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The effects of momentum and vorticity injection for suppressing separation on a NACA 0012 airfoil[1] PHILLIP MUNDAY, KUNIHIKO TAIRA, Florida State University — Flow control actuators are used to modify the behavior of fluid flows by adding forcing input that can consist of mass, momentum, vorticity, and energy. The present computational study focuses on the effects of steady momentum and wall-normal vorticity injection (swirling jets) on separated flow over a NACA 0012 airfoil at Re = 23,000 and angles of attack of 6° and 9°. Large eddy simulations are performed for three-dimensional, spanwise periodic flow, with control input prescribed through velocity boundary conditions near the natural separation point. We observe that the addition of wall-normal momentum mitigates flow separation for a moderate angle of attack of 6° with reduction in drag. For massively separated flows at an increased angle of attack of 9°, the superposition of wall-normal vorticity to wall-normal momentum injection shows significant enhancement in reattaching the flow. It is found that notable lift increase and drag reduction can be achieved in such case. To further understand the roles that vorticity addition plays in separation control, the vorticity flux on the surface of the airfoil is examined in detail. The current findings are compared to the results from the ongoing effort in linear global stability analysis.

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