

ADVANCES IN SPACE-TIME VARIATIONAL SOLVERS FOR FLOW AND RELATED PROBLEMS

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ABSTRACT

Constructing high fidelity numerical methods maintaining stability and inheriting most of the rich structure of complex flow, multi-physics and related problems continues to remain a challenging task. Variational methods enable the natural discretization of such systems. These families of approximation schemes offer the potential to achieve accurate results on computationally feasible grids with a minimum of numerical costs. The efficient iterative solution of the arising algebraic systems adds a further layer of complexity to the simulation.

In this minisymposium recent trends and innovations in the design, analysis and application of space-time variational discretizations are addressed. Topics include, but are not limited to, holistic and slab-wise (time stepping) approaches, a posteriori error control and automatic space-time mesh adaptation [1], optimal control with application to numerical simulation of flow and related problems. Multilevel algebraic solvers for such systems, that are tailored to modern CPU and/or GPU architectures of high performance computing [2], are also of interest.

The minisymposium provides a forum for the presentation and discussion of progress in the aforementioned topics. The speakers are experts in the field of numerical simulation in fluid flow and related applications. They are authors of widely recognized publications addressing various aspects of the problems outlined above.

REFERENCES

- [1] M. Bause, M.P. Bruchhäuser, B. Endtmayer, N. Margenberg, I. Toloupoulos, T. Wick, *Anisotropic space-time goal-oriented error control and mesh adaptivity for convection-diffusion-reaction equations*, J. Numer. Math., in press (2025), pp. 1-35; arXiv:2404.04951
- [2] N. Margenberg, M. Bause, *A monolithic hp space-time multigrid preconditioned Newton-Krylov solver for space-time FEM applied to the incompressible Navier-Stokes equations*, SIAM Sci. Comput., under Review (2026), pp. 1-26; arXiv:2602.13841