Special Issue on Mathematical Problems in Aerospace Sciences

Preface

The role played by the mathematical modeling and analysis of both continuous and discrete systems in all areas of engineering is increasing day by day. Particularly in the aerospace sciences, mathematical methods and computational approaches are commonly used both for doing academic research as well as for carry out industrial developing activities. The present issue of Advances in Aircraft and Spacecraft Science (AAS) publishes some selected works that were presented at the Mathematical Problems in Aerospace Sciences – MPAS2019 symposium that was held during the International Conference of Numerical Analysis and Applied Mathematics ICNAAM 2019 in Rhodes, Greece and that focused on new results and approaches of applied mathematics and computational analysis relevant to all of the aerospace engineering fields. The candidate papers were selected following the oral presentations and they were then amended by the authors to comply with the Journal requirements. The works were sent out for revision to anonymous reviewers and were modified accordingly to the received comments.

In the first contribution to this Special Issue, (Ferrero and D'Ambrosio 2020) propose, in a discontinuous Galerkin framework, a hybrid numerical scheme to study convective fluxes represented as a combination of Local Lax-Friedrichs scheme and Flux Difference Splitting approach with the aim of capturing a shock with sharp resolution avoiding the carbuncle instability. The Authors studied both viscous and inviscid supersonic flows obtaining sound results in terms of carbuncle prevention and accuracy avoiding excessive computational burden. Next, (Navarra *et al.* 2020) propose an approach to speed up the Stochastic Linearization technique that allows to reduce or avoid numerical evaluations of response statistics. The Authors applied such approach to the design of a nonlinear energy sink in order to reduce vibrations of an aircraft wing. It is obtained that the proposed efficient stochastic linearization scheme can be applied to both classically and non-classically damped systems and that the computational time reduction is proportional to the number of iterations. In a previous volume of AAS, Alaimo *et al.* (2019) already published some of the results discussed by the authors at MPAS2019. In that work, the Authors propose an adaptive flight control system to lead the aircraft pitch response. The controller is based on the Simple Adaptive Control approach and is tuned by means of the Population Decline Swarm Optimization method. It is found that the system response is sound even when the elevator rotation limits are considered and when the elevator effectiveness reduces of about 60% with respect to the undamaged case. In the third contribution to this Special Issue, (Conte *et al.* 2020) study numerically the flow field inside a resonant igniter to investigate the effect of different boundary conditions. To this aim, the Unsteady compressible Reynolds Averaged Navier-Stokes equations have been solved by using finite volume scheme. The proposed simplified scheme is used to identify the conditions that causes unstable growth of the numerically computed temperature field. In the contributions of (Xiong *et al.* 2020), the Authors propose an adaptation of a design approach for hypersonic inward-turning inlets to design Rectangular-to-Ellipse Shape Transition inlets. The design approach takes advantage of a multi-objective optimization procedure, namely the Non-dominated Sorting Genetic Algorithm II. Fully three dimensional Euler and Reynolds Averaged Navier-Stokes equations are solved to verify the accuracy of the obtained optimal solution. In the last contribution to this Special Issue, (Alaimo and Orlando 2020) propose a nose landing gear shimmy damping system based on the Modified Simple Adaptive Control. A Parallel Feedforward Compensator has been used to meet the Kalman–Yakubovich–Popov conditions. Physical limitations of the controlling actuator are modeled and windup issue are coped for by implementing a back-propagation anti-windup scheme. The performance of the proposed anti-windup PFC MSAC shimmy suppression system is compared with literature results.

Finally, I hope that contributions published in the present special issue will be of interest to the readers of AAS and, moreover, I would like to thank the other members of MPAS2019 symposium for letting me the responsibility to manage and coordinate the work behind this issue. Moreover, I would like to thank the authors for their precious contributions, the reviewers for their anonymous and valuable work, the Editor-in-Chief of AAS, prof. E. Carrera, for this opportunity and the Assistant Editor (A. Pagani) for his continuous and valuable assistance.

Guest Editor:

Professor Calogero Orlando
calogero.orlando@unikore.it
Kore University of Enna
Italy

References

Alaimo, A., Esposito, A. and Orlando, C. (2019), "P_DSO tuning of PFC-SAC fault tolerant flight control system", *Adv. Aircraft Spacecraft Sci.*, **6**(5), 349-369. https://doi.org/10.12989/aas.2019.6.5.349.

Alaimo, A. and Orlando, C. (2020), "Analysis of a shimming aircraft NLG controlled by the Modified Simple Adaptive Control", *Adv. Aircraft Spacecraft Sci.*, **7**(5), 459-473. https://doi.org/10.12989/aas.2020.7.5.459.

Conte, A., Ferrero, A. and Pastrone, D. (2020), "Numerical investigation for performance prediction of gas dynamic resonant igniters", *Adv. Aircraft Spacecraft Sci.*, **7**(5), 425-440. https://doi.org/10.12989/aas.2020.7.5.425.

Ferrero, A. and D'Ambrosio, D. (2020), "A hybrid numerical flux for supersonic flows with application to rocket nozzles", *Adv. Aircraft Spacecraft Sci.*, **7**(5), 387-404. https://doi.org/10.12989/aas.2020.7.5.387.

Navarra, G., Lo Iacono, F., Oliva, M. and Esposito, A. (2020), "Aircraft wings dynamics suppression by optimal NESs designed through an efficient stochastic linearisation approach", *Adv. Aircraft Spacecraft Sci.*, **7**(5), 405-423. https://doi.org/10.12989/aas.2020.7.5.405.

Xiong, B., Ferlauto, M. and Fan, X. (2020), "Optimal aerodynamic design of hypersonic inlets by using streamline-tracing techniques", *Adv. Aircraft Spacecraft Sci.*, **7**(5), 441-458. https://doi.org/10.12989/aas.2020.7.5.441.