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DNS of laminar/turbulent boundary layer transition induced by solid obstacles[1] PAOLO ORLANDI, MATTEO BERNARDINI, SERGIO PIROZZOLI, Università di Roma "La Sapienza" — Direct numerical simulation is used to investigate how boundary layer transition is affected by the shape and size of an isolated obstacle whose size is of the order of the boundary layer thickness. The Navier-Stokes equations are discretized by means of an energy-conserving second-order staggered finite-difference method, and the geometrical complexity associated with the obstacle is handled through the immersed-boundary technique. A series of simulations have been performed by varying: i) the obstacle shape (cylinders and prisms with rectangular and triangular base); ii) the roughness height (as a fraction of the boundary layer thickness); iii) the width of the obstacle; iv) the Reynolds number of the incoming boundary layer. We have monitored the vorticity dynamics of the structures which are shed past the obstacle, and observed the concurrence of two mechanisms which promote transition to turbulence, namely the unsteady shear layer separation at the top edge of the obstacle, and the regeneration of quasi-streamwise vortices at the sides of the obstacle. The validity of semi-empirical transition criteria based on a suitably defined roughness Reynolds number will also be discussed, and associated with the physical mechanisms responsible for the self-sustainment of the disturbances.

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