C, *hipblasDatatype_t* cType, int ldc, *hipblasDatatype_t* computeType, *hipblasGemmAlgo_t* algo)

BLAS EX API.

gemmEx performs one of the matrix-matrix operations

```
C = alpha*op( A )*op( B ) + beta*C,
```

where op(X) is one of

```
op( X ) = X      or
op( X ) = X**T   or
op( X ) = X**H,
```

alpha and beta are scalars, and A, B, and C are matrices, with op(A) an m by k matrix, op(B) a k by n matrix and C is a m by n matrix.

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.

Note for int8 users - For rocBLAS backend, please read rocblas_gemm_ex documentation on int8 data layout requirements. hipBLAS makes the assumption that the data layout is in the preferred format for a given device as documented in rocBLAS.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **transA** – **[in]** [hipblasOperation_t] specifies the form of op(A).
- **transB** – **[in]** [hipblasOperation_t] specifies the form of op(B).
- **m** – **[in]** [int] matrix dimension m.
- **n** – **[in]** [int] matrix dimension n.
- **k** – **[in]** [int] matrix dimension k.
- **alpha** – **[in]** [const void *] device pointer or host pointer specifying the scalar alpha. Same datatype as computeType.
- **A** – **[in]** [void *] device pointer storing matrix A.
- **aType** – **[in]** [hipblasDatatype_t] specifies the datatype of matrix A.
- **lda** – **[in]** [int] specifies the leading dimension of A.
- **B** – **[in]** [void *] device pointer storing matrix B.
- **bType** – **[in]** [hipblasDatatype_t] specifies the datatype of matrix B.
- **ldb** – **[in]** [int] specifies the leading dimension of B.
- **beta** – **[in]** [const void *] device pointer or host pointer specifying the scalar beta. Same datatype as computeType.
- **C** – **[in]** [void *] device pointer storing matrix C.
- **cType** – **[in]** [hipblasDatatype_t] specifies the datatype of matrix C.
- **ldc** – **[in]** [int] specifies the leading dimension of C.
- **computeType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.
- **algo** – **[in]** [hipblasGemmAlgo_t] enumerant specifying the algorithm type.

hipblasStatus_t **hipblasGemmBatchedEx**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const void *alpha, const void *A[], *hipblasDatatype_t* aType, int lda, const void *B[], *hipblasDatatype_t* bType, int ldb, const void *beta, void *C[], *hipblasDatatype_t* cType, int ldc, int batchCount, *hipblasDatatype_t* computeType, *hipblasGemmAlgo_t* algo)

BLAS EX API.

gemmBatchedEx performs one of the batched matrix-matrix operations C_i = alpha*op(A_i)*op(B_i) + beta*C_i, for i = 1, …, batchCount. where op(X) is one of op(X) = X or op(X) = X**T or op(X) = X**H, alpha and beta are scalars, and A, B, and C are batched pointers to matrices, with op(A) an m by k by batchCount batched matrix, op(B) a k by n by batchCount batched matrix and C a m by n by batchCount batched matrix. The batched matrices are an array of pointers to matrices. The number of pointers to matrices is batchCount.

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.

Note for int8 users - For rocBLAS backend, please read rocblas_gemm_batched_ex documentation on int8 data layout requirements. hipBLAS makes the assumption that the data layout is in the preferred format for a given device as documented in rocBLAS.

Parameters

- `handle` – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- `transA` – **[in]** [hipblasOperation_t] specifies the form of op(A).
- `transB` – **[in]** [hipblasOperation_t] specifies the form of op(B).
- `m` – **[in]** [int] matrix dimension m.
- `n` – **[in]** [int] matrix dimension n.
- `k` – **[in]** [int] matrix dimension k.
- `alpha` – **[in]** [const void *] device pointer or host pointer specifying the scalar alpha. Same datatype as computeType.
- `A` – **[in]** [void *] device pointer storing array of pointers to each matrix A_i.
- `aType` – **[in]** [hipblasDatatype_t] specifies the datatype of each matrix A_i.
- `lda` – **[in]** [int] specifies the leading dimension of each A_i.
- `B` – **[in]** [void *] device pointer storing array of pointers to each matrix B_i.
- `bType` – **[in]** [hipblasDatatype_t] specifies the datatype of each matrix B_i.
- `ldb` – **[in]** [int] specifies the leading dimension of each B_i.
- `beta` – **[in]** [const void *] device pointer or host pointer specifying the scalar beta. Same datatype as computeType.
- `C` – **[in]** [void *] device array of device pointers to each matrix C_i.
- `cType` – **[in]** [hipblasDatatype_t] specifies the datatype of each matrix C_i.
- `ldc` – **[in]** [int] specifies the leading dimension of each C_i.
- `batchCount` – **[in]** [int] number of gemm operations in the batch.
- `computeType` – **[in]** [hipblasDatatype_t] specifies the datatype of computation.
- `algo` – **[in]** [hipblasGemmAlgo_t] enumerant specifying the algorithm type.

hipblasStatus_t **hipblasGemmStridedBatchedEx**(*hipblasHandle_t* handle, *hipblasOperation_t* transA, *hipblasOperation_t* transB, int m, int n, int k, const void *alpha, const void *A, *hipblasDatatype_t* aType, int lda, *hipblasStride* strideA, const void *B, *hipblasDatatype_t* bType, int ldb, *hipblasStride* strideB, const void *beta, void *C, *hipblasDatatype_t* cType, int ldc, *hipblasStride* strideC, int batchCount, *hipblasDatatype_t* computeType, *hipblasGemmAlgo_t* algo)

BLAS EX API.

gemmStridedBatchedEx performs one of the strided_batched matrix-matrix operations

```
C_i = alpha*op(A_i)*op(B_i) + beta*C_i, for i = 1, ..., batchCount
```

where op(X) is one of

```
op( X ) = X      or
op( X ) = X**T   or
op( X ) = X**H,
```

alpha and beta are scalars, and A, B, and C are strided_batched matrices, with op(A) an m by k by batchCount strided_batched matrix, op(B) a k by n by batchCount strided_batched matrix and C a m by n by batchCount strided_batched matrix.

The strided_batched matrices are multiple matrices separated by a constant stride. The number of matrices is batchCount.

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.

Note for int8 users - For rocBLAS backend, please read rocblas_gemm_strided_batched_ex documentation on int8 data layout requirements. hipBLAS makes the assumption that the data layout is in the preferred format for a given device as documented in rocBLAS.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **transA** – **[in]** [hipblasOperation_t] specifies the form of op(A).
- **transB** – **[in]** [hipblasOperation_t] specifies the form of op(B).
- **m** – **[in]** [int] matrix dimension m.
- **n** – **[in]** [int] matrix dimension n.
- **k** – **[in]** [int] matrix dimension k.
- **alpha** – **[in]** [const void *] device pointer or host pointer specifying the scalar alpha. Same datatype as computeType.
- **A** – **[in]** [void *] device pointer pointing to first matrix A_1.
- **aType** – **[in]** [hipblasDatatype_t] specifies the datatype of each matrix A_i.
- **lda** – **[in]** [int] specifies the leading dimension of each A_i.
- **strideA** – **[in]** [hipblasStride] specifies stride from start of one A_i matrix to the next A_(i + 1).
- **B** – **[in]** [void *] device pointer pointing to first matrix B_1.
- **bType** – **[in]** [hipblasDatatype_t] specifies the datatype of each matrix B_i.

