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High-fidelity RANS simulations of subsonic and supersonic performance of an Experimental HTB aircraft at 0º, 5º and 10º angles of attack

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Abstract
In recent years, the international community has been developing research addressing supersonic aviation challenges, NASA and Boom Inc. in the USA [1,2] or the JAXA agency in Japan [3] are working in such kind of aircraft. Aligned with this trend, the EU has a quite relevant experience in both hypersonic and supersonic vehicles [4-6] and it is currently funding the MORE&LESS [7] research project that aims at contributing to a more sustainable supersonic aviation in the near future. One of the goals of the project is to increase the accuracy of predictive models. One of the three prototypes selected as case studies to conduct high-fidelity aerodynamic analysis is an experimental Hypersonic Test Bed (HTB) 24.5 m long, wingspan is 8.9 m with an engine on the top of the fuselage, front canard and V-tail. In this work the results obtained in 20 CFD simulations adopting a steady RANS approach in the range of Mach numbers (0.4, 2.0) and angles of attack 0º, 5º and 10º are reported. The models corresponded to 3D domains with about 16M of cells and 40M nodes created with the software Siemens STAR-CCM+ [8] using a cluster of computers with 64 cores and 180 Gb RAM. As a result the properties of the design in different stages of a mission at subsonic, transonic and supersonic speeds with diverse angles of attack have been identified. The aerodynamic performance of the aircraft has been addressed by means of the aerodynamic coefficients considering ideal and real flow and the associated forces. Interesting features have been identified, such as the shock wave crated at the experimental air-breathing engine located over the fuselage and the remarkable influence of the Mach number in the lift and moment aerodynamic coefficients and forces. The full paper will describe the strategy used for the supersonic simulations and a quite complete description of the results obtained including also pressure distribution profiles at several span wise positions in the wing and graphical presentations of the shock wave and several flow velocities.

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