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# A Comparison of Some Sparse Preconditioners for High-Order Finite Element Systems

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High-order finite elements have been observed to achieve a level of accuracy per degree of freedom that exceeds that achieved for low-order linear finite elements. Furthermore, high-order finite elements have been used in climate modeling for problems involving long time integrations and in MHD simulations to capture physics that standard low-order finite elements fail to capture. Solving these systems efficiently and with a low-memory overhead is thus beneficial to a number of research fields. We present results for preconditioning these systems with an approximate inversion of a matrix with the same rank as the high-order finite element matrix. The preconditioning matrix is sparse as it is derived from a matrix with a stencil size that is equivalent to using low-order finite elements. This sparse matrix is approximately inverted using a single V-cycle of algebraic multigrid. We consider both 2D and 3D problems and also various nodal arrangements on an element for the high-order degrees of freedom.

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