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On Parallel Algebraic Multigrid Preconditioners for Systems of PDEs

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Algebraic multigrid (AMG) is a very efficient, scalable algorithm for solving large linear systems on unstructured grids. When solving linear systems derived from systems of partial differential equations (PDEs) often a different approach is required than for those derived from a scalar PDE. There are mainly two approaches, the function approach (also known as the "unknown" approach), and the nodal or "point" approach. The function approach defines coarsening and interpolation separately for each function. The nodal approach uses AMG in a block manner, where all variables that correspond to the same grid node are coarsened, interpolated and relaxed together. While the function approach is much easier to implement and often more efficient, there are problems for which this approach is not sufficient and the more expensive nodal approach is needed.

Several parallel implementations of both approaches using various coarsening schemes and interpolation operators are investigated. Advantages and disadvantages of both approaches are discussed, and numerical results are presented.