

HIGH-ORDER METHODS FOR COMPUTATION AND OPTIMIZATION IN SPECTRAL GEOMETRY

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ABSTRACT

Spectral geometry concerns the interplay between the shape of a domain or manifold and the spectrum of an associated operator, such as the Laplace–Beltrami operator or the Dirichlet-to-Neumann (Steklov) map. In case of Extremal questions — which shapes optimize a given eigenvalue — connect analysis, geometry, and computation, with recent applications to free boundary minimal surfaces, sharp spectral inequalities, and computer-assisted proofs.

Progress on these problems is often challenged by discretization accuracy: eigenvalue optimization demands many eigenpairs computed to high precision on evolving, non-smooth, or high-genus geometries. If the operators are vectorial or if the domain is unbounded, these questions present additional challenges. High-order methods — boundary integral and layer-potential formulations, the method of particular solutions and related fundamental solution approaches, spectral schemes, hp- and isogeometric finite elements — are uniquely suited to deliver, and increasingly certify, this accuracy.

This minisymposium brings together researchers developing high-order discretizations for spectral problems in challenging settings with those applying them to optimization and inverse problems in spectral geometry.

SPEAKERS

1. Pedro Antunes (U. Lisbon): *Shape optimization of eigenvalues in elasticity equations*
2. Lucas Chesnel (POEMS Ensta): *Perfect reflection or transmission in electromagnetic waveguides*
3. Matthias Hoffman (U. Lisbon): *Eigenvalues of the discrete p -Laplacian via graph surgery*
4. James B. Kennedy (U. Aveiro): *Robin and Cheeger partitions of domains*
5. Roméo Leylekian U. Lisbon: *How to close the nodal line?*
6. Xuefeng Liu (Tokyo Woman's Christian University): *Guaranteed eigenvalue bounds for Schrödinger operators via spectral Galerkin methods*
7. Eloi Martinet (U. Würzburg): *Numerical Exploration of Blaschke–Santaló Diagrams Using Neural Networks*
8. Idriss Mazari-Fouquer (U. Paris Dauphine-PSL): *Some challenges in vectorial spectral optimisation*
9. Jeff Owall (Portland State University): *A Nyström-based eigensolver for the Magnetic Laplace operator*
10. Kshitij Patil (Simon Fraser University): *Generalized exterior Steklov-Helmholtz eigenvalues via boundary integral approaches*
11. Stefan Sauter (U. Zurich): *Computation of whispering gallery modes*