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Numerical investigation of boundary layer receptivity to free-stream disturbances and surface excrescences ADRIAN SESCU, Mississippi State University, MIGUEL VISBAL, DONALD RIZZETTA, Air Force Research Laboratory — In this study, the receptivity of boundary layers to surface imperfections and free-stream disturbances is analyzed in two-dimensions using a high-fidelity Navier-Stokes solver based on high-order compact spatial schemes, and implicit time integration. The surface imperfection is an idealized form of typical excrescences that exist on the surface of aircraft wings, while the free-stream disturbances mimic real perturbations existing in the atmosphere or in wind tunnels. The geometry consists of an superelliptic-leading-edge flat plate with a forward or rearward excrescence on its surface. Acoustic and vortical waves are generated using a source term, as opposed to using inflow boundary conditions, to avoid spurious waves that may propagate from boundaries. The results show that the acoustic waves are very efficient in exciting the Tollmien-Schlichting (TS) waves downstream of the step, as expected, and that the wavelength of TS waves scales linearly with the wavelength of the acoustic waves. The vorticity waves are less likely to excite the TS waves, but when they do so the TS waves are grouped in wave packets that are consistent with the wavelength of the vorticity waves. Other relevant results will be included and discussed.

Adrian Sescu
Mississippi State University

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