Experiments in Fluid Mechanics 2015

Title of presentation:
Fluid-Structure Interaction Studies Using Optical Measurement Techniques.

Authors: Alex Nila

Organisation(s): LaVision GmbH

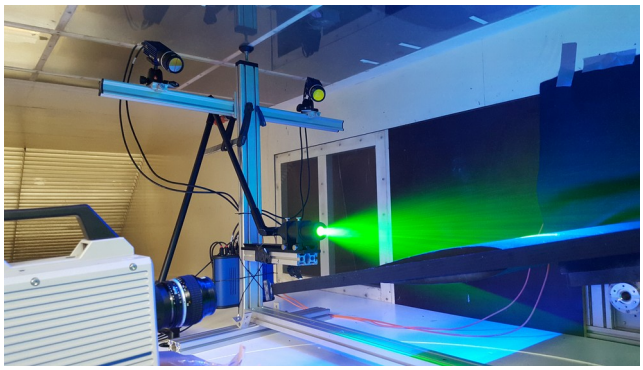
Email(s): anila@lavision.com

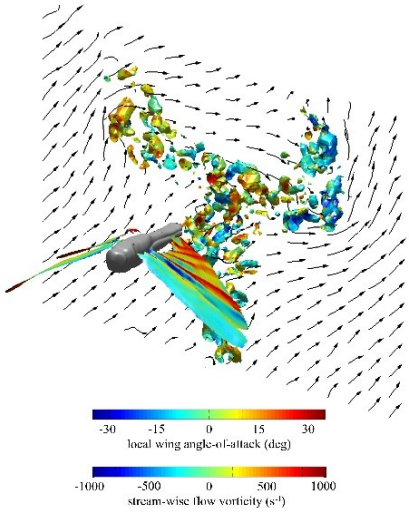
Abstract:

The study of Fluid-Structure Interaction (FSI) phenomena, such as aeroelasticity, has long been an important challenge for industry and academia alike. In recent years, the requirements for a better understanding of this phenomenon have been raised by such factors as the fast growing deployment of composite materials in aeronautical structures, or the need for more economical and innovative designs.

At present, numerical simulations are being used to model the behaviour of fluid flows around deforming and/or moving structures and the interactions that occur between the two. Nevertheless, the numerical modelling of such complex systems is not only very computational demanding, but also a cumbersome procedure that is highly sensitive to errors caused by various assumptions. Therefore, these new numerical models need to be validated and, preferably, experimental investigations need to offer a better view of the dynamics of FSI.

This presentation describes a viable alternative to conducting FSI experimental investigations that yield full-field, instantaneous data of the fluid flow as well as the structural response. Through the use of Digital Image Correlation (DIC) - for describing structural response - and synchronized Particle Image Velocimetry (PIV) - for the characterization of the fluid flow - new opportunities are created in the field of FSI. LaVision's experience in providing state-of-the art optical measurement solutions including high-performance hardware and robust and accurate processing software, translates into a viable and flexible way of conducting FSI experiments, as will be exemplified throughout this presentation. The various projects presented herein have shown the versatility of optical measurements in analysing FSI problems such as flows over a flexible wing, aeroelastic flutter or insect flight description.





Acknowledgments and references:

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N. Phillips application note (LaVision): 'Fluid-Structure Interaction Studies of Bioscience Subjects' authors: Dr. N. Phillips et al., Structure and Motion Laboratory, Royal Veterinary College, UK

J. Ertveldt application note (LaVision): 'Fluid-Structure Interaction Study: Towards Active Flutter Control of a Composite Wing' authors: Dr. A. Nila, Dr. D. Hollis, LaVision UK Ltd., UK; J. Ertveldt, B. De Pauw, Vrije

Universiteit Brussel, Belgium, Department of Mechanical Engineering, Vrije Universiteit Brussel, Belgium