ParisTech

Arts et Métiers Sciences et Technologies

RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM

Field: Materials Science, Mechanics, Fluids

Subfield: Mechanical Engineering

Title: Optimizing flow control actuators by data-driven reduced-order models

ParisTech School: Arts et Métiers Sciences et Technologies

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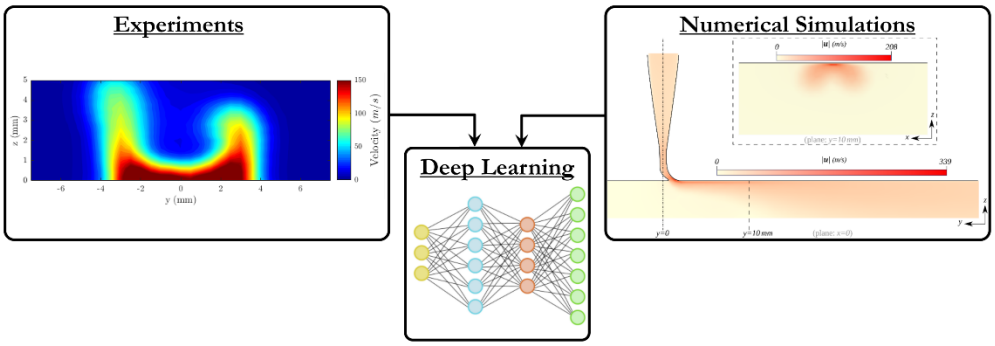
Short description of possible research topics for a PhD: Physics informed neural networks are tools recently developed to solve learning tasks within the framework of physical constraints. Starting from a set of data, the neural network can also be used to find a mathematical model (a set of partial differential equations) that well reproduces the data. The objective of this project is to apply physics-informed deep learning to find a reduced-order model that acutely describes the fluid dynamics of an active flow control device. The actuator of interest in this project is a centimeter-size device designed to inject momentum near a wall exploiting Coandă effect. It results that an optimal boundary layer control depends on the blowing regime employed for the actuator. We aim at using numerical simulations (CFD, see figure) and experimental hot-wire measurements (see figure) to synergically perform the data-driven training of a data-driven neural network. Sparse low-rank algorithms will be used to derive the reduced-order model of the actuators. Thanks to the cheap computational costs associated to the reduced-order system, a wide parameter space can be explored in order to optimize the operating conditions of the actuators.



Required background of the student: Fluid Mechanics or Applied Mathematics

A list of 5 (max.) representative publications of the group:

1. N. Mazellier, P. Joseph, F. Stella, A. Kourta, P. Sujar-Garrido, and Zhou Y., TSFP10, Chicago 2017.
2. J.-L. Aider, P. Joseph, T. Ruiz, P. Gilotte, Y. Eulalie, C. Edouard, and X. Amandolese, Int. J. Flow Control, vol. 6(1), 1-20, 2014.
3. P. Joseph, D. Bortolus, and F. Grasso, Comptes Rendus-Mécanique, vol. 342(6-7), 376-381, 2014.
4. P. Joseph, X. Amandolese, C. Edouard, and J.-L. Aider, Exp. Fluids, vol. 54(1), 1-12, 2013.