informatics mathematics
Inria

Post-Doctoral Position at INRIA, Rennes, France:

« Reduced-Order Model And Data: A Compressed Modeling Approach »

Our Offer

We offer a 16-month post-doctoral position within the research center INRIA in Rennes, France. The research will address the derivation of methodologies for "compressing" the high-order dynamical model (viewed as a set of constraints) into a reduced-order model, constituted by a small set of constraints complementary to the data. The post-doctoral fellow will investigate the performance of these compressed models to approximate large dynamical systems (*e.g.*, geophysical systems), using partial and noisy observations (e.*g.*, image data captured by satellite). See more details in the "Scientific Context" section. The post-doctoral fellow is expected to start between October 2016 and January 2017**.** The gross monthly salary is 2,621€.

Your Working Environment

You will join the *ASPI* team (http://www.irisa.fr/aspi/index-en.html) 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.

Your Skills and Profile

You hold a PhD degree and have an outstanding academic record. You have good command of English as working language. You have solid knowledge in applied mathematics, and specifically in constrained optimization, machine learning techniques and statistical analysis. You have good skills in Matlab and C/C++. Research experiences out of France are an asset.

Scientific Context

Model reduction consists in approximating a high-dimensional system by some model 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. The high-dimensional system is simplified by constraining its state to belong to some low-dimensional sub-space. The choice of this sub-space should be made so that it allows for a good approximation of a set of system states in some particular regimes (for example, for some initial conditions or parameter values). Many techniques have been proposed in the literature to identify such subspaces: reduced basis [1], POD [2], etc.

In some situations, the set of states to be reproduced by the reduced model can be observed through some partial and noisy observations. As an example, one can think of meteorological applications, where the scientists are interested in reproducing atmospheric winds. In such setups, we have at our disposal a large number of satellite images capturing the evolution of variables (*e.g.*, temperature, pressure, humidity) related indirectly to winds. These images thus provide noisy and partial observations of the winds of interest, see *e.g.*, [3].

Assuming the knowledge of the observation operator and of the regimes to reproduce, you will be in charge of designing method to infer a "good" sub-space for compressed modeling, working in conjunction with a set of observations. This challenging task has recently attracted the attention of many authors both theoretical and practical levels, see [4,5,6,7]. Based on these recent works, you will investigate compressed model constructions yielding tractable implementation and/or stable recovery guarantees.

[1] A. Quarteroni, G. Rozza, and A. Manzoni. “Certified Reduced Basis Approximation for Parametrized Partial Differential Equations and Applications”. Journal of Mathematics in Industry, 1(1): 1–49, Dec. 2011
[2] A. Antoulas, “Approximation of Large-Scale Dynamical Systems”. Advances in Design and Control, SIAM 2005.
[3] P. Héas, F. Lavancier, S. Kadri Harouna. “Self-similar Prior and Wavelet Bases for Hidden Incompressible Turbulent Motion”. SIAM Journal on Imaging Sciences, Volume 7, Issue 2, pp. 1171-1209, 2014.
[4] Y. Traonmilin, and R. Gribonval, “Stable Recovery of Low-dimensional Cones in Hilbert Spaces: One RIP to Rule Them All”. Arxiv , october 2015
[5] Y. Maday, A.T. Patera, J.D. Penn, M. Yano, “A Parameterized-Background Data-Weak Approach to Variational Data Assimilation: Formulation, Analysis and Application to Acoustics”. International J. Numer. Meth. Engineering 102:933–965, 2015.
[6] P. Binev, A. Cohen, W. Dahmen,. R. DeVore, G. Petrova, and P. Wojtaszczyk, “Data Assimilation in Reduced Modeling”. ArXiv, June 2015.
[7] Dihlmann, M., Haasdonk, B, « A Reduced Basis Kalman Filter for Parametrized Partial Differential Equations », ESAIM: Control, Optimisation and Calculus of Variations, EDP Sciences, 2015

Interested in the Job?

Please send your candidature (a resume, motivation and reference letters) to

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