
Lazy Stencil Integration in multigrid algorithms

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Multigrid algorithms are among the most efficient solvers for elliptic partial differential equations. However, we have to invest into an expensive matrix setup phase before we kick off the actual solve. This assembly effort is non-negligible; particularly if the fine grid stencil integration is laborious. Our manuscript proposes to start multigrid solves with very inaccurate, geometric fine grid stencils which are then updated and improved in parallel to the actual solve. This update can be realised greedily and adaptively. We furthermore propose that any operator update propagates at most one level at a time, which ensures that multiscale information propagation does not hold back the actual solve. The increased asynchrony, i.e. the lazyness improves the runtime without a loss of stability if we make the grid update sequence take into account that multiscale operator information propagates at finite speed.

Keywords: additive multigrid, matrix assembly, asynchronous stencils.