

Multilevel methods

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Multigrid methods are known to be among the most efficient solvers for elliptic partial differential equations. They are asymptotically optimal in the sense that the work is only proportional to the number of unknowns in the discretization. They draw their strength from coupling the discretization across different resolution levels. However, multigrid methods are not only asymptotically optimal, but well-implemented multigrid algorithms achieve also very low work counts in absolute values. In particular, the two-dimensional Poisson-problem can be solved with discretization error accuracy in only 30 operations per unknown, independent of the mesh size. Part one of the lectures will be given as a general introduction to multigrid methods, while part two will present some advanced techniques, including adaptivity and parallelization.