- **ldb** – **[in]** [int] specifies the leading dimension of each B_i.
- **strideB** – **[in]** [hipblasStride] specifies stride from start of one B_i matrix to the next B_(i + 1).
- **beta** – **[in]** [const void *] device pointer or host pointer specifying the scalar beta. Same datatype as computeType.
- **C** – **[in]** [void *] device pointer pointing to first matrix C_1.
- **cType** – **[in]** [hipblasDatatype_t] specifies the datatype of each matrix C_i.
- **ldc** – **[in]** [int] specifies the leading dimension of each C_i.
- **strideC** – **[in]** [hipblasStride] specifies stride from start of one C_i matrix to the next C_(i + 1).
- **batchCount** – **[in]** [int] number of gemm operations in the batch.
- **computeType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.
- **algo** – **[in]** [hipblasGemmAlgo_t] enumerant specifying the algorithm type.

1.9.5.2 hipblasTrsmEx + Batched, StridedBatched

hipblasStatus_t **hipblasTrsmEx**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const void *alpha, void *A, int lda, void *B, int ldb, const void *invA, int invAsize, *hipblasDatatype_t* computeType)

BLAS EX API

trsmEx solves

```
op(A)*X = alpha*B or X*op(A) = alpha*B,
```

where alpha is a scalar, X and B are m by n matrices, A is triangular matrix and op(A) is one of

```
op( A ) = A   or   op( A ) = A^T   or   op( A ) = A^H.
```

The matrix X is overwritten on B.

This function gives the user the ability to reuse the invA matrix between runs. If invA == NULL, hipblasTrsmEx will automatically calculate invA on every run.

Setting up invA: The accepted invA matrix consists of the packed 128x128 inverses of the diagonal blocks of matrix A, followed by any smaller diagonal block that remains. To set up invA it is recommended that hipblasTrtriBatched be used with matrix A as the input.

Device memory of size 128 x k should be allocated for invA ahead of time, where k is m when HIPBLAS_SIDE_LEFT and is n when HIPBLAS_SIDE_RIGHT. The actual number of elements in invA should be passed as invAsize.

To begin, hipblasTrtriBatched must be called on the full 128x128 sized diagonal blocks of matrix A. Below are the restricted parameters:

- n = 128
- ldinvA = 128
- stride_invA = 128x128
- batchCount = k / 128,

Then any remaining block may be added:

- n = k % 128
- invA = invA + stride_invA * previousBatchCount
- ldinvA = 128
- batchCount = 1

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **side** – **[in]** [hipblasSideMode_t] HIPBLAS_SIDE_LEFT: op(A)*X = alpha*B. HIPBLAS_SIDE_RIGHT: X*op(A) = alpha*B.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: A is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: A is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_N: op(A) = A. HIPBLAS_OP_T: op(A) = A^T. HIPBLAS_ON_C: op(A) = A^H.
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: A is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: A is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of B. m >= 0.
- **n** – **[in]** [int] n specifies the number of columns of B. n >= 0.
- **alpha** – **[in]** [void *] device pointer or host pointer specifying the scalar alpha. When alpha is &zero then A is not referenced, and B need not be set before entry.
- **A** – **[in]** [void *] device pointer storing matrix A. of dimension (lda, k), where k is m when HIPBLAS_SIDE_LEFT and is n when HIPBLAS_SIDE_RIGHT only the upper/lower triangular part is accessed.
- **lda** – **[in]** [int] lda specifies the first dimension of A. if side = HIPBLAS_SIDE_LEFT, lda >= max(1, m), if side = HIPBLAS_SIDE_RIGHT, lda >= max(1, n).
- **B** – **[inout]** [void *] device pointer storing matrix B. B is of dimension (ldb, n). Before entry, the leading m by n part of the array B must contain the right-hand side matrix B, and on exit is overwritten by the solution matrix X.
- **ldb** – **[in]** [int] ldb specifies the first dimension of B. ldb >= max(1, m).
- **invA** – **[in]** [void *] device pointer storing the inverse diagonal blocks of A. invA is of dimension (ld_invA, k), where k is m when HIPBLAS_SIDE_LEFT and is n when HIPBLAS_SIDE_RIGHT. ld_invA must be equal to 128.
- **invAsize** – **[in]** [int] invAsize specifies the number of elements of device memory in invA.
- **computeType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation

hipblasStatus_t **hipblasTrsmBatchedEx**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const void *alpha, void *A, int lda, void *B, int ldb, int batchCount, const void *invA, int invAsize, *hipblasDatatype_t* computeType)

BLAS EX API

trsmBatchedEx solves

```
op(A_i)*X_i = alpha*B_i or X_i*op(A_i) = alpha*B_i,
```

for i = 1, . . . , batchCount; and where alpha is a scalar, X and B are arrays of m by n matrices, A is an array of triangular matrix and each op(A_i) is one of

```
op( A_i ) = A_i   or   op( A_i ) = A_i^T   or   op( A_i ) = A_i^H.
```

Each matrix X_i is overwritten on B_i.

This function gives the user the ability to reuse the invA matrix between runs. If invA == NULL, hipblasTrsmBatchedEx will automatically calculate each invA_i on every run.

Setting up invA: Each accepted invA_i matrix consists of the packed 128x128 inverses of the diagonal blocks of matrix A_i, followed by any smaller diagonal block that remains. To set up each invA_i it is recommended that hipblasTrtriBatched be used with matrix A_i as the input. invA is an array of pointers of batchCount length holding each invA_i.

Device memory of size 128 x k should be allocated for each invA_i ahead of time, where k is m when HIPBLAS_SIDE_LEFT and is n when HIPBLAS_SIDE_RIGHT. The actual number of elements in each invA_i should be passed as invAsize.

To begin, hipblasTrtriBatched must be called on the full 128x128 sized diagonal blocks of each matrix A_i. Below are the restricted parameters:

- n = 128
- ldinvA = 128
- stride_invA = 128x128
- batchCount = k / 128,

Then any remaining block may be added:

- n = k % 128
- invA = invA + stride_invA * previousBatchCount
- ldinvA = 128
- batchCount = 1

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **side** – **[in]** [hipblasSideMode_t] HIPBLAS_SIDE_LEFT: op(A)*X = alpha*B. HIPBLAS_SIDE_RIGHT: X*op(A) = alpha*B.
- **uplo** – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: each A_i is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: each A_i is a lower triangular matrix.
- **transA** – **[in]** [hipblasOperation_t] HIPBLAS_OP_N: op(A) = A. HIPBLAS_OP_T: op(A) = A^T. HIPBLAS_OP_C: op(A) = A^H.
- **diag** – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: each A_i is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: each A_i is not assumed to be unit triangular.
- **m** – **[in]** [int] m specifies the number of rows of each B_i. m >= 0.
- **n** – **[in]** [int] n specifies the number of columns of each B_i. n >= 0.
- **alpha** – **[in]** [void *] device pointer or host pointer alpha specifying the scalar alpha. When alpha is &zero then A is not referenced, and B need not be set before entry.

