Postdoctoral Position

Optimal Transport and Machine Learning Methods for High-Dimensional Inverse Problems

- **Starting Date:** Flexible. Ideally between September 2022 and December 2022.
- **Duration:** Two years.
- **Location:** TU Eindhoven (the Netherlands)
- **Contact:** Olga Mula / o.mula@tue.nl
- **How to apply**: Please, send your CV along with a transcript of records, and a piece of code that you are proud of.
- **Deadline:** June 15, 2022. Evaluation of applications will continue until the position is filled.

Scientific setting

We are looking for a postdoctoral candidate who will work within the new research group on Data-Driven Scientific Computing led by Olga Mula, located at CASA, the Center for Analysis, Scientific Computing and Applications of TU Eindhoven.

The goal of the group is to develop algorithms mixing the strengths of physics-based PDE methods with the ones offered by data-driven machine learning approaches. Both strategies have classically been considered separately, despite that they often provide complementary descrptions of the same reality. The group will adress the growing need to combine them in an optimal way, using strategies that will depend on the application.

The candidate's research project will consist in developping numerical methods for inverse problems where the goal is to recover the state of a physical system based on a limited set of noisy partial observations. The study will focus on physical phenomena that are modeled with high-dimensional PDEs involving strong advection effects. Examples of such equations can be conservation laws, transport or kinetic equations, Fokker-Planck equations, or Mean Field Game Equations. For this type of advection-dominated problems, it is known that classical linear approximation methods are not well suited. The postdoctoral candidate will adress this problem by developing nonlinear methods based on optimal transport, and machine learning. In order to address high dimensionality, and many-query evaluations, nonlinear model order reduction of parametric PDEs may be required. References [1, 2] could serve as a starting point for the intended research project.

Candidate profile

The ideal candidate will have the following skills:

- PhD degree in Applied Mathematics (Numerical Analysis, Applied Analysis, Scientific Computing), Statistics, or Machine Learning.

- Interest and some knowledge in at least one of the following topics: Optimal Transport, Machine Learning, Inverse Problems, Data-Assimilation, Optimization, Numerical Schemes for Conservation Laws or Mean Field Games, Model Order Reduction of parametric PDEs.
- Provable coding experience in Python, Julia, or C++.
- Interest in teaching activities.
- Strong interpersonal, organizational and communication skills. Ability to work both independently and in a team.
- Working and teaching is in English so excellent skills in this language are required.

Employment terms

Postdoctoral positions at TU/e are salaried, fixed-term positions. The position will have an initial contract of one year which will be extended for a second year after positive evaluation. The gross monthly salary depends on the candidates' experience. In addition, TU/e offers a wide range of secondary benefits, such as child care, sports facilities, generous holiday allowances (both in the form of leave hours and as financial benefit), and many others.

References

[1] V. Ehrlacher, D. Lombardi, O. Mula, and F.-X. Vialard. Nonlinear model reduction on metric spaces. application to one-dimensional conservative pdes in wasserstein spaces. *ESAIM M2AN*, 54(6):2159–2197, 2020.

[2] Albert Cohen, Wolfgang Dahmen, Olga Mula, and James Nichols. Nonlinear reduced models for state and parameter estimation. *SIAM/ASA Journal on Uncertainty Quantification*, 10(1):227–267, 2022.