

# APPROXIMATION AND ADAPTIVE SAMPLING IN HIGH DIMENSIONS

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## ABSTRACT

The cost of spectral and high-order methods for PDEs can grow rapidly with dimension and approximation order. Tensor approximations and model reduction offer compressed representations, but constructing and evolving them often requires costly high-dimensional integration. This minisymposium explores how structured approximation and adaptive sampling can be combined to address these computational challenges. Topics include regularity-dependent tensor approximation, optimal sampling, low-rank time integration, certified error control, and learning of PDE solution maps. A central question is how structured representations, sampling strategies, and model reduction can reduce computational cost while retaining the accuracy of high-order methods.

## SPEAKERS

1. Nando Hegemann (Physikalisch-Technische Bundesanstalt, Berlin, Germany): *Sample-based almost-sure quasi-optimal approximation in reproducing kernel Hilbert spaces.*
2. Matthieu Dolbeault (Centrale Nantes, Nantes, France): *Greedy algorithms for optimal experimental design.*
3. Charles Miranda (Centrale Nantes, Nantes, France): *Optimal sampling for natural gradient schemes.*
4. Agustín Somacal (Centrale Nantes, Nantes, France): *Optimal sampling and natural gradient for fast online learning in non-linear reduced order models.*
5. Sergey Dolgov (University of Bath, Bath, United Kingdom): *Fast-to-learn transport maps for Bayesian inverse problems.*
6. Josephine Westermann (ETH Zürich, Zürich, Switzerland): *High-dimensional approximation for measure transport.*
7. Virginie Ehrlacher (École des Ponts ParisTech, Champs-sur-Marne, France): *Low-rank approximation of dynamical quantum optimal transport geodesics.*
8. Olga Mula (University of Vienna, Vienna, Austria): *Solving high-dimensional Fokker–Planck equations with Gaussian mixtures.*
9. Wolfgang Dahmen (RWTH Aachen University, Aachen, Germany): *Accuracy controlled learning of data-to-state maps for parametric systems of PDEs.*
10. Markus Bachmayr (RWTH Aachen University, Aachen, Germany): *Time integration of low-rank tensor representations: balancing ranks and accuracy.*
11. Benjamin Peherstorfer (New York University, New York, NY, USA): *Dirac–Frenkel Dynamics with Momentum.*
12. Martin Eigel (Weierstrass Institute for Applied Analysis and Stochastics, Berlin, Germany): *Certified error control for Dirac–Frenkel dynamics on tensor train manifolds.*
13. Helmut Harbrecht (University of Basel, Basel, Switzerland): *Tensor approximation of high-dimensional functions of isotropic and anisotropic Sobolev smoothness.*
14. Philipp Trunschke (Physikalisch-Technische Bundesanstalt, Berlin, Germany): *Revisiting Quantised Tensor Trains for the approximation of PDE solutions.*

15. Xuemeng Wang (Simon Fraser University, Burnaby, BC, Canada): *Into the danger zone: stable extrapolation in high-dimensional function and operator learning.*
16. Daniel Kressner (École polytechnique fédérale de Lausanne, Lausanne, Switzerland): *Adaptive randomized pivoting and applications.*
17. Anthony Nouy (Centrale Nantes, Nantes, France): *Randomized methods for model order reduction of dynamical systems.*
18. Fabio Nobile (École polytechnique fédérale de Lausanne, Lausanne, Switzerland): *On the sample complexity of the active subspace method.*
19. Alexandre Pasco (École polytechnique fédérale de Lausanne, Lausanne, Switzerland): *Surrogate to Poincaré inequalities on manifolds for collective dimension reduction in nonlinear feature spaces.*
20. Janina Schütte (Weierstrass Institute for Applied Analysis and Stochastics, Berlin, Germany): *Low-Rank Tensor Flows: Physics-informed sampling and theoretical guarantees.*
21. Mario Ullrich (Johannes Kepler University Linz, Linz, Austria): *On  $s$ -numbers in approximation theory.*