Special Issue on modelling progress in aerospace sciences

Preface

Nowadays, many industries are investing in modeling and simulation technologies recognizing the important role played by computational analysis in several relevant sectors. This is particularly true for the aerospace industry, where simulation is used not only for flight training but also for system design and verification by aerospace manufacturers and, of course, by academia involved in aviation and space research programs. Paramount importance is given to the possibility of modeling and simulating how a new component will perform once during the flight, or to the use of a digital model to look for optimized design – from aerodynamic to airframe, from control systems to mission trajectories, to cite a few.

The present Special Issue of Advances in Aircraft and Spacecraft Science (AAS) collects some works on such topics focusing on new applications and results of modeling and simulation approaches relevant to aviation and space engineering. The submitted manuscripts underwent anonymous peer-review and were modified accordingly to the received comments. The first contribution to this Special Issue, (Tarasov *et al.* 2022) proposes the use of a deep learning artificial neural network to model the properties of complex alloys such as nickel alloys that, for instance, can find application in critical jet engine parts. Taking into account the alloy chemical composition and the known interaction of the alloy constituents, the ANN simulates the system response in terms of some relevant physics parameters. The second contribution to the Special Issue (Pavano 2022) uses finite element simulation to numerically compare the mechanical behavior of sandwich panels with a conventional honeycomb core along with an alternative sandwich made with an additively fabricated lattice core. The numerical campaign allowed to determine the best geometric dimension of the pyramidal cell analyzed to maximize the mechanical properties of the reticular core. Next, (Masseni 2022) proposes a model of an electric pump-fed hybrid rocket engine that allows the selection of the optimal battery configuration. As a test case, a two-stage vehicle for Mars return mission is investigated and the best battery characteristic by carrying out a combined engine/trajectory optimization. In the fourth contribution to this Special Issue, (Errante *et al.* 2022) study the impact of secondary flows on loss generation in low-pressure gas turbines. With this aim, a Discontinuous Galerkin (DG) formulation is employed to solve the Reynolds-averaged Navier-Stokes (RANS) equations. Comparison with literature experimental data shows that the Spalart Allmaras model allows to well describe the turbulence phenomena. In the work of (Pontani 2022), a quaternion-based nonlinear reduced-attitude control algorithm is proposed to lead a vehicle to perform autonomous lunar ascent and orbit injection. The two-step control algorithm is then verified by running Monte Carlo simulations to investigate the influence of errors on the initial conditions and thrust oscillations concluding that the combination of locally-flat near-optimal guidance along with the nonlinear reduced-attitude control algorithm appears to be an effective control approach for the investigated study-case. In the sixth contribution to the Special Issue, (Bermejo *et al.* 2022) consider a space-telescopes placed in the Sun-Earth second Lagrange point (L2) as a study case and propose an alternative analytic solution that can speed-up the computation of sky observation

parameters with respect to numerical approaches. The proposed analytic model solution, obtained under the assumption that the precession motion is slow compared to the spin motion, has been found to be sound as an alternative approach for a preliminary study phase. In the contribution of (Krasnov *et al.* 2022), the Authors use a higher-order DG method to compare various schemes for the computation of flows in presence of shock waves. It is obtained that the use of Godunov's or HLLC flow can engender instability; the Rusanov-Lax-Friedrichs flow results in high computation dissipation, while hybrid flow appears to be preferable in terms of model simulation accuracy. In the last contribution to this Special Issue, (Grossi *et al.* 2022) propose an alternative one-dimensional approach to model pressure oscillations in hydrodynamic instability-driven solid rocket motors. The Authors obtained a good match with experimental data in terms of pressure oscillation time windows confirming the capability of the proposed model of dealing with the investigated phenomenon.

Hoping that the manuscripts published in the present special issue will be of interest to the readers of AAS, I would like to thank the Authors for their valuable contributions, the Reviewers for their anonymous and precious work, and the Editorial team of ASS for their continuous and valuable assistance.

Prof. Calogero Orlando
Kore University of Enna
Enna EN, Italy
E-mail: calogero.orlando@unikore.it