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Direct numerical simulation for irregular roughness on a curved surface HAOLIANG YU, UMBERTO CIRI, ARIF MALIK, STEFANO LEONARDI, The University of Texas at Dallas — Surface roughness is critical to aerodynamic performance. Ice accretion, insect contamination, dust accumulation, and surface erosion represent major sources affecting surface perturbations in atmospheric applications. In wind energy, for example, insect contamination on turbine surfaces can significantly increase skin drag and reduce power production. Although some experiments and numerical simulations have been carried out to study roughness effects, the contributions of different roughness parameters are not well understood, particularly when over curved surfaces. Commonly used engineering models for roughness penalty prediction also demand more insights and validation. Therefore, this study includes direct numerical simulations for irregular roughness over a curved (airfoil) surface. A precursor simulation is conducted to generate fully developed turbulent inflow. The blade geometry and roughness are defined by the ray triangle intersection test and modeled using immersed boundary method. Resulting flow fields are analyzed and compared for the various parametric cases.

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