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Editorial

Special Issue: Aeroelasticity

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Received: 21 August 2019; Accepted: 23 August 2019; Published: 23 August 2019

Aeroelasticity belongs to the larger family of fluid-structure interaction problems that are characterized by the interplay between a fluid and deforming body. Aeroelasticity has also been the central topic of this special issue that has received a large number of high-quality submissions. These submissions reflect well-coordinated efforts to tackle unique challenges posed by aeroelasticity in our modern times. Through interactions among the industry, research centres and universities, and international collaborations extending across the USA, Europe, China and Australia, this special Issue reports on the latest developments in understanding, modelling and exploiting aeroelastic phenomena for safer and more efficient vehicles.

First, we have reviewed the research that contributed development of the theory and enhanced the fundamental understanding of aeroelastic phenomena. Quero et al [1] introduced the generation of a generalized state-space aeroservoelastic model based on tangential interpolation. The approach provides a minimal order realization with exact interpolation of the unsteady aerodynamic forces in tangential directions and overcomes certain drawbacks of the classical rational function approximation approach. Boutet et al [2] discussed the development of an unsteady aerodynamic model based on the combination of Wagner theory and lifting line theory through the unsteady Kutta–Joukowski theorem. The resulting set of closed-form linear ordinary differential equations are solved analytically or by using a Runge–Kutta–Fehlberg algorithm. Eaton et al [3] applied a numerical continuation method to an aeroelastic plant with geometric nonlinearity to predict subcritical limit cycle oscillations. Vio et al [4] investigated transient temperature effects that dominate the aerothermoelastic behavior of hypersonic vehicles. Finally, Muc [5] considered the problem to move the occurrence of undesired aeroelastic phenomena to higher airspeeds by optimizing the structural layout of laminated plates.

As a necessary step to validate prediction methods, a number of aeroelastic demonstrators have been designed, built and flight tested. For example, Rozov et al [6] performed computational fluid dynamics-based analyses and compared results with standard aerodynamic methods for the design of a low-speed flutter demonstrator. The work was carried out as part of the European Commission funded project *Flutter Free Flight Envelope Expansion for Economical Performance Improvement*. Pusch et al [7] developed a flight control system for a highly flexible flutter demonstrator, developed in the European FLEXOP project. The flight control system includes a baseline controller to operate the aircraft fully autonomously and a flutter suppression controller to stabilize the unstable aeroelastic modes and extend the aircraft's operational range. Grauer et al [8] presented the system identification from measured flight test data conducted using the X-56A aeroelastic demonstrator to identify a longitudinal flight dynamics model that included the short period, first symmetric wing bending and first symmetric wing torsion modes. Sun et al [9] dealt with the problem of correcting measured wind tunnel data from aeroelastic deformations, and demonstrated the methodology on the High Reynolds Number Aero-Structural Dynamics wing model.

Active control is an inherent element of any aeroelastic system when either desired characteristics are not met by design or to further improve the vehicle performances. Fichera et al [10] designed and tested a high-bandwidth continuous actuator to control the aeroelastic behaviour of a wind tunnel model. Wang et al [11] discussed the implementation of an adaptive feedforward control strategy to enhance the aeroelastic stability of a plan compared to a classical feedback control strategy. Finally, Cheng et al [12] investigated the potential benefits of harvesting aeroelastic energy caused by discrete gusts to partly power a control system.

Acknowledgments: The editor of this Special Issue would like to thank each one of these authors for their contributions and for making this Special Issue a success.

Conflicts of Interest: The author declares no conflict of interest.

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