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Numerical simulation and turbulence modelling of a 3D transonic regime around a supercritical wing involving strong separation

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The present paper details the simulations carried out for the 3D-V2C wing configuration designed by Dassault Aviation in the context of the TEAMAERO European programme, «Towards Effective Flow Control and Mitigation of Shock Effects in Aeronautical Applications», https://cordis.europa.eu/project/id/860909/fr . The results concern the constant section wing. The computations have been carried out by using the Organised Eddy Simulation - OES approach (Szubert et al, 2015) and hybrid approaches, especially the DES-OES (Bourguet et al, 2008, Shinde et al 2014, Simiriotis 2020). The results analyse the transonic buffet dynamics by means of spectral and POD analysis in case of the constant section wing. They also examine onset of unsteadiness at 7° of incidence.
A numerical study by means of statistical and hybrid turbulence modelling involving stochastic forcing (Szubert et al, 2015, Simiriotis, 2020) has been carried out to analyse the buffet phenomenon around a transonic wing of constant section and a swept wing at high Reynolds number. The predictions, obtained by using the NSMB - Navier Stokes MultiBlock code (Hoarau et al, 2016, Vos et al 1998), have shown the ability of all the methods in capturing the buffet's frequency bump, but at different spectral amplitudes and width of the bump. The OES and DES-OES simulations provided a physically correct shock amplitude and a good comparison of the mean forces coefficients with experiments carried out by the Institute of Aviation in the context of the TFAST European project coordinated by IMP-PAN. A detailed POD study shows the role of the most energetic modes in respect of the buffet spatial oscillation amplitude as well as the impact of higher-order modes in the shear layer dynamics and in the stochastic forcing.

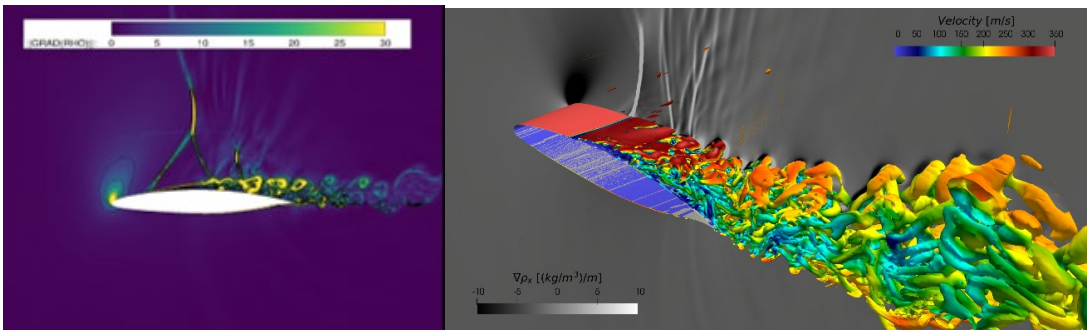

Figure 1. Iso-contours of the density gradient by Detached Eddy Simulation illustrating the buffet dynamics and the shock-vortex interaction around the V2C wing

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