

NUMERICAL METHODS TAMING MULTIPLE SCALES

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ABSTRACT

Many scientific and engineering applications involve phenomena evolving across multiple, possibly non-separated, spatial and temporal scales, posing significant challenges for numerical simulation. This minisymposium brings together recent advances in the design, analysis, and implementation of specialized numerical methods for such multiscale problems, highlighting complementary perspectives and methodologies. Topics include algorithms that accurately capture fine-scale effects while remaining computationally tractable. Particular emphasis is placed on high-order techniques; examples include higher-order multiscale approximation spaces, optimal hp -approximation, and high-order expansions in time. Applications range from the propagation of waves and the flow of fluids in heterogeneous media to mechanics and quantum physics, as well as network dynamics. These applications illustrate how modern numerical methods can be used to reliably simulate complex multiscale phenomena that would otherwise be too computationally intensive. The minisymposium aims to bring together researchers from different countries and research directions, fostering the exchange of ideas and establishing new collaborations on high-order numerical methods for taming multiple scales.

SPEAKERS

1. Roland Maier (Karlsruhe Institute of Technology): Higher-order multiscale constructions for time-dependent PDEs
2. Elisa Iacomini (University of Ferrara): Multifidelity and multilevel methods for traffic flow

3. Oliver Sander (Technical University of Dresden): Formation of wrinkles on a coated substrate
4. Zhaonan Dong (Inria Paris): Pressure-robust error estimates for the localized orthogonal decomposition method for the Stokes problem in perforated domains
5. Jörg Nick (University of Birmingham): The modulated Fourier expansion for waves propagating through time-modulated media
6. Mahima Yadav (Ruhr University Bochum): Convergence of Sobolev Gradient Methods for Ground States in Multiscale Ginzburg–Landau Model
7. Théophile Chaumont-Frelet (Inria Sophia Antipolis Méditerranée): A stable local commuting projector in $H(\text{curl})$ yielding local-best equivalence and optimal hp approximation
8. Martin Vohralík (Inria Paris and Charles University Prague): A stable local commuting projector in $H(\text{div})$ yielding local-best equivalence and optimal hp approximation