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Editorial

Aerospace Best Paper Awards 2019

Aerospace Editorial Office

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Aerospace has launched annual awards to recognize outstanding papers published in the journal. We are pleased to announce the "*Aerospace* Best Paper Awards" for 2019. Nominations were chosen from all papers published in 2019, and decisions were made by the Editorial Board together with the Editorial Office. Following a review process by the Editorial Board, the following three top-voted research articles, in no particular order, have won "Aerospace Best Paper Awards" for 2019:

Effects of Nozzle Pressure Ratio and Nozzle-to-Plate Distance to Flowfield Characteristics of an Under-Expanded Jet Impinging on a Flat Surface
Duy Thien Nguyen, Blake Maher and Yassin Hassan (Figure 1)
Aerospace **2019**, *6*, 4; doi:10.3390/aerospace6010004
Available online: https://www.mdpi.com/2226-4310/6/1/4

Impinging jet configuration has received many considerations from researchers due to its widespread use in many industrial applications. For example, impinging jets can be used for cooling of hot surfaces such as turbine blade, rocket engines or vertical and short takeoff and landing aircraft, and as torque generators in turbomachinery systems. The flow characteristics of impinging jets, despite their geometrical simplicity, are very complex and have posed challenges to numerical simulations, particularly for turbulence modelling.

In the current communication, we experimentally study the under-expanded turbulent impinging jets featuring in many important applications of turbomachinery and aerospace engineering. Particularly, the test model is a convergence–divergence nozzle, which is typically installed in turbomachinery systems of many power plants in the United States. Velocity measurements of subsonic and supersonic under-expanded free jets and jets impinging on a solid surface with various nozzle pressure ratios (NPRs) ranging from 2 to 2.77, and different values of nozzle-to-plate gaps, i.e., e = 10 mm, 20 mm, and 30 mm, are performed using two-dimensional two-component (2D2C) particle image velocimetry (PIV) technique to acquire high-spatial resolution measurements of the velocity fields for different flow configurations of under-expanded jets.

The mean velocity fields showed the jet flow deflection caused by the impinging surface, while the turbulent kinetic energy contours illustrated significant high levels along the shear layers near the nozzle exit and on top of the solid surface, where the jet shear layers impinged. At high NPRs, the presence of a stand-off shock and a stagnation region was observed, and the peaks of turbulent kinetic energy were found in the region of the stand-off shock. POD analysis is applied to the PIV velocity snapshots of free jets and impinging jets to reveal the most dominant flow structures that play important roles in the flow dynamics and acoustic characteristics of subsonic and supersonic jets. The POD velocity decompositions have shown that the coherent large-scale structures extracted from the velocity fields of NPR_1 = 2 and NPR_2 = 2.2 were different to those extracted from the velocity fields of NPR_3 = 2.5 and NPR_4 = 2.77. This indicated the differences in large-scale flow structures and transition of energy-contained eddies when the impinging jet flows have undergone transition from subsonic to supersonic conditions.

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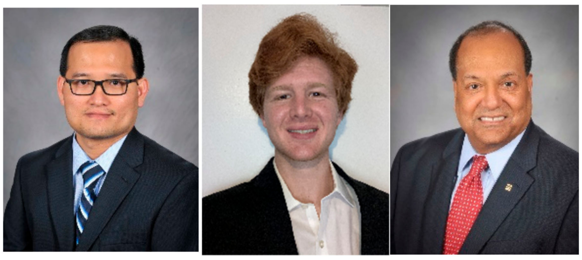

(**a**) (**b**) (**c**)

Figure 1. Dr. Nguyen's research group: (**a**) Duy Thien Nguyen, (**b**) Blake Maher, and (**c**) Yassin Hassan.

Structured Control Design for a Highly Flexible Flutter Demonstrator
Manuel Pusch, Daniel Ossmann, Tamás Luspay
Aerospace **2019**, *6*, 27; doi:10.3390/aerospace6030027
Available online: https://www.mdpi.com/2226-4310/6/3/27

In order to improve environmental sustainability and economic efficiency of aircraft, multidisciplinary aircraft design approaches are imperative where the effects and potentials of active control functions are considered from early design stages onwards. Within the FLEXOP research project and its succession project FLIPASED, both part of the EU Horizon 2020 supporting program, such multidisciplinary aircraft design capabilities are developed and validated. An important contribution thereby is the development of an advanced control system which allows for autonomously flying a highly flexible flutter demonstrator beyond its nominal flight velocity range.

