

Kokkos Kernels 5.2.0 Release Briefing

Kokkos Kernels team

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5.2.0 Release Highlights

- ▶ New Features
- ▶ General Enhancements
- ▶ Benchmarks
- ▶ Deprecations and other breaking changes
- ▶ Bug Fixes
- ▶ Documentation

Online Resources:

- ▶ <https://github.com/kokkos>:
 - ▶ Primary Kokkos GitHub Organization
- ▶ <https://github.com/kokkos/kokkos-tutorials/wiki/Kokkos-Lecture-Series>:
 - ▶ Slides, recording and Q&A for the Full Lectures
- ▶ <https://kokkos.org/kokkos-kernels/docs/>:
 - ▶ Kokkos Kernels' online documentation (also available in source repo)
- ▶ <https://kokkosteam.slack.com>:
 - ▶ Slack space for Kokkos with #kokkos-kernels channel.
 - ▶ Please join: fastest way to get your questions answered.
 - ▶ Can whitelist domains, or invite individual people.

New Features

After adding `KokkosLapack::geqrf` to decompose matrices in 5.1 we now add support to apply and/or compute Q

- ▶ `KokkosLapack::gemqr`
- ▶ `KokkosLapack::gegqr`

Also bringing support for Cholesky decomposition with the following kernels:

- ▶ `KokkosLapack::potrf`
- ▶ `KokkosLapack::potrs`

New kernels:

- ▶ scaled l2 norm computation
- ▶ serial, team and teamvector implementations of rot, rotg, rotm and rotmg.
- ▶ batched swap
- ▶ batched norm with support for ℓ_1 , ℓ_2 and ℓ_∞

New variants:

- ▶ Implement Team and TeamVector lamax

Support conjugate mode for sparse matrix transpose:

```
▶ template <typename crsMat_t>  
    crsMat_t transpose_matrix(const crsMat_t &A, const bool conjugate_values=false);
```

Add merge-path algorithms for load balancing:

```
▶ template <typename CView, typename ExecSpace, typename AView, typename BView>  
    CView merge(const ExecSpace &space, const AView &a, const BView &b)
```

General Enhancements

Build System

- ▶ Always turn on `INST_MEMSPACE_HOSTSPACE` by default
- ▶ Remove the configure output for the list of kernels being ETI

Batched

Adding ConjTrans support for the following kernels

- ▶ `KokkosBatched::TeamGemm`
- ▶ `KokkosBatched::TeamVectorGemm`
- ▶ `KokkosBatched::SerialTrsv`

Blas

Refactor of `KokkosBlas::axpby` unification layer, importantly it avoids `Kokkos::deep_copy()` in all cases.

Sparse

- ▶ Call `cusparseSpMV_preprocess` unless a fast setup is required in the cusparse code paths of SpMV

Benchmarks

Significant coverage increase in Blas 1 benchmark with the following additions:

- ▶ axpy single and multi-vector versions
- ▶ axpby single and multi-vector versions
- ▶ scal single and multi-vector versions
- ▶ swap single and multi-vector versions
- ▶ nrminf single and multi-vector versions
- ▶ nrm1 single and multi-vector versions
- ▶ nrm2 single and multi-vector versions

Deprecations

Moving the InnerProductSpaceTraits from Kokkos to Kokkos Kernels header and namespace

- ▶ `Kokkos_InnerProductSpaceTraits.hpp` →
 `KokkosKernels_InnerProductSpaceTraits.hpp`
- ▶ `[[deprecated("...")]] Kokkos::Details::InnerProductSpaceTraits` →
 `KokkosKernels::Details::InnerProductSpaceTraits`

Bug Fixes

- ▶ Fix call to `KokkosBlas::scal()` in `KokkosBlas::gemm()` that was missing an execution space instance.
- ▶ Graph Coarsening team policy uses at most `vector_length_max()` instead of hard coded values.
- ▶ Householder reflector computation kernels uses math function overloaded for Sacado types.
- ▶ Remove calls to `rand()` in favor of c++ standard library equivalent for Windows support.
- ▶ In `KokkosSparse::SPGEMMHandle` constructor we no longer overwrite `SPGEMM_DEFAULT` with host based algorithm

Documentation

Multiple new API documentation and examples in batched dense

- ▶ KokkosBatched::`{Serial,Team,TeamVector}`Dot documentation + example
- ▶ KokkosBatched::`{Serial,Team,TeamVector}`Nrm documentation + example
- ▶ KokkosBatched::`{Serial,Team,TeamVector}``{Rot,Rotg,Rotm,Rotmg}` documentation + example
- ▶ KokkosBatched::`{Serial,Team,TeamVector}`Swap documentation + example
- ▶ KokkosBlas::`{abs,scal,swap}` examples
- ▶ KokkosBatched::`{Team,TeamVector}`Iamx documentation update