Rapid Aerodynamic Modelling at Airbus

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The main difficulty of aircraft design can be summarised in a simple question: how to converge towards the right product at the right time and at the right cost with the most appropriate process for each step of the a/c development?

Among all the disciplines involved in the overall aircraft design, aerodynamic models aim at providing mandatory inputs for Handling Qualities, Performance and Loads thanks to various numerical and experimental means, such as CFD or wind tunnel tests. Developing the *right product at the right time and at the right cost*, can be transposed to the aerodynamic perimeter to select and use efficiently the most relevant capabilities at each stage of the development process, to evaluate multiple aircraft configurations.

Deep learning and Artificial Neural Networks have been successfully applied to many fields. Image recognition, object detection or natural language processing are some of the most active fields of Data Science research. The ability of computer vision algorithms in particular, based on convolutional neural networks, have been demonstrated to detect and model features of images, from the most basic (vertical or horizontal lines) to the most complex (human faces, eyes...).

Aerodynamics models, either based on global aircraft coefficients or skin pressures, based on large volumes of data produced by experimental or numerical means, include some specific visual patterns like stalls at high angle of attack, supersonic rooftops or stagnation points. These peculiar *visual* phenomena can be captured and modelled quite properly thanks to deep learning algorithms.

In this context, combining deep learning based data fusion, data scaling or high dimensional surrogate modelling with more traditional aerodynamic capabilities (rapid CFD such vortex lattice methods, RANS CFD or wind tunnel tests), appears to be a game changer to generate quickly Aerodynamic Models with the right level of fidelity, in particular in the earlier phases of the aircraft design process.

In this presentation, we will give some examples of how these digital techniques are combined with more classical aerodynamic capabilities at Airbus to produce quickly accurate aerodynamic models. A particular focus on the challenges to be tackled in the near future for an industrial company like Airbus will also be given.