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Computationally efficient uncertainty quantification for sparse Bayesian learning

Speaker.
Jan Glaubitz
Department of Mathematics
Linköping University
SE-581 83, Linköping, Sweden

Bio.
Jan Glaubitz is an Assistant Professor in Scientific Computing in the Division of Applied Mathematics at Linköping University. He aims to advance foundational computational methodologies at the intersection of numerical analysis, Bayesian inverse problems, and uncertainty quantification. Before joining Linköping University, he held postdoctoral positions at the Massachusetts Institute of Technology, where he was part of Youssef Marzouk's UQ Group, and Dartmouth College, where he worked with Anne Gelb. He earned his PhD in Mathematics under the guidance of Thomas Sonar from the Technical University Braunschweig.

Abstract.
Sparse Bayesian learning (SBL) is an advanced statistical modeling technique for inverse problems that builds upon traditional Bayesian methods by integrating hierarchical structures within prior distributions. This approach allows for extracting intricate relationships between parameters at various levels, fostering information sharing throughout the model. It is particularly effective when dealing with limited, noisy, or indirect data, yielding more accurate and robust inferences. Consequently, SBL has proven successful in diverse fields, such as machine learning, signal processing, and remote sensing.

In this talk, we introduce a novel approach for efficient Markov chain Monte Carlo (MCMC) sampling from the complex SBL posterior. The core innovation involves using prior-normalizing transport maps, which are deterministic couplings that transform the hierarchical sparsity-promoting SBL prior into a standard normal distribution. These maps

transform the complex target posterior into a simpler reference distribution equipped with a standard normal prior that can be sampled more efficiently. Numerical experiments will demonstrate order-of-magnitude speedups for standard MCMC techniques.

This talk is based on joint work with Youssef Marzouk (MIT).

Keywords: Inverse problems, sparse Bayesian learning, transport maps, uncertainty quantification