

APPLICATION OF NON-INTRUSIVE OPTICAL METHODS FOR IN-FLIGHT FLOW VISUALISATION

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ABSTRACT

The design or modification of an aircraft requires substantial numerical and experimental studies. The outcome of the design process and therefore the definitive quality of the aircraft will be verified during the flight tests for certification. The extrapolation of the data obtained during wind tunnel experiments or at low Reynolds number simulations to real flight conditions is not straight forward and often based on engineering experience or estimations. In terms of measurement techniques, non-intrusive optical image based methods have undergone considerable technological progress during the past decade. The main objective of the European project Advanced In-Flight Measurement Techniques (AIM) is the further development of these optical methods such that they can be routinely applied to flight tests to provide detailed quantitative information on various important parameters e.g. pressure distribution on a wing or density gradient and flow vector fields near airplanes and helicopters. This research project belongs to the 6th European Framework and is funded by the European Commission.

One of the applied advanced in-flight measurement techniques is the particle image velocimetry (PIV) method. This mature wind tunnel measurement technique delivers instantaneous flow velocity vector fields with high spatial and temporal accuracy, which can be used to validate numerical simulations. The arrangement of this experimental procedure has been specified and certified for a Dornier DO228 aircraft by the German Aerospace Center (DLR) together with the Cranfield University. The following paper will give a brief overview on the measurement technique PIV and the main challenges such as certifying an airborne class 4 laser system, or the search for suitable seeding, before being able to apply the technique to flight tests. In what follows, the measurement setup and the flight tests will be described. Some of the first results and an outlook on future activities will conclude the paper.