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Algebraic Multigrid on the GPU: Exposing Fine-Grained Paallelism

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Computational simulation in environments with dedicated computing units such as the GPU (or an APU) is becoming more practical as software and algorithms mature. In this this talk, we focus on the ability of algebraic multigrid (AMG) to adapt to the parallelism of the GPU.

Our approach is to build on the well developed sparse matrix-vector multiply (SpMV) on the GPU, as well as more general operations such as sort, gather, scatter, and scan. We focus on a smoothed-aggregation based AMG approach and concentrate on the core elements of the setup phase namely strength, aggregation, the triple-matrix product, etc., and on the performance of the cycling phase. We highlight tangible speed-ups with an implementation that adheres to the computing kernels on the GPU, and expose several directions for increasing performance in a more general setting.