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On the interaction of streamwise vortices with surface textures[1]
SAIKISHAN SURYANARAYANAN, DAVID GOLDSTEIN, The University of Texas at Austin, GARRY BROWN, Princeton University, ALEXANDRE BERGER, EDWARD WHITE, Texas AM University — Recent studies (Suryanarayanan et al., AIAA 2017-4417, AIAA 2018-3077) have demonstrated the possibility of mitigating roughness induced transition using surface textures that can dissipate the streamwise vortices responsible for the lift-up effect. In order to identify the optimal surface texture geometry, a fundamental investigation into the effect of surface textures on the evolution of a streamwise vortex in a boundary layer is performed. This study involves a combination of scaling arguments (of the enstrophy flux transport equation) and direct numerical simulations of a single streamwise vortex in a laminar boundary layer with different (2D) surface textures. The results are analyzed from a vorticity dynamics point of view. The effects of local flow acceleration and enhanced dissipation are separately studied using appropriate synthetic simulations. Simple models are suggested and connections are made to previous work on the evolution of perturbations over wavy walls. Supporting wind tunnel experiments that study the development of streamwise vortices generated by micro vortex generators in the presence of surface textures will be presented. Applications to cross flow instability and other technologically relevant scenarios will be discussed.

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