The model-based flight control system has been developed by the team depicted in Figure 2, and includes a baseline controller to operate the aircraft fully autonomously plus a flutter suppression controller to stabilize unstable couplings between aerodynamics and structural dynamics. The baseline control system features a classical cascade flight control structure with scheduled control loops to augment the lateral and longitudinal axis of the aircraft. The flutter suppression controller uses an advanced blending technique to blend the flutter relevant sensor and actuator signals. These blends decouple the unstable modes and individually control them by scheduled single loop controllers. For the tuning of the free parameters in the defined controller structures, a model-based approach is used based on solving multi-objective, non-linear optimization problems. The developed control system, including baseline and flutter control algorithms, is verified in an extensive simulation campaign using a high-fidelity simulator. The simulator is embedded in MATLAB and a features non-linear model of the aircraft dynamics itself and detailed sensor and actuator descriptions.

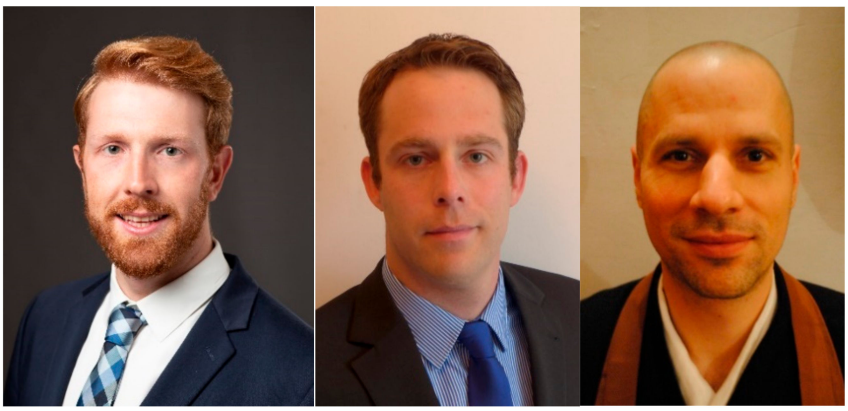

Figure 2. The control design team consisting of (from left to right) Manuel Pusch, Daniel Ossmann, and Tamás Luspay.

High-Bandwidth Morphing Actuator for Aeroelastic Model Control
Sebastiano Fichera, Irma Isnardi and John E. Mottershead
Aerospace **2019**, *6*, 13; doi:10.3390/aerospace6020013
Available online: https://www.mdpi.com/2226-4310/6/2/13

Numerous morphing designs have been proposed over the past years for achieving continuous aerofoil camber deformation; however, most of such solutions are scale dependent and are not designed for controlling responses in the frequency range of interest for gust loads alleviation and flutter suppression. The University of Liverpool research group composed by Dr S. Fichera, Ms I. Isnardi and Prof. J.E. Mottershead (Figure 3) over the past few years has focused on addressing these challenges, with the overarching goal of investigating morphing in the context of aeroelastic, actively controlled, aeronautical structures. In the work "High-Bandwidth Morphing Actuator for Aeroelastic Model Control", the Authors propose a morphing design capable of stratifying the typical aeroelastic models' requirements in terms of deflection, bandwidth and torque provided. The camber morph is achieved by using tailored piezoelectric patches in a sandwich configuration with a linear trailing edge slider to allow the necessary compliance. The morphing actuator is designed for a NACA 0018 aerofoil with a chord of 300 mm and a span of 40 mm. Static and dynamic experimental tests are carried out on a prototype, and a camber variation control technique is implemented. It is proven that the actuator bandwidth is up to 25 Hz and the equivalent maximum deflection is $\pm$15 degrees.

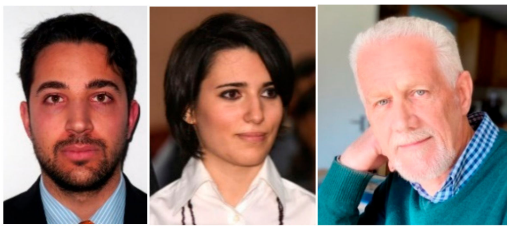

Figure 3. University of Liverpool, School of Engineering: "Experimental Aeroelasticity, Morphing and Active Control research lab"—left to right Sebastiano Fichera, Irma Isnardi and John E. Mottershead.

On behalf of the Prize Awarding Committee, we would like to warmly congratulate the winners on their accomplishments. The caliber of research that we received for the Best Paper Awards was outstanding. As such, I would like to take this opportunity to thank all of the nominated research groups that participated and acknowledge their contributions to *Aerospace*; finally, to thank the Award Committee for voting and helping these awards in being a great success.

In recognition of their accomplishments, each team will be entitled to publish a paper free of charge in *Aerospace* in 2021.

Prize Awarding Committee
Aerospace Editorial Board