- **A** – **[in]** [void *] device array of device pointers storing each matrix A_i. each A_i is of dimension (lda, k), where k is m when HIPBLAS_SIDE_LEFT and is n when HIPBLAS_SIDE_RIGHT only the upper/lower triangular part is accessed.
- **lda** – **[in]** [int] lda specifies the first dimension of each A_i. if side = HIPBLAS_SIDE_LEFT, lda >= max(1, m), if side = HIPBLAS_SIDE_RIGHT, lda >= max(1, n).
- **B** – **[inout]** [void *] device array of device pointers storing each matrix B_i. each B_i is of dimension (ldb, n). Before entry, the leading m by n part of the array B_i must contain the right-hand side matrix B_i, and on exit is overwritten by the solution matrix X_i
- **ldb** – **[in]** [int] ldb specifies the first dimension of each B_i. ldb >= max(1, m).
- **batchCount** – **[in]** [int] specifies how many batches.
- **invA** – **[in]** [void *] device array of device pointers storing the inverse diagonal blocks of each A_i. each invA_i is of dimension (ld_invA, k), where k is m when HIPBLAS_SIDE_LEFT and is n when HIPBLAS_SIDE_RIGHT. ld_invA must be equal to 128.
- **invAsize** – **[in]** [int] invAsize specifies the number of elements of device memory in each invA_i.
- **computeType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation

hipblasStatus_t **hipblasTrsmStridedBatchedEx**(*hipblasHandle_t* handle, *hipblasSideMode_t* side, *hipblasFillMode_t* uplo, *hipblasOperation_t* transA, *hipblasDiagType_t* diag, int m, int n, const void *alpha, void *A, int lda, *hipblasStride* strideA, void *B, int ldb, *hipblasStride* strideB, int batchCount, const void *invA, int invAsize, *hipblasStride* strideInvA, *hipblasDatatype_t* computeType)

BLAS EX API

trsmStridedBatchedEx solves

```
op(A_i)*X_i = alpha*B_i or X_i*op(A_i) = alpha*B_i,
```

for i = 1, . . . , batchCount; and where alpha is a scalar, X and B are strided batched m by n matrices, A is a strided batched triangular matrix and op(A_i) is one of

```
op( A_i ) = A_i    or   op( A_i ) = A_i^T    or   op( A_i ) = A_i^H.
```

Each matrix X_i is overwritten on B_i.

This function gives the user the ability to reuse each invA_i matrix between runs. If invA == NULL, hipblasTrsmStridedBatchedEx will automatically calculate each invA_i on every run.

Setting up invA: Each accepted invA_i matrix consists of the packed 128x128 inverses of the diagonal blocks of matrix A_i, followed by any smaller diagonal block that remains. To set up invA_i it is recommended that hipblasTrtriBatched be used with matrix A_i as the input. invA is a contiguous piece of memory holding each invA_i.

Device memory of size 128 x k should be allocated for each invA_i ahead of time, where k is m when HIPBLAS_SIDE_LEFT and is n when HIPBLAS_SIDE_RIGHT. The actual number of elements in each invA_i should be passed as invAsize.

To begin, hipblasTrtriBatched must be called on the full 128x128 sized diagonal blocks of each matrix A_i. Below are the restricted parameters:

- n = 128

- ldinvA = 128
- stride_invA = 128x128
- batchCount = k / 128,

Then any remaining block may be added:

- n = k % 128
- invA = invA + stride_invA * previousBatchCount
- ldinvA = 128
- batchCount = 1

Parameters

- `handle` – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- `side` – **[in]** [hipblasSideMode_t] HIPBLAS_SIDE_LEFT: op(A)*X = alpha*B. HIPBLAS_SIDE_RIGHT: X*op(A) = alpha*B.
- `uplo` – **[in]** [hipblasFillMode_t] HIPBLAS_FILL_MODE_UPPER: each A_i is an upper triangular matrix. HIPBLAS_FILL_MODE_LOWER: each A_i is a lower triangular matrix.
- `transA` – **[in]** [hipblasOperation_t] HIPBLAS_OP_N: op(A) = A. HIPBLAS_OP_T: op(A) = A^T. HIPBLAS_OP_C: op(A) = A^H.
- `diag` – **[in]** [hipblasDiagType_t] HIPBLAS_DIAG_UNIT: each A_i is assumed to be unit triangular. HIPBLAS_DIAG_NON_UNIT: each A_i is not assumed to be unit triangular.
- `m` – **[in]** [int] m specifies the number of rows of each B_i. m >= 0.
- `n` – **[in]** [int] n specifies the number of columns of each B_i. n >= 0.
- `alpha` – **[in]** [void *] device pointer or host pointer specifying the scalar alpha. When alpha is &zero then A is not referenced, and B need not be set before entry.
- `A` – **[in]** [void *] device pointer storing matrix A. of dimension (lda, k), where k is m when HIPBLAS_SIDE_LEFT and is n when HIPBLAS_SIDE_RIGHT only the upper/lower triangular part is accessed.
- `lda` – **[in]** [int] lda specifies the first dimension of A. if side = HIPBLAS_SIDE_LEFT, lda >= max(1, m), if side = HIPBLAS_SIDE_RIGHT, lda >= max(1, n).
- `strideA` – **[in]** [hipblasStride] The stride between each A matrix.
- `B` – **[inout]** [void *] device pointer pointing to first matrix B_i. each B_i is of dimension (ldb, n). Before entry, the leading m by n part of each array B_i must contain the right-hand side of matrix B_i, and on exit is overwritten by the solution matrix X_i.
- `ldb` – **[in]** [int] ldb specifies the first dimension of each B_i. ldb >= max(1, m).
- `strideB` – **[in]** [hipblasStride] The stride between each B_i matrix.
- `batchCount` – **[in]** [int] specifies how many batches.
- `invA` – **[in]** [void *] device pointer storing the inverse diagonal blocks of each A_i. invA points to the first invA_1. each invA_i is of dimension (ld_invA, k), where k is m when HIPBLAS_SIDE_LEFT and is n when HIPBLAS_SIDE_RIGHT. ld_invA must be equal to 128.
- `invAsize` – **[in]** [int] invAsize specifies the number of elements of device memory in each invA_i.

- **strideInvA** – **[in]** [hipblasStride] The stride between each invA matrix.
- **computeType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation

1.9.5.3 hipblasAxpyEx + Batched, StridedBatched

hipblasStatus_t **hipblasAxpyEx**(*hipblasHandle_t* handle, int n, const void *alpha, *hipblasDatatype_t* alphaType, const void *x, *hipblasDatatype_t* xType, int incx, void *y, *hipblasDatatype_t* yType, int incy, *hipblasDatatype_t* executionType)

BLAS EX API.

axpyEx computes constant alpha multiplied by vector x, plus vector y

```
y := alpha * x + y

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.
```

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in x and y.
- **alpha** – **[in]** device pointer or host pointer to specify the scalar alpha.
- **alphaType** – **[in]** [hipblasDatatype_t] specifies the datatype of alpha.
- **x** – **[in]** device pointer storing vector x.
- **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **y** – **[inout]** device pointer storing vector y.
- **yType** – **[in]** [hipblasDatatype_t] specifies the datatype of vector y.
- **incy** – **[in]** [int] specifies the increment for the elements of y.
- **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

hipblasStatus_t **hipblasAxpyBatchedEx**(*hipblasHandle_t* handle, int n, const void *alpha, *hipblasDatatype_t* alphaType, const void *x, *hipblasDatatype_t* xType, int incx, void *y, *hipblasDatatype_t* yType, int incy, int batchCount, *hipblasDatatype_t* executionType)

BLAS EX API.

axpyBatchedEx computes constant alpha multiplied by vector x, plus vector y over a set of batched vectors.

y := alpha * x + y

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in each x_i and y_i.
- **alpha** – **[in]** device pointer or host pointer to specify the scalar alpha.

