Università degli Studi di Pavia
Computational Mechanics & Advanced Materials Group - DICAr

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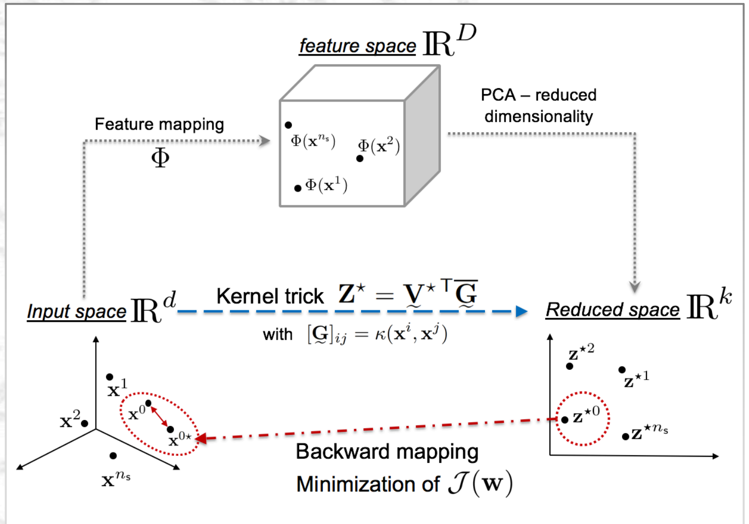
Virtual Modeling and Additive Manufacturing for Advanced Materials

SEMINAR

A kernel Principal Component Analysis (kPCA) digest with a new backward mapping (pre-image reconstruction) strategy

Methodologies for multidimensionality reduction aim at discovering low-dimensional manifolds where data ranges. Principal Component Analysis (PCA) is very effective if data have linear structure. But fails in identifying a possible dimensionality reduction if data belong to a nonlinear low-dimensional manifold. For nonlinear dimensionality reduction, kernel Principal Component Analysis (kPCA) is appreciated because of its simplicity and ease implementation. We aim at providing a concise explanation of PCA and kPCA main ideas, trying to collect the aspects that are often dispersed. Moreover, a strategy to map back the reduced dimension into the original high dimensional space is also devised, based on the minimization of a discrepancy functional.



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September 24th, 12:00pm (sharp)
Aula MS1, DICAr
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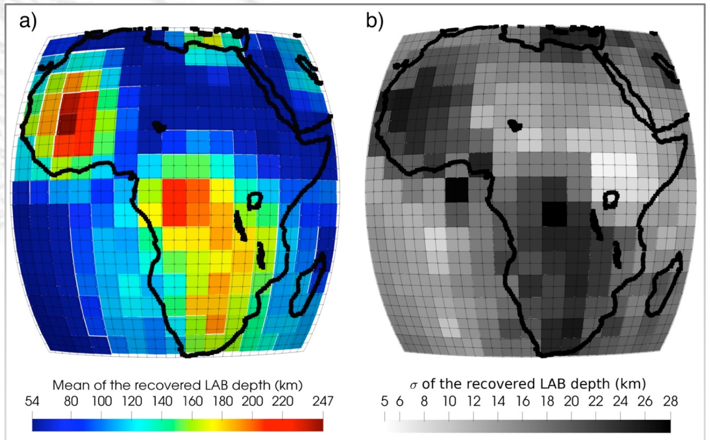
Combining Reduced Order Methods with Bayesian inference for the solution of inverse problems with application in Geophysics



One of the main challenges in modern lithospheric research is the understanding and characterization of the present day physical state of the thermal and compositional structure of the Earth's lithospheric and sublithospheric mantle. In doing so, high resolution inverse problems need to be solved.
One of the most abundant and better constrained data used for the inversion is the Earth's topography. Despite its quality, the topography models included in inversion schemes are usually very simplistic, based on density contrasts and neglecting any dynamic component. The reason for this is simply computational efficiency; 3D dynamic models are just too expensive to be included within the inversion.
In this context we propose the use of a greedy reduced basis strategy within an probabilistic Bayesian inversion scheme (MCMC) that makes feasible accounting for the fully dynamic topography model within the inversion.
We tested the proposed approach in a synthetic experiment aiming to recover the shape of the bottom of a lithospheric plate described by 225 parameters. Our synthetic model is located in Africa, as it is well-agreed within the geophysical community that the dynamic component in the region is not negligible. Our scheme is able to successfully recover the expected shape of the plate while reducing the computational time to less than 1% when compared to a full Finite Element approach.

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