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AI-MACHINE LEARNING METHODOLOGIES TO ACCELERATE CFD-BASED DESIGN AND OPTIMISATION

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ABSTRACT

Data driven methods under the Artificial Intelligence (AI) umbrella and its associated subset Machine Learning (ML) have seen extensive development in recent years. This is mainly due to a number of powerful opensource codes democratising the use Deep Neural Network (DNN), and increase in computing powers with new GPU and CPU chips. The AI methods although originally developed to replicate the human brain, once trained, are shown to be able to be to learn highly complex relationships in engineering datasets.

The ability to apply the AI methods to physical problems, ranges from analytical, to numerical as well as experimental fluid mechanics. The new AI/ML methods is claimed to cut simulation times from days/hours to near instant and improves efficiency. However, these methods often require a large amount of training data, to produce accurate results for the highly non-linear fluid mechanics problems, nearly all the results published in the literature relating to high-dimensional test cases have used large number of simulations often much higher than even "classical" surrogate models used in the industrial optimisation workflows.

In this STS, we would like to review and discuss novel methods that are used to address the aforementioned inefficiencies, aiming to accelerate CFD simulations used to design turbomachinery components like multi-stage Fan, Compressor and Turbine components in a fraction of the cost and time associated with direct design using high-fidelity analysis.