



Kokkos Kernels 4.2.0 Release highlights

Presented by

Luc Berger-Vergiat



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- Major new features
 1. BLAS 2 functions
 2. LAPACK
 3. Sparse on stream
 4. ODE: Newton solver
- Other news
 1. TPLs support improvement (oneMKL SpMV, GEMV, dot)
 2. Sparse BSR and MDF improvements
- Upcoming features in 4.3
 1. Algorithms development in LAPACK
 2. TPL support for LAPACK

A network diagram background consisting of a grid of nodes connected by lines. The nodes are represented by small circles, and the lines are thin and light blue. The background is divided into several color zones: a light blue gradient on the left, a white area on the top right, a dark blue horizontal band across the middle, and a white area on the bottom right. A thin, multi-colored horizontal line is located at the bottom of the dark blue band.

New major features

BLAS 2 functions



New functions added in BLAS level 2

- SYR (symmetric rank update) fully supported with native and TPL implementations
- HER (hermitian rank update) fully supported with native and TPL implementations
- As all other BLAS functions, they are non-blocking, thread-safe and can be called on stream (for TPL implementation check vendor documentation)



New LAPACK component added

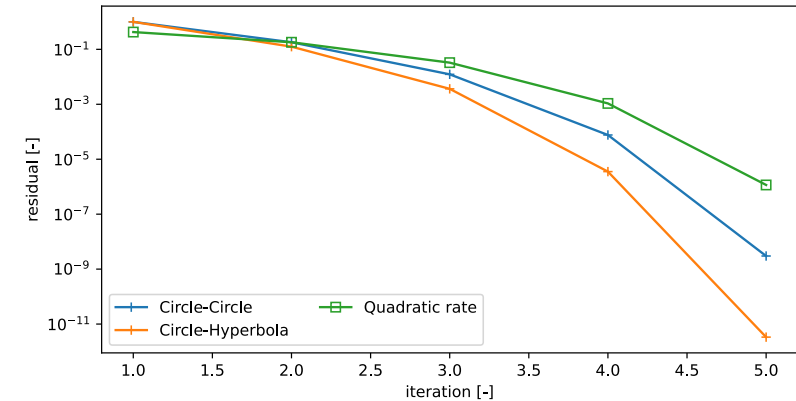
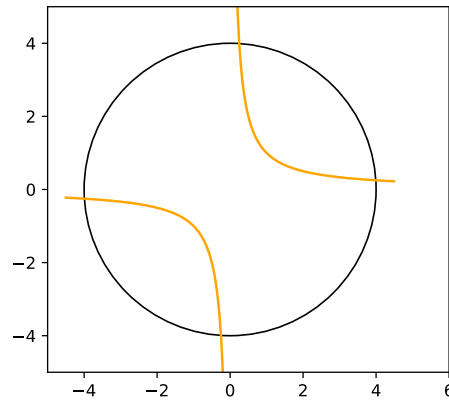
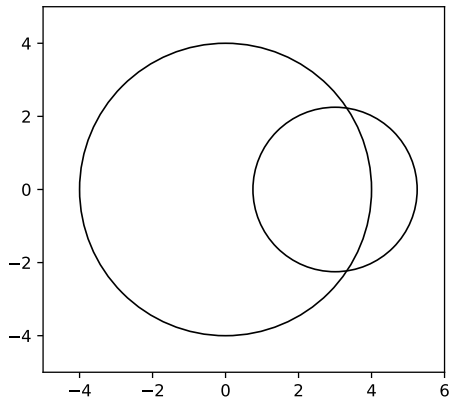
- Moved gesv and trtri from BLAS to Lapack
- No new algorithms or TPL support (LAPACK and MAGMA)
- Future work (already completed) will add support for cuSOLVER and rocSOLVER
- Expect more algorithms in the future (getrf, getri, geqrf, geqri, gesvd...)
- New algorithms may or may not have native implementation

Sparse algorithms enhancement for stream/queue execution

- Matrix-Vector product accepts execution space instance
 - Stream/Queue can be attached to individual instances to run on stream
 - Stream/Queue forwarded to TPL when possible
 - Change implemented for CrsMatrix SpMV and BsrMatrix SpMV
- Diagonal matrix extraction
 - Can divide a matrix in N row-blocks
 - The diagonal part of each row block can be extracted into individual sub-matrices
 - Stream/Queue preconditioners can operate on sub-matrices directly
- Gauss-Seidel preconditioner can now run on streams/queues like ILU(K)

ODE solvers are expanding toward implicit algorithms

- Newton solver implemented
- Only support analytical Jacobian
- Always recomputes Jacobian and calls gesv as solver
- No sparse Jacobian supported yet



A network diagram with nodes and connecting lines, overlaid on a background with light blue and white sections. A dark blue horizontal band is present in the middle, and a thin, multi-colored line runs horizontally across the bottom. The text 'Other updates' is centered in the dark blue band.

Other updates

TPL Support: oneMKL



Adding support for matrix-vector multiplication

- GEMV supports oneMKL
- SpMV supports oneMKL

Upcoming support

- BLAS1 oneMKL support (nrm1 and dot already implemented)
- GEMM support for oneMKL
- SpGEMM support for oneMKL

After upcoming updates most used parts of the libraries should be more performant on Intel GPUs

Sparse: Bsr and MDF improvements



- Bsr improvements
 - SpMV TPL support improved with rocSPARSE and cuSPARSE
 - Removed redundant checks for performance
 - Check scalar type carefully before allowing tensor-core code path
- MDF improvements
 - More sub kernels are parallelized
 - count functor
 - Use unordered set to update non-factorized rows (avoid $O(n^2)$ check)

A network diagram background consisting of a complex web of light blue lines connecting various nodes. The nodes are represented by small circles, some of which are larger and more prominent. The diagram is set against a light blue background on the left and a white background on the right. A dark blue horizontal band is positioned across the middle of the image, containing the text "Upcoming work".

Upcoming work

Kokkos Kernels 4.3 forecast



More algorithms in LAPACK:

- Likely candidates
 - LU (getrf, getri)
 - QR (geqrf, geqri)
 - SVD (gesvd)
 - Let us know if you need something else?

Further TPL work

- Adding cuSOLVER and rocSOLVER for LAPACK vendor support
- Adding BLIS with standard BLAS interface



**Thank you for your attention
Any Questions?**