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Investigation and control of dynamic stall of an aerofoil ramp up motion MARCO EDOARDO ROSTI, MOHAMMAD OMIDYEGANEH, ALFREDO PINELLI, City University London — Direct Numerical Simulations of the flow around a NACA0020 aerofoil at $Re_c = 20 \times 10^3$ undergoing a ramp up motion has been undertaken ($\alpha \in [0°, 20°], \dot{\alpha}_{\mathrm{rad}} c/U_\infty = 0.12$). New insights on the vorticity dynamics in the baseline case are discussed using a number of post-processing techniques. We will also present and discuss the effects of a passive control technique based on the use of a thin flap hinged via a torsional spring to the suction side of the aerofoil. The interaction between the flap dynamics (modelled as an infinitely thin plate) and the fluid have been carried out using an original Immersed Boundary Method applied to a finite volume solver. When the spring constant is chosen to lock the flap oscillations into the main shedding frequency, the back flow induced by the primary vortex is strongly reduced by the presence of the flap inhibiting the generation of massive separation. Moreover, the flap is capable to enhance and protract the lift overshoot typical of the dynamic stall also alleviating the subsequent lift-breakdown. These beneficial behaviour is mainly due to the establishment of a fluid structure interaction cycle that continuously regenerate the primary vortex which is ultimately responsible for the enhanced lift.

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