- **alphaType** – **[in]** [hipblasDatatype_t] specifies the datatype of alpha.
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **y** – **[inout]** device array of device pointers storing each vector y_i.
- **yType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.
- **batchCount** – **[in]** [int] number of instances in the batch.
- **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

hipblasStatus_t **hipblasAxpyStridedBatchedEx**(*hipblasHandle_t* handle, int n, const void *alpha, *hipblasDatatype_t* alphaType, const void *x, *hipblasDatatype_t* xType, int incx, *hipblasStride* stridex, void *y, *hipblasDatatype_t* yType, int incy, *hipblasStride* stridey, int batchCount, *hipblasDatatype_t* executionType)

BLAS EX API.

axpyStridedBatchedEx computes constant alpha multiplied by vector x, plus vector y over a set of strided batched vectors.

y := alpha * x + y

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in each x_i and y_i.
- **alpha** – **[in]** device pointer or host pointer to specify the scalar alpha.
- **alphaType** – **[in]** [hipblasDatatype_t] specifies the datatype of alpha.
- **x** – **[in]** device pointer to the first vector x_1.
- **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) to the next one (x_i+1). There are no restrictions placed on stridex, however the user should take care to ensure that stridex is of appropriate size, for a typical case this means stridex >= n * incx.
- **y** – **[inout]** device pointer to the first vector y_1.
- **yType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.
- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) to the next one (y_i+1). There are no restrictions placed on stridey, however the user should take care to ensure that stridey is of appropriate size, for a typical case this means stridey >= n * incy.
- **batchCount** – **[in]** [int] number of instances in the batch.
- **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

1.9.5.4 hipblasDotEx + Batched, StridedBatched

hipblasStatus_t **hipblasDotEx**(*hipblasHandle_t* handle, int n, const void *x, *hipblasDatatype_t* xType, int incx, const void *y, *hipblasDatatype_t* yType, int incy, void *result, *hipblasDatatype_t* resultType, *hipblasDatatype_t* executionType)

BLAS EX API.

dotEx performs the dot product of vectors x and y

```
result = x * y;
```

dotcEx performs the dot product of the conjugate of complex vector x and complex vector y

```
result = conjugate (x) * y;

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.
```

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in x and y.
- **x** – **[in]** device pointer storing vector x.
- **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of y.
- **y** – **[in]** device pointer storing vector y.
- **yType** – **[in]** [hipblasDatatype_t] specifies the datatype of vector y.
- **incy** – **[in]** [int] specifies the increment for the elements of y.
- **result** – **[inout]** device pointer or host pointer to store the dot product. return is 0.0 if n <= 0.
- **resultType** – **[in]** [hipblasDatatype_t] specifies the datatype of the result.
- **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

hipblasStatus_t **hipblasDotBatchedEx**(*hipblasHandle_t* handle, int n, const void *x, *hipblasDatatype_t* xType, int incx, const void *y, *hipblasDatatype_t* yType, int incy, int batchCount, void *result, *hipblasDatatype_t* resultType, *hipblasDatatype_t* executionType)

BLAS EX API.

dotBatchedEx performs a batch of dot products of vectors x and y

```
result_i = x_i * y_i;
```

dotcBatchedEx performs a batch of dot products of the conjugate of complex vector x and complex vector y

```
result_i = conjugate (x_i) * y_i;
```

where (x_i, y_i) is the i-th instance of the batch. x_i and y_i are vectors, for i = 1, . . . , batchCount

```
- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.
```

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in each x_i and y_i.
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **y** – **[in]** device array of device pointers storing each vector y_i.
- **yType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.
- **batchCount** – **[in]** [int] number of instances in the batch
- **result** – **[inout]** device array or host array of batchCount size to store the dot products of each batch. return 0.0 for each element if n <= 0.
- **resultType** – **[in]** [hipblasDatatype_t] specifies the datatype of the result.
- **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

hipblasStatus_t **hipblasDotStridedBatchedEx**(*hipblasHandle_t* handle, int n, const void *x, *hipblasDatatype_t* xType, int incx, *hipblasStride* stridex, const void *y, *hipblasDatatype_t* yType, int incy, *hipblasStride* stridey, int batchCount, void *result, *hipblasDatatype_t* resultType, *hipblasDatatype_t* executionType)

BLAS EX API.

dotStridedBatchedEx performs a batch of dot products of vectors x and y

```
result_i = x_i * y_i;
```

dotc_strided_batched_ex performs a batch of dot products of the conjugate of complex vector x and complex vector y

```
result_i = conjugate (x_i) * y_i;
```

where (x_i, y_i) is the i-th instance of the batch. x_i and y_i are vectors, for i = 1, . . . , batchCount

```
- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.
```

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in each x_i and y_i.
- **x** – **[in]** device pointer to the first vector (x_1) in the batch.
- **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1)
- **y** – **[in]** device pointer to the first vector (y_1) in the batch.
- **yType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.

- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) and the next one (y_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch
- **result** – **[inout]** device array or host array of batchCount size to store the dot products of each batch. return 0.0 for each element if n <= 0.
- **resultType** – **[in]** [hipblasDatatype_t] specifies the datatype of the result.
- **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

1.9.5.5 hipblasDotcEx + Batched, StridedBatched

hipblasStatus_t **hipblasDotcEx**(*hipblasHandle_t* handle, int n, const void *x, *hipblasDatatype_t* xType, int incx, const void *y, *hipblasDatatype_t* yType, int incy, void *result, *hipblasDatatype_t* resultType, *hipblasDatatype_t* executionType)

BLAS EX API.

dotEx performs the dot product of vectors x and y

```
result = x * y;
```

dotcEx performs the dot product of the conjugate of complex vector x and complex vector y

```
result = conjugate (x) * y;

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.
```

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in x and y.
- **x** – **[in]** device pointer storing vector x.
- **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of y.
- **y** – **[in]** device pointer storing vector y.
- **yType** – **[in]** [hipblasDatatype_t] specifies the datatype of vector y.
- **incy** – **[in]** [int] specifies the increment for the elements of y.
- **result** – **[inout]** device pointer or host pointer to store the dot product. return is 0.0 if n <= 0.
- **resultType** – **[in]** [hipblasDatatype_t] specifies the datatype of the result.
- **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

hipblasStatus_t **hipblasDotcBatchedEx**(*hipblasHandle_t* handle, int n, const void *x, *hipblasDatatype_t* xType, int incx, const void *y, *hipblasDatatype_t* yType, int incy, int batchCount, void *result, *hipblasDatatype_t* resultType, *hipblasDatatype_t* executionType)

