Aerodynamic Modeling and System Identification from Flight Data – Recent Applications at DLR

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Abstract:

This paper provides an overview of a few selected system-identification activities carried out during the last decade at DLR, the German Aerospace Center. After a brief account of parameter-estimation methods, and of consistency checking of recorded flight data, an emphasis is placed on 1) development of global, high-fidelity aerodynamic databases for training simulators; 2) models for in-flight simulator; 3) modeling of stall hysteresis; 4) estimation of aerodynamic flowfield characteristics and validation of aircraft reaction models from wake vortex encounter flights; and 5) a parametric wake distortion model to improve helicopter coupling off-axis response. These examples cover a variety of flight vehicles with widely different characteristics, namely, the military transport aircraft Transall C-160, commuter aircraft Dornier 328, in-flight simulator VFW-614 ATTAS, high altitude research aircraft G850 Strato 2C, Airbus-type aircraft, fly-by-wire helicopter BO-105, and fly-by-light helicopter EC-135. Besides parameter estimation aspects, those related to model validation are discussed. Through succinct examples it is brought out that system identification has become an indispensable tool to support not only research but also industry activities in various key areas such as model validation, handling qualities evaluation, control law design, and flight vehicle design and certification. Thus, it contributes significantly to risk and cost reduction.

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