Data-free likelihood informed subspace for dimension reduction of Bayesian inverse problems

Olivier Zahm[*], **Tiangang Cui**[†], **Youssef Marzouk**[‡]

[*] Inria-Grenoble
700 avenue Centrale
38401 Saint-Martin-d'Hères, France
e-mail: olivier.zahm@inria.fr

[†] Monash University
9 Rainforest walk
Monash VIC3800, Australia
e-mail: tiangang.cui@monash.edu

[‡] Massachusetts Institute of Technologies (MIT)
77 Massachusetts avenue
Cambridge, 02139, MA, USA.
e-mail: ymarz@mit.edu

ABSTRACT

A high dimensional Bayesian inverse problem has a low effective dimension when the data are informative only on a low-dimensional subspace of the input parameter space. Detecting this subspace is essential for reducing the complexity of the inverse problem. In [1], a methodology to detect and exploit such a subspace has been proposed. It relies on gradients evaluations of the log-likelihood function and it allows to certify the approximation error when reducing the dimension of the problem. In this talk, we address the problem of finding such an informed subspace before the data is observed. The main idea is to trade optimality for generality: instead of constructing a data-dependent subspace which satisfies some optimality condition, we seek a data-free subspace which allows to control the approximation error on average over the data. We also discuss different sampling strategy that exploit this notion of informed subspace to draw efficiently samples from the posterior distribution.

REFERENCES

[1] O. Zahm, T. Cui, K. Law, A. Spantini, Y. Marzouk *Certified dimension reduction in nonlinear Bayesian inverse problems* arXiv:1807.03712