BLAS EX API.

dotBatchedEx performs a batch of dot products of vectors x and y

```
result_i = x_i * y_i;
```

dotcBatchedEx performs a batch of dot products of the conjugate of complex vector x and complex vector y

```
result_i = conjugate (x_i) * y_i;
```

where (x_i, y_i) is the i-th instance of the batch. x_i and y_i are vectors, for i = 1, …, batchCount

```
- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.
```

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in each x_i and y_i.
- **x** – **[in]** device array of device pointers storing each vector x_i.
- **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **y** – **[in]** device array of device pointers storing each vector y_i.
- **yType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.
- **batchCount** – **[in]** [int] number of instances in the batch
- **result** – **[inout]** device array or host array of batchCount size to store the dot products of each batch. return 0.0 for each element if n <= 0.
- **resultType** – **[in]** [hipblasDatatype_t] specifies the datatype of the result.
- **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

hipblasStatus_t **hipblasDotcStridedBatchedEx**(*hipblasHandle_t* handle, int n, const void *x, *hipblasDatatype_t* xType, int incx, *hipblasStride* stridex, const void *y, *hipblasDatatype_t* yType, int incy, *hipblasStride* stridey, int batchCount, void *result, *hipblasDatatype_t* resultType, *hipblasDatatype_t* executionType)

BLAS EX API.

dotStridedBatchedEx performs a batch of dot products of vectors x and y

```
result_i = x_i * y_i;
```

dotc_strided_batched_ex performs a batch of dot products of the conjugate of complex vector x and complex vector y

```
result_i = conjugate (x_i) * y_i;
```

where (x_i, y_i) is the i-th instance of the batch. x_i and y_i are vectors, for i = 1, …, batchCount

```
- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.
```

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.

- **n** – **[in]** [int] the number of elements in each x_i and y_i.
- **x** – **[in]** device pointer to the first vector (x_1) in the batch.
- **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector x_i.
- **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1)
- **y** – **[in]** device pointer to the first vector (y_1) in the batch.
- **yType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector y_i.
- **incy** – **[in]** [int] specifies the increment for the elements of each y_i.
- **stridey** – **[in]** [hipblasStride] stride from the start of one vector (y_i) and the next one (y_i+1)
- **batchCount** – **[in]** [int] number of instances in the batch
- **result** – **[inout]** device array or host array of batchCount size to store the dot products of each batch. return 0.0 for each element if n <= 0.
- **resultType** – **[in]** [hipblasDatatype_t] specifies the datatype of the result.
- **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

1.9.5.6 hipblasNrm2Ex + Batched, StridedBatched

hipblasStatus_t **hipblasNrm2Ex**(*hipblasHandle_t* handle, int n, const void *x, *hipblasDatatype_t* xType, int incx, void *result, *hipblasDatatype_t* resultType, *hipblasDatatype_t* executionType)

BLAS_EX API.

nrm2Ex computes the euclidean norm of a real or complex vector

```
result := sqrt( x'*x ) for real vectors
result := sqrt( x**H*x ) for complex vectors
```

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in x.
- **x** – **[in]** device pointer storing vector x.
- **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of the vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of y.
- **result** – **[inout]** device pointer or host pointer to store the nrm2 product. return is 0.0 if n, incx<=0.
- **resultType** – **[in]** [hipblasDatatype_t] specifies the datatype of the result.
- **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

hipblasStatus_t **hipblasNrm2BatchedEx**(*hipblasHandle_t* handle, int n, const void *x, *hipblasDatatype_t* xType, int incx, int batchCount, void *result, *hipblasDatatype_t* resultType, *hipblasDatatype_t* executionType)

BLAS_EX API.

nrm2BatchedEx computes the euclidean norm over a batch of real or complex vectors

```
    result := sqrt( x_i'*x_i ) for real vectors x, for i = 1, ..., batchCount
    result := sqrt( x_i**H*x_i ) for complex vectors x, for i = 1, ..., batchCount
```

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.

  Parameters

  - **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
  - **n** – **[in]** [int] number of elements in each x_i.
  - **x** – **[in]** device array of device pointers storing each vector x_i.
  - **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector x_i.
  - **incx** – **[in]** [int] specifies the increment for the elements of each x_i. incx must be > 0.
  - **batchCount** – **[in]** [int] number of instances in the batch
  - **result** – **[out]** device pointer or host pointer to array of batchCount size for nrm2 results. return is 0.0 for each element if n <= 0, incx<=0.
  - **resultType** – **[in]** [hipblasDatatype_t] specifies the datatype of the result.
  - **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

hipblasStatus_t **hipblasNrm2StridedBatchedEx**(*hipblasHandle_t* handle, int n, const void *x, *hipblasDatatype_t* xType, int incx, *hipblasStride* stridex, int batchCount, void *result, *hipblasDatatype_t* resultType, *hipblasDatatype_t* executionType)

BLAS_EX API.

nrm2StridedBatchedEx computes the euclidean norm over a batch of real or complex vectors

```
    := sqrt( x_i'*x_i ) for real vectors x, for i = 1, ..., batchCount
    := sqrt( x_i**H*x_i ) for complex vectors, for i = 1, ..., batchCount
```

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.

  Parameters

  - **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
  - **n** – **[in]** [int] number of elements in each x_i.
  - **x** – **[in]** device pointer to the first vector x_1.
  - **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector x_i.
  - **incx** – **[in]** [int] specifies the increment for the elements of each x_i. incx must be > 0.

- **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) and the next one (x_i+1). There are no restrictions placed on stride_x, however the user should take care to ensure that stride_x is of appropriate size, for a typical case this means stride_x >= n * incx.
- **batchCount** – **[in]** [int] number of instances in the batch
- **result** – **[out]** device pointer or host pointer to array for storing contiguous batchCount results. return is 0.0 for each element if n <= 0, incx<=0.
- **resultType** – **[in]** [hipblasDatatype_t] specifies the datatype of the result.
- **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

1.9.5.7 hipblasRotEx + Batched, StridedBatched

hipblasStatus_t **hipblasRotEx**(*hipblasHandle_t* handle, int n, void *x, *hipblasDatatype_t* xType, int incx, void *y, *hipblasDatatype_t* yType, int incy, const void *c, const void *s, *hipblasDatatype_t* csType, *hipblasDatatype_t* executionType)

BLAS EX API.

rotEx applies the Givens rotation matrix defined by c=cos(alpha) and s=sin(alpha) to vectors x and y. Scalars c and s may be stored in either host or device memory, location is specified by calling hipblasSetPointerMode.

