Chair of Aerodynamics and Fluid Mechanics
TUM School of Engineering and Design
Technical University of Munich

Application of Neural Networks to Aerodynamic Data Fusion for High Agility A/C

Master Thesis

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The Chair of Aerodynamics and Fluidmechanics is offering an opportunity for a M.Sc. student to work within an industrial setting on the development of methods for aerodynamic dataset modelling.

Background

For modern high-performance aircraft configurations, where a Flight Control System (FCS) is used to offer carefree handling qualities in the presence of inherently unstable aircraft dynamics, detailed knowledge of the aircraft aerodynamics is of paramount importance. An accurate aerodynamic model allows the FCS to be designed as close as possible to the aircrafts limits and capabilities. In order to generate a sufficiently accurate model of the aerodynamic forces and moments acting on the aircraft, a vast amount of data originating from different sources (wind tunnel, flight test, computational fluid dynamics) is collected. The resulting aerodynamic model of the aircraft shall reflect the information contained in the various data sources according to their individual measurement accuracy levels.

Work Description

The primary focus of this work is to adapt and evaluate the application of an existing Neural Network based machine learning approach (which has so far been successfully applied to single source WT data) to the task of fusing aerodynamic coefficient and surface data from different data sources. As main use case, the fusion of existing WT data and CFD data shall be investigated. Optionally, existing FT data as a third source could be added to the process and/or used as validation reference. Of particular interest for the assessment of the method is the investigation of ways to control the resulting fusion model based on accuracy information from the different data sources.

Content

- Familiarisation with existing aerodynamic data and database structure (mySQL).
- Familiarisation with machine learning methodology based on Artificial Neural Networks (PyTorch).
- Definition of sensible criteria for assessing the data fusion result accounting for accuracy information.
- Adaptation and implementation of required modifications to the existing Neural Network method for use with multiple data sources.
- Assessment of the generated models by application of the previously defined criteria.
- Proper documentation of the results.

Requirements

- Founded knowledge of mathematics, statistics and aerodynamics.
- Interest and insight into the theory of machine learning and uncertainty quantification.
- Advanced programming skills (Matlab and Python).
- Knowledge of common relational database systems (mySQL).
- Self-organized work approach.

If you are interested in this opportunity, please send your application including a CV, a brief statement of motivation and a transcript of records to Ferdinand Dunkes (ferdinand.dunkes@tum.de).