Postdoctoral Position at INRIA, Rennes, France:

« Exploiting Image Data in the Process of Model Order Reduction»

Our Offer

We offer a 12 months post-doctoral position within the research center INRIA in Rennes, France. The research will address the derivation of new methodologies for the reduction of large complex models. The post-doctorate will investigate the exploitation of image data (e.g., captured by satellite) in the construction of reduced-order models (please see section « Scientific Context» for more information). The post-doctoral fellow is expected to start any time from February 2016 to June 2016**.** The net salary is between 2000€ and 2500€ (depending on your past experience).

Your Working Environment

You will work in collaboration with the teams *ASPI* (http://www.irisa.fr/aspi/index-en.html) and *Fluminance* (http://www.irisa.fr/fluminance/) in the INRIA research center in Rennes, France. INRIA (http://www.inria.fr/en/) is the French National Institute for computer science and applied mathematics. Its goal is to promote "scientific excellence for technology transfer and society". INRIA has currently 2,700 employees graduated from the world's top universities working in its labs. The ASPI team is an INRIA research group whose goals are the design, the theoretical analysis and the implementation of interacting Monte Carlo methods, including sequential Monte Carlo methods and Monte Carlo Markov Chain algorithms. The Fluminance team is another INRIA research group dedicated to the study of methods for the measurement, the analysis and the control of fluid flows from image sequences.

Your Skills and Profile

You hold a PhD degree and have an outstanding academic record. You enjoy cross-disciplinary work in an international environment and integrate easily into a project team. You have good command of English as working language. You have solid knowledge in applied mathematics, and specifically in probability theory, statistical analysis, machine learning techniques and constrained optimization. You have good skills in Matlab and C/C++.

Scientific Context

Model reduction consists in approximating a high-dimensional model by some system driven by a few degrees of freedom. Model reduction has become very popular in the last decades because it enables to cope with systems whose complexity would be intractable otherwise (see [1] for an overview of the reduction techniques for linear dynamical systems).

Because reduced-order models are only approximations of their high-dimensional counterparts, they are only expected to reproduce properly the behaviour of the latter in some particular regimes (for example, for some initial conditions or parameter values). The knowledge of such regimes is thus often used (sometimes explicitly but most often implicitly) in the construction of reduced-order models. Unfortunately, in some situations, the set of trajectories to be reproduced by the reduced model is not given explicitly but only observed through some partial and noisy observations. As an example, one can think of oceanography applications, where the scientists are interested in reproducing the streams in the ocean. In such setups, the boundary conditions defining the trajectories of the high-dimensional system are rarely known. However, we have at our disposal a large number of satellite images capturing the evolution of some passive tracers (*e.g.*, temperature,

salinity) conveyed by the ocean. These images thus provide noisy and partial observations of system of interest, see *e.g.*, [2].

Following recent work in the domain, see [3,4,5], you will be in charge of providing solutions to this type of problem, both at a methodological and a practical point of view. Your job will include the derivation of new methodologies, based in particular on Monte Carlo interacting methods for the construction of reduced-order models in the presence of uncertainties on the systems by exploiting image observations. Your work will also concern the theoretical analysis of the error committed by the reduced order model and their application to practical setups.

[1] A. Antoulas, “Approximation of Large-Scale Dynamical Systems”, Advances in Design and Control, SIAM 2005.
[2] Vincent Chabot, Maëlle Nodet, Nicolas Papadakis, Arthur Vidard. Accounting for observation errors in image data assimilation. Tellus A, Co-Action Publishing, 2015, 67 (23629), pp.19.
[3] Y. Maday, O. Mulla, “A generalized empirical interpolation method: application of reduced basis techniques to data assimilation”, Analysis and Numerics of Partial Differential Equations. Springer 2013.
[4] Y. Maday et al, “A Parameterized-Background Data-Weak Approach to Variational Data Assimilation: Formulation, Analysis and Application to Acoustics”, Technical report 2014, submitted to Int. J. Numer. Meth. Engineering.
[5] E.M. Ronquist, A.T. Patera, “Regression on parametric manifolds: Estimation of spatial fields, functional outputs an parameters from noisy data”, C.R. Acad. Sciences Paris, Ser. I, 350: 343-347, 2012.

Interested in the Job?

Please send your candidature (a resume and a copy of three of your most significant scientific publications) to

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