In the case where cs_type is real: x := c * x + s * y y := c * y - s * x

In the case where cs_type is complex, the imaginary part of c is ignored: x := real(c) * x + s * y y := real(c) * y - conj(s) * x

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] number of elements in the x and y vectors.
- **x** – **[inout]** device pointer storing vector x.
- **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of vector x.
- **incx** – **[in]** [int] specifies the increment between elements of x.
- **y** – **[inout]** device pointer storing vector y.
- **yType** – **[in]** [hipblasDatatype_t] specifies the datatype of vector y.
- **incy** – **[in]** [int] specifies the increment between elements of y.
- **c** – **[in]** device pointer or host pointer storing scalar cosine component of the rotation matrix.
- **s** – **[in]** device pointer or host pointer storing scalar sine component of the rotation matrix.
- **csType** – **[in]** [hipblasDatatype_t] specifies the datatype of c and s.
- **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

hipblasStatus_t **hipblasRotBatchedEx**(*hipblasHandle_t* handle, int n, void *x, *hipblasDatatype_t* xType, int incx, void *y, *hipblasDatatype_t* yType, int incy, const void *c, const void *s, *hipblasDatatype_t* csType, int batchCount, *hipblasDatatype_t* executionType)

BLAS EX API.

rotBatchedEx applies the Givens rotation matrix defined by c=cos(alpha) and s=sin(alpha) to batched vectors x_i and y_i, for i = 1, …, batchCount. Scalars c and s may be stored in either host or device memory, location is specified by calling hipblasSetPointerMode.

In the case where cs_type is real: x := c * x + s * y y := c * y - s * x

In the case where cs_type is complex, the imaginary part of c is ignored: x := real(c) * x + s * y y := real(c) * y - conj(s) * x

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.

  Parameters

  - **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
  - **n** – **[in]** [int] number of elements in each x_i and y_i vectors.
  - **x** – **[inout]** device array of deivce pointers storing each vector x_i.
  - **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector x_i.
  - **incx** – **[in]** [int] specifies the increment between elements of each x_i.
  - **y** – **[inout]** device array of device pointers storing each vector y_i.
  - **yType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector y_i.
  - **incy** – **[in]** [int] specifies the increment between elements of each y_i.
  - **c** – **[in]** device pointer or host pointer to scalar cosine component of the rotation matrix.
  - **s** – **[in]** device pointer or host pointer to scalar sine component of the rotation matrix.
  - **csType** – **[in]** [hipblasDatatype_t] specifies the datatype of c and s.
  - **batchCount** – **[in]** [int] the number of x and y arrays, i.e. the number of batches.
  - **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

hipblasStatus_t **hipblasRotStridedBatchedEx**(*hipblasHandle_t* handle, int n, void *x, *hipblasDatatype_t* xType, int incx, *hipblasStride* stridex, void *y, *hipblasDatatype_t* yType, int incy, *hipblasStride* stridey, const void *c, const void *s, *hipblasDatatype_t* csType, int batchCount, *hipblasDatatype_t* executionType)

BLAS Level 1 API.

rotStridedBatchedEx applies the Givens rotation matrix defined by c=cos(alpha) and s=sin(alpha) to strided batched vectors x_i and y_i, for i = 1, …, batchCount. Scalars c and s may be stored in either host or device memory, location is specified by calling hipblasSetPointerMode.

In the case where cs_type is real: x := c * x + s * y y := c * y - s * x

In the case where cs_type is complex, the imaginary part of c is ignored: x := real(c) * x + s * y y := real(c) * y - conj(s) * x

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.

  Parameters

  - **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
  - **n** – **[in]** [int] number of elements in each x_i and y_i vectors.

- **x** – **[inout]** device pointer to the first vector x_1.
- **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector x_i.
- **incx** – **[in]** [int] specifies the increment between elements of each x_i.
- **stridex** – **[in]** [hipblasStride] specifies the increment from the beginning of x_i to the beginning of x_(i+1)
- **y** – **[inout]** device pointer to the first vector y_1.
- **yType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector y_i.
- **incy** – **[in]** [int] specifies the increment between elements of each y_i.
- **stridey** – **[in]** [hipblasStride] specifies the increment from the beginning of y_i to the beginning of y_(i+1)
- **c** – **[in]** device pointer or host pointer to scalar cosine component of the rotation matrix.
- **s** – **[in]** device pointer or host pointer to scalar sine component of the rotation matrix.
- **csType** – **[in]** [hipblasDatatype_t] specifies the datatype of c and s.
- **batchCount** – **[in]** [int] the number of x and y arrays, i.e. the number of batches.
- **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

1.9.5.8 hipblasScalEx + Batched, StridedBatched

hipblasStatus_t **hipblasScalEx**(*hipblasHandle_t* handle, int n, const void *alpha, *hipblasDatatype_t* alphaType, void *x, *hipblasDatatype_t* xType, int incx, *hipblasDatatype_t* executionType)

BLAS EX API.

scalEx scales each element of vector x with scalar alpha.

```
x := alpha * x
```

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.

Parameters

- **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
- **n** – **[in]** [int] the number of elements in x.
- **alpha** – **[in]** device pointer or host pointer for the scalar alpha.
- **alphaType** – **[in]** [hipblasDatatype_t] specifies the datatype of alpha.
- **x** – **[inout]** device pointer storing vector x.
- **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of vector x.
- **incx** – **[in]** [int] specifies the increment for the elements of x.
- **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

hipblasStatus_t **hipblasScalBatchedEx**(*hipblasHandle_t* handle, int n, const void *alpha, *hipblasDatatype_t* alphaType, void *x, *hipblasDatatype_t* xType, int incx, int batchCount, *hipblasDatatype_t* executionType)

BLAS EX API.

scalBatchedEx scales each element of each vector x_i with scalar alpha.

```
x_i := alpha * x_i
```

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.

  Parameters

  - **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
  - **n** – **[in]** [int] the number of elements in x.
  - **alpha** – **[in]** device pointer or host pointer for the scalar alpha.
  - **alphaType** – **[in]** [hipblasDatatype_t] specifies the datatype of alpha.
  - **x** – **[inout]** device array of device pointers storing each vector x_i.
  - **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector x_i.
  - **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
  - **batchCount** – **[in]** [int] number of instances in the batch.
  - **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

hipblasStatus_t **hipblasScalStridedBatchedEx**(*hipblasHandle_t* handle, int n, const void *alpha, *hipblasDatatype_t* alphaType, void *x, *hipblasDatatype_t* xType, int incx, *hipblasStride* stridex, int batchCount, *hipblasDatatype_t* executionType)

BLAS EX API.

scalStridedBatchedEx scales each element of vector x with scalar alpha over a set of strided batched vectors.

x := alpha * x

- Supported types are determined by the backend. See rocBLAS/cuBLAS documentation.

  Parameters

  - **handle** – **[in]** [hipblasHandle_t] handle to the hipblas library context queue.
  - **n** – **[in]** [int] the number of elements in x.
  - **alpha** – **[in]** device pointer or host pointer for the scalar alpha.
  - **alphaType** – **[in]** [hipblasDatatype_t] specifies the datatype of alpha.
  - **x** – **[inout]** device pointer to the first vector x_1.
  - **xType** – **[in]** [hipblasDatatype_t] specifies the datatype of each vector x_i.
  - **incx** – **[in]** [int] specifies the increment for the elements of each x_i.
  - **stridex** – **[in]** [hipblasStride] stride from the start of one vector (x_i) to the next one (x_i+1). There are no restrictions placed on stridex, however the user should take care to ensure that stridex is of appropriate size, for a typical case this means stridex >= n * incx.
  - **batchCount** – **[in]** [int] number of instances in the batch.
  - **executionType** – **[in]** [hipblasDatatype_t] specifies the datatype of computation.

