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How fast are multigrid methods?

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The most efficient multigrid algorithms known require less than 30 operations per unknown to solve the 5-point stencil discretization of the Poisson equation in 2D to the level of truncation error. This uses full multigrid and a clever implementation of an FAS-like scheme using hierarchical basis transformations. We will briefly review the features of this algorithm will also discuss its generalizations for other problems. Unfortunately, the real performance of multigrid algorithms on current computer systems is much lower than predicted by such work estimates. We will discuss why this is the case, and what can be done about it.