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Advantages of Neural Network Based Air Data Estimation for Unmanned Aerial Vehicles

Authors : Angelo Lerro, Manuela Battipede, Piero Gili, Alberto Brandl

Abstract : Redundancy requirements for UAV (Unmanned Aerial Vehicle) are hardly faced due to the generally restricted amount of available space and allowable weight for the aircraft systems, limiting their exploitation. Essential equipment as the Air Data, Attitude and Heading Reference Systems (ADAHRS) require several external probes to measure significant data as the Angle of Attack or the Sideslip Angle. Previous research focused on the analysis of a patented technology named Smart-ADAHRS (Smart Air Data, Attitude and Heading Reference System) as an alternative method to obtain reliable and accurate estimates of the aerodynamic angles. This solution is based on an innovative sensor fusion algorithm implementing soft computing techniques and it allows to obtain a simplified inertial and air data system reducing external devices. In fact, only one external source of dynamic and static pressures is needed. This paper focuses on the benefits which would be gained by the implementation of this system in UAV applications. A simplification of the entire ADAHRS architecture will bring to reduce the overall cost together with improved safety performance. Smart-ADAHRS has currently reached Technology Readiness Level (TRL) 6. Real flight tests took place on ultralight aircraft equipped with a suitable Flight Test Instrumentation (FTI). The output of the algorithm using the flight test measurements demonstrates the capability for this fusion algorithm to embed in a single device multiple physical and virtual sensors. Any source of dynamic and static pressure can be integrated with this system gaining a significant improvement in terms of versatility.

Keywords : aerodynamic angles, air data system, flight test, neural network, unmanned aerial vehicle, virtual sensor
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