1.9.6 Auxiliary

1.9.6.1 hipblasCreate

hipblasStatus_t **hipblasCreate**(*hipblasHandle_t* *handle)

Create hipblas handle.

1.9.6.2 hipblasDestroy

hipblasStatus_t **hipblasDestroy**(*hipblasHandle_t* handle)

Destroys the library context created using *hipblasCreate()*

1.9.6.3 hipblasSetStream

hipblasStatus_t **hipblasSetStream**(*hipblasHandle_t* handle, hipStream_t streamId)

Set stream for handle.

1.9.6.4 hipblasGetStream

hipblasStatus_t **hipblasGetStream**(*hipblasHandle_t* handle, hipStream_t *streamId)

Get stream[0] for handle.

1.9.6.5 hipblasSetPointerMode

hipblasStatus_t **hipblasSetPointerMode**(*hipblasHandle_t* handle, *hipblasPointerMode_t* mode)

Set hipblas pointer mode.

1.9.6.6 hipblasGetPointerMode

hipblasStatus_t **hipblasGetPointerMode**(*hipblasHandle_t* handle, *hipblasPointerMode_t* *mode)

Get hipblas pointer mode.

1.9.6.7 hipblasSetVector

hipblasStatus_t **hipblasSetVector**(int n, int elemSize, const void *x, int incx, void *y, int incy)

copy vector from host to device

Parameters

- **n** – **[in]** [int] number of elements in the vector
- **elemSize** – **[in]** [int] Size of both vectors in bytes
- **x** – **[in]** pointer to vector on the host
- **incx** – **[in]** [int] specifies the increment for the elements of the vector
- **y** – **[out]** pointer to vector on the device
- **incy** – **[in]** [int] specifies the increment for the elements of the vector

1.9.6.8 hipblasGetVector

hipblasStatus_t **hipblasGetVector**(int n, int elemSize, const void *x, int incx, void *y, int incy)

copy vector from device to host

Parameters

- **n** – **[in]** [int] number of elements in the vector
- **elemSize** – **[in]** [int] Size of both vectors in bytes
- **x** – **[in]** pointer to vector on the device
- **incx** – **[in]** [int] specifies the increment for the elements of the vector
- **y** – **[out]** pointer to vector on the host
- **incy** – **[in]** [int] specifies the increment for the elements of the vector

1.9.6.9 hipblasSetMatrix

hipblasStatus_t **hipblasSetMatrix**(int rows, int cols, int elemSize, const void *AP, int lda, void *BP, int ldb)

copy matrix from host to device

Parameters

- **rows** – **[in]** [int] number of rows in matrices
- **cols** – **[in]** [int] number of columns in matrices
- **elemSize** – **[in]** [int] number of bytes per element in the matrix
- **AP** – **[in]** pointer to matrix on the host
- **lda** – **[in]** [int] specifies the leading dimension of A, lda >= rows
- **BP** – **[out]** pointer to matrix on the GPU
- **ldb** – **[in]** [int] specifies the leading dimension of B, ldb >= rows

1.9.6.10 hipblasGetMatrix

hipblasStatus_t **hipblasGetMatrix**(int rows, int cols, int elemSize, const void *AP, int lda, void *BP, int ldb)

copy matrix from device to host

Parameters

- **rows** – **[in]** [int] number of rows in matrices
- **cols** – **[in]** [int] number of columns in matrices
- **elemSize** – **[in]** [int] number of bytes per element in the matrix
- **AP** – **[in]** pointer to matrix on the GPU
- **lda** – **[in]** [int] specifies the leading dimension of A, lda >= rows
- **BP** – **[out]** pointer to matrix on the host
- **ldb** – **[in]** [int] specifies the leading dimension of B, ldb >= rows

1.9.6.11 hipblasSetVectorAsync

hipblasStatus_t **hipblasSetVectorAsync**(int n, int elemSize, const void *x, int incx, void *y, int incy, hipStream_t stream)

asynchronously copy vector from host to device

hipblasSetVectorAsync copies a vector from pinned host memory to device memory asynchronously. Memory on the host must be allocated with hipHostMalloc or the transfer will be synchronous.

Parameters

- **n** – **[in]** [int] number of elements in the vector
- **elemSize** – **[in]** [int] number of bytes per element in the matrix
- **x** – **[in]** pointer to vector on the host
- **incx** – **[in]** [int] specifies the increment for the elements of the vector
- **y** – **[out]** pointer to vector on the device
- **incy** – **[in]** [int] specifies the increment for the elements of the vector
- **stream** – **[in]** specifies the stream into which this transfer request is queued

1.9.6.12 hipblasGetVectorAsync

hipblasStatus_t **hipblasGetVectorAsync**(int n, int elemSize, const void *x, int incx, void *y, int incy, hipStream_t stream)

asynchronously copy vector from device to host

hipblasGetVectorAsync copies a vector from pinned host memory to device memory asynchronously. Memory on the host must be allocated with hipHostMalloc or the transfer will be synchronous.

Parameters

- **n** – **[in]** [int] number of elements in the vector
- **elemSize** – **[in]** [int] number of bytes per element in the matrix
- **x** – **[in]** pointer to vector on the device
- **incx** – **[in]** [int] specifies the increment for the elements of the vector
- **y** – **[out]** pointer to vector on the host
- **incy** – **[in]** [int] specifies the increment for the elements of the vector
- **stream** – **[in]** specifies the stream into which this transfer request is queued

1.9.6.13 hipblasSetMatrixAsync

hipblasStatus_t **hipblasSetMatrixAsync**(int rows, int cols, int elemSize, const void *AP, int lda, void *BP, int ldb, hipStream_t stream)

asynchronously copy matrix from host to device

hipblasSetMatrixAsync copies a matrix from pinned host memory to device memory asynchronously. Memory on the host must be allocated with hipHostMalloc or the transfer will be synchronous.

Parameters

- **rows** – **[in]** [int] number of rows in matrices

- **cols** – **[in]** [int] number of columns in matrices
- **elemSize** – **[in]** [int] number of bytes per element in the matrix
- **AP** – **[in]** pointer to matrix on the host
- **lda** – **[in]** [int] specifies the leading dimension of A, lda >= rows
- **BP** – **[out]** pointer to matrix on the GPU
- **ldb** – **[in]** [int] specifies the leading dimension of B, ldb >= rows
- **stream** – **[in]** specifies the stream into which this transfer request is queued

1.9.6.14 hipblasGetMatrixAsync

hipblasStatus_t **hipblasGetMatrixAsync**(int rows, int cols, int elemSize, const void *AP, int lda, void *BP, int ldb, hipStream_t stream)

asynchronously copy matrix from device to host

hipblasGetMatrixAsync copies a matrix from device memory to pinned host memory asynchronously. Memory on the host must be allocated with hipHostMalloc or the transfer will be synchronous.

