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**Algebraic Multilevel Preconditioners Based on
Aggregation Procedures: A Demonstration for the
Navier-Stokes Equations with Associated Heat and Mass
Transfer**

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In this talk a class of algebraic preconditioners, based on the concept of (smoothed) aggregation, is introduced. The resulting procedure, that does not require geometric information, is completely algebraic and well-suited for parallel computations on unstructured grids in two and three dimensions. This technique is described in the context of a simple elliptic model problem with convergence estimates and numerical experiments presented. The procedure is then applied as a preconditioner to our coupled systems of interest in a Newton-Krylov solution procedure.

In the context of Navier-Stokes with coupled heat and mass transfer, we present parallel and algorithmic scaling studies on large-scale distributed memory parallel computers. Comparisons are reported with 1-level domain decomposition preconditioners, and with two-level domain decomposition preconditioners with coarse grids.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.