Séminaire du laboratoire PIMM

Jeudi 22 septembre 2022 à 13h30 en Amphi Esquillan

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présentera dans le cadre du séminaire ces travaux intitulés :

Digital twin and data-driven modeling for simulation and control of industrial processes

Simulation and control of industrial processes can become a tricky issue, especially when it involves real-time feedback, requiring a set of control inputs every few milliseconds. Therefore, classical simulation techniques are combined with model reduction ones to tackle computation time issues. However, despite the impressive progress in computational mechanics and hardware technology, reliable simulations of some industrial processes remain intractable in real-time. Thus, the coupling of simulation techniques with data-driven method offers the possibilities of improving the simulation results. Moreover, when simulation fails to produce fast enough predictions, fully data-driven techniques show to be a promising approach.

Previous works used dynamic mode decomposition (DMD) to build a digital twin, learning therefore a stable correction and integrator of the controller, using a linear transfer function between the inputs and outputs of the process. Moreover, regularization is used to train a stable time integrator using DMD method. On the other hand, DMD can be extended to nonlinear settings, where DMD is trained locally, which leads to the need of training multiple local integrators and then select the most appropriate one during the operation, depending on the location in the phase space.

In this work, we build a non-linear integrator of industrial control processes, using machine learning techniques and advanced recurrent neural networks. Multiple models are trained and used in this work. The result is first a real-time controller behaviour prediction in fraction of milliseconds. Second, a stable real-time integrator is trained to perform real-time controller simulations. Both models are tested against data sets never used in the training.