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Using AMG as an eigensolver to improve smoothed aggregation for AMG

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The growing complexity of physical effects that are simulated pose challenges for the linear solver's robustness. Frequently, the background of the problems to be solved are elliptic partial differential equations and then multigrid methods are the preferred choice for these applications. However, the linear systems can include very high aspect rations and huge heterogeneities in the matrix stencils. Both of these properties make the linear system challenging for the solution process and may lack robustness.

Smoothed aggregation [1,2] is a appropriate way to handle these ill-conditioned problems, but therefore it is necessary to have a sufficient representation of the rigid body modes. But the rigid body modes, e.g. as the first few eigenvectors, are difficult to calculate as the problem is ill-conditioned. A rough estimation of the first few eigenvectors can be calculated by using AMG with standard coarsening approaches and thus improve the smoothed aggregation itself. For the eigensolver approximation we use a preliminary constructed level hierarchy to calculate an estimated solution of the eigenproblems [3].

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