Proposal for Master thesis:
Physics-informed Machine Learning methods for fluid dynamics

Fluid dynamics and Machine Learning

Machine Learning (ML) is emerging as a key technology to analyse large data in modern society (social networks are just an example). Nonetheless, ML has also remarkable potential in different scientific fields, when it comes to reduce the complexity of large amounts of data [1]. In this view, ML can be efficiently exploited to extract information from experiments as well as from numerical simulations. This thesis focuses on the development of ML algorithms (using Python language) able to analyse fluid dynamics data. A typical representative problem [2] will be analysed first by numerical simulations; successively, the obtained simulations will be used to train a proper ML algorithm and extrapolate results to different conditions. This will finally allow to understand how simulations and the newly emerging Artificial Intelligence can be efficiently combined to reduce the computational cost of simulations in fluid mechanics.

Figure 1: Air bubbles rising in water. Figure taken from [2].

References

[1] Moen et al. Deep learning for cellular image analysis. Nature Methods 16 (2019) 1233-1246
[2] Figure taken from: Stockfreeimages.com

Keywords

Computational Fluid Dynamics; Machine Learning; Image analysis

Supervisor

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Host laboratory

Multi-Scale Modeling Laboratory - http://www.polito.it/small/

Requirements

Strong interest in computational fluid dynamics and strong attitude to coding is required.
Friendliness with MATLAB and (at least) basic knowledge of Linux operating systems are required.
Knowledge of Python language and basics of C programming are very welcome.