# 2024 SIAM Conference on Parallel Processing for Scientific Computing

Part of CP2 Multigrid and Domain Decomposition

**An AMG Reduction Framework for Domains with Symmetries**

**Abstract.** Divergence constraints are present in the governing equations of many physical phenomena, and they usually lead to a Poisson equation whose solution is one of the most challenging parts of scientific simulation codes. Algebraic Multigrid (AMG) is probably the most powerful preconditioner for Poisson's equation, and its effectiveness results from the complementary roles played by the smoother, responsible for damping high-frequency error components, and the coarse-grid correction, which in turn reduces low-frequency modes. This work presents a more compute-intensive variant of AMG. It arises from leveraging spatial symmetries, often present in academic and industrial configurations, to impose a consistent ordering giving rise to a multigrid reduction framework. In particular, we introduce an aggressive coarsening to the top level of the multigrid hierarchy, reducing the setup, memory footprint and application costs of the top-level smoother. Numerical experiments leveraging reflection and translational symmetries on CFD and structural mechanics problems will be presented at the conference.

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PP24 Home 2024 | Program | Speaker Index