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Aerodynamic performance of an airfoil with a prescribed wall protuberance at low Reynolds numbers. CARLOS DUQUE-DAZA, CRISTIAN MEJIA, DIEGO CAMACHO, Dept. of Mechanical and Mechatronics Engineering, Universidad Nacional de Colombia, DUNCAN LOCKERBY, School of Engineering, The University of Warwick — Numerical simulations of flow around a modified NACA0012 airfoil, featuring a small surface perturbation on the upper wall, were performed at two low Reynolds numbers. The aerodynamic performance was examined under conditions of incompressible steady state flow. Simulations at different angles of attack (AOA) were performed: 0, 6, 9.25 and 12 degrees for Re=5000, and 6, 9.25 and 12 for Re=50000. The effect of the wall-perturbation was assessed in terms of changes of drag and lift coefficients, and alterations of the upper wall turbulent boundary layer. Examination of mean velocity profiles reveals that the wall perturbation promotes boundary-layer separation near the leading edge and increase of the skin friction drag. An arguably improvement of the effectiveness, i.e. ratio of lift to drag, was observed for the modified profile for Re = 5000, especially at AOA of 6 degrees. This effect seems to be caused by a double effect: boundary layer separation approaching the leading edge and an increase of the lift coefficient caused by the larger pressure drop on the upper surface. The effect of the perturbation was always negative for the airfoil operating at Re=50000, independently of AOA.

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