Numerical investigation of wing-gust interaction

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This work investigates the effect of different gust events impacting the aerodynamic forces and wake structures of an A320 wing. Gusts are defined as a sudden increase in wind speed intensity and a change in direction. In the context of climate change, the occurrence of extreme gusty events is expected to increase, especially in the vicinity of major international airports, affecting aircrafts daily operations. From particular interest are vertical gusts, which turns out to be even more dangerous close to the ground during the critical phases of landing and take-off. One of the most studied case in the literature corresponds to a determinisitc gust profile following a ‘‘1-cosine’’ formulation, based on civil aviation certifications. From a strucutral point of view, such profile is usually studied only as an upwash motion applied to the wing and increasing the lift, adding up positively to the loads already existing without the presence of the gust. However, the downwash vertical gust is not often studied, even though the potential loss of lift can be detrimental or even fatal, espcecially close to the ground. In this study, the effect of both up- and downwash gusts are investigated.

The configuration studied corresponds to an A320 Reduced Scale protoype with a chord of 70 cm, which is approximately 1/4th of the real-scale MAC of the A320 wing. The supercritical wing is investigated in the low subsonic regime (Mach number of 0.063), for Reynolds number 1 million and for an incidence of 10°. The numerical simulations are performed in synergy with experiments in wind tunnel for calibration, using the Navier Stokes Multi-Block (NSMB) code. The Organised Eddy Simulation (OES) turbulence modelling approach is employed to capture the impact of gusts on the coherent structures around the wing and in the wake.

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