S-mart 2021

17ème colloque national S-mart AIP-PRIMECA

Le Jumeau Numérique au service de l'industrie 4.0

Paco CHINESTA – ESI - ENSAM

Summary:

World is changing very rapidly. Today we do not sell aircraft engines, but hours of flight, we do not sell an electric drill but good quality holes, … and so on. We are nowadays more concerned by performances than by the products themselves. Thus, the new needs imply focusing on the real system subjected to the real loading that it experienced until the present time in order to predict the future responses and in this manner, anticipate any fortuity event or improve the performances. Here, usual modeling and simulation techniques are limited because of the fact that a model is sometimes no more than a crude representation of the reality. Artificial Intelligence irrupted and became a major protagonist in many areas of technology and society at the beginning of the third millennium, however many times it requires impressive training efforts (incredible amount of data, most of them inexistent, difficult to collect and manipulate, extremely expensive in time and resources).

A highway to circumvent these difficulties and successfully accomplishing the most efficient (fast, accurate and frugal) generation of information and knowledge facilitating a real-time decision-making in engineering consists of a hybrid paradigm combining real-time physics ad real-time data-driven modelling.

From the physics-based modeling viewpoint, an appealing route consists of using Model Order Reduction for solving physics-based models in almost real-time, enabling simulation, optimization, inverse analysis, uncertainty propagation, simulation-based control, ... all them under the stringent real-time constraint.

From the data-driven modeling viewpoint, we will address four main topics: (i) real-time data-assimilation; (ii) physics-aware machine learning technologies able to proceed in real-time and in the low-data limit; (iii) addressing data issues related to the data intrinsic dimensionality, the existence of hidden variables, addressing outliers, noise and missing data, …; and (iv) the hybridation between the physics-based and the data-driven models for defining efficient dynamics data-driven application systems.