

SUBSTRUCTURING AND HYBRIDIZATION METHODS

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ABSTRACT

High-order discretizations provide exceptional accuracy, but their computational efficiency depends critically on solvers that exploit local structure while controlling the cost of global coupling. Substructuring and hybridization address this challenge by organizing the computation around local problems coupled through interfaces, traces, or skeleton variables. Depending on the formulation, these interface unknowns arise from a decomposition of the discrete problem or are introduced as a part of the discretization itself.

This minisymposium brings together research on the analysis, design, and implementation of solvers based on this local-to-global structure. It encompasses methods that eliminate or solve for interior unknowns locally and formulate the remaining global interaction as an interface problem. The emphasis is on the resulting solver architecture, whether the interface formulation is obtained algebraically, constructed through hybridization, or developed directly at the operator level.

The minisymposium focuses on questions that become particularly important in the high-order regime: the construction and representation of interface operators, robustness with respect to discretization parameters and problem complexity, computational and memory efficiency, parallel scalability, and the interaction between local discretization structure and global solution strategies. Its aim is to connect researchers working with different formulations through the shared mathematical and computational principles of local elimination and interface coupling.

SPEAKERS

1. Michal Outrata (Charles University): On new direct AMG method and its geometrical realization.
2. Gabriele Ciaramella (Politecnico di Milano): Two-level substructured Schwarz methods.
3. Tommaso Vanzan (Politecnico di Torino): Schwarz methods for HHO discretizations.
4. Hussam Al Daas (Rutherford Appleton Laboratory): LS-AMG-DD a robust spectral algebraic multigrid domain decomposition preconditioner for some hybridized discretisations.
5. Owen Melia (Flatiron Institute): GPU acceleration of high-order direct solvers of variable-coefficient elliptic problems in 2D and 3D.
6. Boris Martin (University of Liège): Investigations of spectral coarse space in non-overlapping Schwarz Methods for the Helmholtz Equation.
7. Axel Modave (CNRS & ENSTA at Palaiseau): Hybridized DG methods with transmission variables for the iterative solution of time-harmonic wave problems.
8. Ari Rappaport (ENSTA): From local scattering maps to iterative solvers for the time-harmonic Maxwell equations.
9. Per-Gunnar Martinsson (University of Texas at Austin): Interface formulations for high-order multidomain spectral collocation.
10. Simon Dirckx (University of Texas at Austin): Two-level and multilevel hierarchical overlapping solvers using interface maps.
11. Andreas Granath (University of Umeå): Low-rank and tensor based domain decomposition with SBP-SAT discretization.
12. Ben Southworth (Los Alamos National Laboratory): Leveraging broken spaces for robust algebraic solvers of high-order mass and stiffness matrices.
13. Marion Darbas (Université Sorbonne Paris Nord): Hybrid solvers for boundary integral formulations of 3D acoustic multiple scattering problems
14. Martin J. Gander (Université de Genève): The method of reflections for wave propagation problems