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Bypass transition of low-speed boundary layers using realistic sandpaper roughness JESSE CAPECELATRO, WENTAO ZHANG, RYAN FONTAINE, GREGORY ELLIOT, DANIEL BODONY, JONATHAN FREUND, University of Illinois Urbana-Champaign, THE CENTER FOR EXASCALE SIMULATION OF PLASMA-COUPLED COMBUSTION (XPACC) TEAM — The transition process from laminar to turbulent flow over three-dimensional irregular surfaces is known to affect downstream quantities of interest. Properly simulating this transition numerically is therefore potentially critical for accurate predictions of turbulent flows. In this work, a numerical study of bypass transition of a Blasius boundary layer subjected to realistic sandgrain roughness is presented to analyze the effects of surface topography on the characteristics of the downstream turbulence. Direct numerical simulations are performed using a high-order finite difference scheme in general curvilinear coordinates that is fitted to the roughness. A main goal is to model sandpaper-induced transition and quantify its impact on downstream boundary layer turbulence. A simple but effective model for the sandpaper roughness is presented, and parameters for the roughness profile are chosen to match low-order moments of the surface height, in addition to the spectral content measured from real sandpaper. The effects of roughness Reynolds number and ratio of upstream laminar boundary layer thickness to the roughness height are also investigated.

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