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Code parallelization alternatives: measuring performance portability within the Gaia AVU-GSR case study

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Modern computing needs for astronomical applications are soon reaching the ExaFLOPs scale. This calls for the usage of heterogeneous supercomputers accelerated with GPUs which, however, span several architectures that might imply portability problems of applications. For this purpose, several programming frameworks that allow portability of codes across these architectures without significant performance losses have been developed. We experiment the effective performance portability of some of these frameworks (HIP, C++ PSTL, SYCL, and OpenMP offloaded to GPU) using the AVU-GSR code of the Gaia mission as a study case. The code aims to find with a 10-100 micro-arcsecond accuracy the astrometric parameters of up to 10^8 primary stars in the Milky Way with LSQR iterative algorithm, widely employed in other scientific applications. This approach also allows to provide an optimized version of the solver used in the Gaia GSR pipeline with a > 2x speedup over the less optimized CUDA porting currently in production. These results are fundamental for the future Gaia Data Releases and other LSQR-based codes.

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