Parameters

- **rows** – **[in]** [int] number of rows in matrices
- **cols** – **[in]** [int] number of columns in matrices
- **elemSize** – **[in]** [int] number of bytes per element in the matrix
- **AP** – **[in]** pointer to matrix on the GPU
- **lda** – **[in]** [int] specifies the leading dimension of A, lda >= rows
- **BP** – **[out]** pointer to matrix on the host
- **ldb** – **[in]** [int] specifies the leading dimension of B, ldb >= rows
- **stream** – **[in]** specifies the stream into which this transfer request is queued

1.9.6.15 hipblasSetAtomicsMode

hipblasStatus_t **hipblasSetAtomicsMode**(*hipblasHandle_t* handle, *hipblasAtomicsMode_t* atomics_mode)

Set hipblasSetAtomicsMode.

1.9.6.16 hipblasGetAtomicsMode

hipblasStatus_t **hipblasGetAtomicsMode**(*hipblasHandle_t* handle, *hipblasAtomicsMode_t* *atomics_mode)

Get hipblasSetAtomicsMode.

1.9.6.17 hipblasStatusToString

const char ***hipblasStatusToString**(*hipblasStatus_t* status)

HIPBLAS Auxiliary API

hipblasStatusToString

Returns string representing hipblasStatus_t value

Parameters **status** – **[in]** [hipblasStatus_t] hipBLAS status to convert to string

1.10 Contributing

1.10.1 Pull-request guidelines

Our code contriubtion guidelines closely follows the model of GitHub pull-requests. The hipBLAS repository follows a workflow which dictates a /master branch where releases are cut, and a /develop branch which serves as an integration branch for new code. Pull requests should:

- target the **develop** branch for integration
- ensure code builds successfully.
- do not break existing test cases
- new unit tests should integrate within the existing googletest framework.
- tests must have good code coverage
- code must also have benchmark tests, and performance must approach the compute bound limit or memory bound limit.

1.10.2 Coding Guidelines:

- Do not use unnamed namespaces inside of header files.
- Use either `template` or `inline` (or both) for functions defined outside of classes in header files.
- Do not declare namespace-scope (not `class`-scope) functions `static` inside of header files unless there is a very good reason, that the function does not have any non-`const` `static` local variables, and that it is acceptable that each compilation unit will have its own independent definition of the function and its `static` local variables. (`static` `class` member functions defined in header files are okay.)
- Use `static` for `constexpr` `template` variables until C++17, after which `constexpr` variables become `inline` variables, and thus can be defined in multiple compilation units. It is okay if the `constexpr` variables remain `static` in C++17; it just means there might be a little bit of redundancy between compilation units.

1.10.2.1 Format

C and C++ code is formatted using `clang-format`. To run clang-format use the version in the `/opt/rocm/llvm/bin` directory. Please do not use your system's built-in `clang-format`, as this may be an older version that will result in different results.

To format a file, use:

```
/opt/rocm/llvm/bin/clang-format -style=file -i <path-to-source-file>
```

To format all files, run the following script in rocBLAS directory:

```
#!/bin/bash
git ls-files -z *.cc *.cpp *.h *.hpp *.cl *.h.in *.hpp.in *.cpp.in | xargs -0 /opt/rocm/
↪llvm/bin/clang-format -style=file -i
```

Also, githooks can be installed to format the code per-commit:

```
./.githooks/install
```

1.10.3 Static Code Analysis

`cppcheck` is an open-source static analysis tool. This project uses this tool for performing static code analysis.

Users can use the following command to run cppcheck locally to generate the report for all files.

```
$ cd hipBLAS
$ cppcheck --enable=all --inconclusive --library=googletest --inline-suppr -i./build --
↪suppressions-list=./CppCheckSuppressions.txt --template="{file}:{line}: {severity}:
↪{id} :{message}" . 2> cppcheck_report.txt
```

For more information on the command line options, refer to the cppcheck manual on the web.

CHAPTER

TWO

DESIGN DOCUMENTATION

2.1 Clients

There are two client executables that can be used with hipBLAS. They are,

1. hipblas-bench
2. hipblas-test

These two clients can be built by following the instructions in the Building and Installing hipBLAS github page . After building the hipBLAS clients, they can be found in the directory `hipBLAS/build/release/clients/staging`.

The next two sections will cover a brief explanation and the usage of each hipBLAS client.

2.1.1 hipblas-bench

hipblas-bench is used to measure performance and to verify the correctness of hipBLAS functions.

It has a command line interface. For more information:

```
./hipblas-bench --help
```

For example, to measure performance of sgemm:

```
./hipblas-bench -f gemm -r f32_r --transposeA N --transposeB N -m 4096 -n 4096 -k 4096 --
↪alpha 1 --lda 4096 --ldb 4096 --beta 0 --ldc 4096
```

On a vega20 machine the above command outputs a performance of 11941.5 Gflops below:

```
transA,transB,M,N,K,alpha,lda,ldb,beta,ldc,hipblas-Gflops,us
N,N,4096,4096,4096,1,4096,4096,0,4096,11941.5,11509.4
```

A useful way of finding the parameters that can be used with `./hipblas-bench -f gemm` is to turn on logging by setting environment variable `ROCBLAS_LAYER=2`. For example if the user runs:

```
ROCBLAS_LAYER=2 ./hipblas-bench -f gemm -i 1 -j 0
```

The above command will log:

```
./rocblas-bench -f gemm -r f32_r --transposeA N --transposeB N -m 128 -n 128 -k 128 --
↪alpha 1 --lda 128 --ldb 128 --beta 0 --ldc 128
```

The user can copy and change the above command. For example, to change the datatype to IEEE-64 bit and the size to 2048:

```
./hipblas-bench -f gemm -r f64_r --transposeA N --transposeB N -m 2048 -n 2048 -k 2048 --
↪alpha 1 --lda 2048 --ldb 2048 --beta 0 --ldc 2048
```

Logging affects performance, so only use it to log the command to copy and change, then run the command without logging to measure performance.

Note that hipblas-bench also has the flag `-v 1` for correctness checks.

If multiple arguments or even multiple functions need to be benchmarked there is support for data driven benchmarks via a yaml format specification file.

```
./hipblas-bench --yaml <file>.yaml
```

An example yaml file that is used for a smoke test is hipblas_smoke.yaml but other examples can be found in the rocBLAS repository.

2.1.2 hipblas-test

hipblas-test is used in performing hipBLAS unit tests and it uses Googletest framework.

To run the hipblas tests:

```
./hipblas-test
```

To run a subset of tests a filter may be provided. For example to only run axpy function tests via command line use:

```
./hibblas-test --gtest_filter=*axpy*
```

The pattern for `--gtest_filter` is:

```
--gtest_filter=POSTIVE_PATTERNS[-NEGATIVE_PATTERNS]
```

If specific function arguments or even multiple functions need to be tested there is support for data driven testing via a yaml format test specification file.

```
./hipblas-test --yaml <file>.yaml
```

An example yaml file that is used to define a smoke test is hipblas_smoke.yaml but other examples can be found in the rocBLAS repository. Yaml based tests list function parameter values in the test name which can be also used for test filtering via the gtest_filter argument. To run the provided smoke test use:

```
./hipblas-test --yaml hipblas_smoke.yaml
```

INDEX

H