FOR APPLICATION, PLEASE CONTACT ADVISOR(S) BY EMAIL WITH COPY TO:
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Research Topic for the ParisTech/CSC PhD Program

Field: Materials Science, Mechanics, Fluids

Subfield: Mech. Eng.

Title: A strategy to build reduced mechanical models of composites structures based on data and machine learning

ParisTech School: Arts et Métiers (Campus of Bordeaux)

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Short description of possible research topics for a PhD:

A change of paradigm is being observed in most of industrial sectors with the constant increase of available data and the massive use of artificial intelligence. In mechanical engineering, a reliable and rich phenomenological/experimental database can be sometimes more efficient than models based on physics.

In the domain of designing composite structures, the complexity of existing models can be damning due to the high number of parameters to identify considering the multi-scale, multiple failure modes, coupling and natural variability aspects. There is therefore a great challenge in combining a good knowledge of the physics and available data to get a quick assessment of the behavior of a structure and the risk of failure, including variability.

The aim of this project is to explore new approaches based on model reduction, data analysis techniques and machine learning in order to build hybrid models (based on physics and data) on the fly and to reduce considerably the complexity of designing process.

Required background of the student:
Mechanical engineering, numerical methods, programming, composites materials

A list of 5(max.) representative publications of the group: (Related to the research topic)

S. Metoui, E. Prulière, A. Ammar, F. Dau, I. Iordanoff, The proper generalized decomposition for the simulation of delamination using cohesive zone model, à paraître dans *International Journal for Numerical Methods in Engineering*, 99:13 (2014), pp 1000–1022

S. Metoui, E. Pruliere, A. Ammar, F. Dau, I. Iordanoff, A multiscale separated representation to compute the mechanical behavior of composites with periodic microstructure, Mathematics and Computers in Simulation, In Press (published online)

E. Prulière, F. Chinesta, A. Ammar, On the deterministic solution of multidimensional parametric models using the Proper Generalized Decomposition, *Mathematics and Computers in Simulation*, 81:4 (2010), pp 791-810