Data-driven computational fluid mechanics

Amine Ammar, Jose Vicente Aguado[2], Emmanuelle Abisset-Chavanne[2], Francisco Chinesta[2], and Elias Cueto[3]

[1] *Arts et Metiers ParisTech. ENSAM Angers, France.*

[2] *ICI, High Performance Computing Institute, Ecole Centrale de Nantes, 1 rue de la Noe, 44300 Nantes, France*

[3] *I3A, Universidad de Zaragoza. Maria de Luna, s.n., E-50018 Zaragoza, Spain*

Standard simulation in classical mechanics is based on the use of two very different types of equations. The first one, of axiomatic character, is related to balance laws (momentum, mass, energy, ...), whereas the second one consists of models that scientists have extracted from collected, natural or synthetic data. Even if one can be confident on the first type of equations, the second one contains modelling errors. Moreover, this second type of equations remains too particular and often fails in describing new experimental results. The vast majority of existing models lack of generality, and therefore must be constantly adapted or enriched to describe new experimental findings. In this work we propose a new method, able to directly link data to computers in order to perform numerical simulations in the field of fluid mechanics. These simulations will employ axiomatic, universal laws while minimizing the need of explicit, often phenomenological, models. This technique is based on the use of manifold learning methodologies, that allow extracting the relevant information from large experimental datasets.