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Linear and nonlinear receptivity of the boundary layer in transonic flows ANATOLY RUBAN, MARINA KRAVTSOVA, TOMASS BERNOTS, Imperial College London — This paper is concerned with the phenomenon of the generation of Tollmien-Schlichting waves in laminar boundary layer on an aircraft wing in transonic flow regime. A particular form of the boundary layer receptivity is considered when the boundary layer encounters a local roughness on the wing surface in the form of a gap, step or a hump. We assume that the boundary layer is exposed to acoustic noise and study the interaction of the acoustic waves with the flow perturbations produced in the boundary layer by the roughness. Two approaches are used. The first one is theoretical; it is based on large Reynolds number asymptotic analysis of the Navier-Stokes equations leading to the transonic version of the triple-deck theory. Under assumptions that the acoustic noise level is weak, and the roughness height is small, and analytic formula for the amplitude of the generated Tollmien-Schlichting wave is deduced. In the second, numerical, approach the restriction on the roughness height is lifted, which allows for the flows with local separation near the roughness to be considered. The calculations have been perform for different value of the Karman number, and we found that in the flow separation always leads to a significant enhancement of the receptivity process.

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