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MANEUVER-BASED CROSS-VALIDATION APPROACH FOR ANGLE-OF-ATTACK ESTIMATION

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In 2019, two tragedies related to the failure of the Air Data System (ADS) led to a growing interest in synthetic sensors for aerodynamic angles. The MIDAS project is funded by Clean Sky 2 with the aim of design and manufacture a modular, fully integrated and digital ADS equipped with synthetic sensors based on neural networks [1]. Started at the end of 2018, it is following a certifiable process based on DO-254 and DO-160 and in 2021 it will constitute a rare case of certifiable probe equipped with synthetic estimators of AOA/AOS. In literature, it is usually studied the choice of the architecture of the neural network, regardless of the efficiency of the training phase. However, the generalization capabilities of the estimator cannot be predicted nor optimized. This work proposes a technique to improve the performance of the sensor, independently from the architecture. Instead of partitioning by experience the dataset in a training set and a test set, this work proposes to apply a partitioning based on the flight condition, followed by the Cross-Validation technique. It is hence possible to generate several different pairs of training sets and test sets and to choose the best estimator [2]. In this framework, it is possible to subdivide each flight so that each partition can be identified with a flight maneuver. Once the CV training is conducted, the analysis of the selected training and test sets can help to analyze which are the most suitable maneuvers and which ones can be discarded. The comparison can be conducted both on the error timeseries and on the uncertainty charts. In fact, one of the most interesting result is the homogeneity assumed by the uncertainty on the flight envelope. A drawback of this method is that the computational cost increases by the number of possible training sets and, sometimes, the various partitions will contain more than a singular flight maneuver in order to reduce the number of trials. This work gives evidence that a careful definition of the training set can help to reduce the error peaks without modifying the neural architecture, provided a sufficient number of neurons. Moreover, it provides some insight in the definition of the best set of flight maneuvers necessary to properly design a virtual sensor.

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