Postdoctoral positition opened, 1 year,
machine learning and numerical simulation in mechanics,
Mines de St-Etienne, France, fall 2020.

Context of the position

This position is part of the MINDS project (MInes : Numérique, Data and Simulation) funded by the Carnot M.I.N.E.S. Institute to which many of the « Écoles des Mines » engineering colleges contribute. The overall goal of the MINDS project is to enhance the level of proficiency within the Institut Carnot M.I.N.E.S. in the booming research domain that is the convergence between intensive numerical simulation and data sciences. In practice, the MINDS project will create a numerical platform for research and development shared between the actors of the Institute that will foster synergies between researchers, leverage research and answer questions stemming from industry.

Scientific background

The postdoctoral researcher will study links between machine learning and flows in porous media. At the origin of the project is the existence of random fields that condition flows within the porous media and that can now be learned and generated by machine learning technics.
The random fields which determine the flows occur in many contexts such as geological structures and metal foams. In the current project, the application considered is a preform made of natural or synthetic fibers through which an epoxy resin flows during the manufacturing of a structural component made of composite materials. Such fiber preforms are complex media characterized by the variation of their properties through space and manufacturing instances, which limits the significance of deterministic simulations. Nevertheless, progress in AI, intensive computing and probabilities shed a new light on these issues.

Scientific objectives

The goal of the postdoctorate is to study the potential of machine learning to better monitor and control the variability of porous media in manufacturing. Two tasks are envisionned.
Starting from a data set of permeability or porosity fields, the first task will be to learn to generate new field instances. To this aim, generative models such as GANs – Generative Adversial Networks – or VAEs – Variational Auto Encoders – will be studied. Physical features of the fields may be used : permeabilities are tensors ; there are two scales, the microscopic scale of the fibers and the macroscopic scale of the equivalent homogeneous medium at which permeability tensors are defined.
The second task is to construct an inverse model that takes as input the macroscopic time records of resin flow and pressure in the mold, and infers from it probable permeability fields. Bayesian statistics are possible methods to transform an a priori on a nominal permeability field into a field posterior to the data recorded during the infusion.

Profile of the candidate

The postdoctoral researcher should hold a PhD either in relation to machine learning, either in the field of applied mathematics, or computer science or numerical mechanics. The details of the research program may be adapted to better match the background of the candidate.

The motivation, the scientific skills and the coherence of the professional perspectives will be the main criteria for the selection. This postdoctorate will take place within a collaboration between two teams in St-Etienne and one in Sophia-Antipolis so that the candidate should demonstrate team spirit.

Work location
École des Mines de Saint-Étienne, France (42) with periodic stays at the CEMEF (Mines ParisTech) Sophia-Antipolis.

Type of contract
Public service fixed term contract of 12 months.

How to candidate
Send a CV, a motivation letter and recommendation letters to (rodolphe.leriche@mines-stetienne.fr), (julien.bruchon@mines-stetienne.fr) and (nicolas.moulin@mines-stetienne.fr)

For further information, please contact :

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