Postdoctoral Position

Reduced Modeling and Statistical Learning for Nonlinear State Estimation Algorithms

- **Starting Date:** October 2019 (flexible)
- **Duration:** One year, extendable to two.
- **Location:** Paris Dauphine University
- **Monthly salary (before taxes):** around 2500 euros.
- **Contact:** Olga Mula / mula@ceremade.dauphine.fr
- **How to apply**: Please, send your CV with a list of publications, a short motivation letter and contact information of two references.

Scientific setting

The candidate will work within the research group Models & Measures financed by the Emergences Program of the Paris City Council. The topic are *inverse state estimation* problems where the goal is to reconstruct numerically the state of a physical system (given by a function living in a high dimensional space) from a limited amount of measurement observations and the knowledge of a physical PDE model. Due to their ill-posedness, these problems are often addressed with Bayesian approaches that consist in searching for the most plausible solution using sampling strategies of the posterior density (see [1]). In view of their high numerical cost, especially in a high dimensional framework, novel methodologies involving reduced models have recently been proposed as a vehicle to reduce complexity and achieve near real time in the reconstructions.

Recent works on the topic have been devoted to find optimal linear reconstruction algorithms, see [2, 3, 4]. The task of the post-doctoral candidate will be to develop fast nonlinear solution strategies to the state estimation problem, with possible time-dependence. The envisaged approach is to combine reduced modeling with statistical learning algorithms such as mixture distributions and clustering algorithms.

As a support for our numerical tests, we will consider an application related to air pollution in the city of Paris which is currently being developed within the project Models & Measures.

Candidate profile

- A PhD in Numerical Analysis, Scientific Computing or Statistics.
- Solid experience in the development of numerical methods or data analysis with Python, Julia or C++.
- Solid working knowledge in at least one of the following topics: reduced modeling of PDEs,

uncertainty quantification, Bayesian inverse problems, non-parametric statistics, optimization, machine learning.

References

[1] A. M. Stuart. Inverse problems: a Bayesian perspective. *Acta Numerica*, 19:451–559, 2010.

[2] Y. Maday, A. T. Patera, J. D. Penn, and M. Yano. A parameterized-background data-weak approach to variational data assimilation: formulation, analysis, and application to acoustics. *International Journal for Numerical Methods in Engineering*, 102(5):933–965, 2015.

[3] P. Binev, A. Cohen, W. Dahmen, R. DeVore, G. Petrova, and P. Wojtaszczyk. Data assimilation in reduced modeling. *SIAM/ASA Journal on Uncertainty Quantification*, 5(1):1–29, 2017.

[4] A. Cohen, W. Dahmen, R. DeVore, J. Fadili, O. Mula, and J. Nichols. Optimal affine recovery algorithm for state estimation. Submitted, 2019.