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Optimal Control of Gortler Vortices by Means of Local Wall Deformations ADRIAN SESCU, Mississippi State University, MOHAMMED AFSAR, Strathclyde University — We explore an optimal control strategy in the framework of high Reynolds number asymptotics in which the growth of Gortler vortices is reduced by local wall deformations. The Gortler vortices are excited by a row of roughness elements that enter the analysis through upstream conditions derived previously using an asymptotic analysis (Goldstein et al., J. Fluid Mech., 613, pp. 95-124, 2011). Since the leading order Navier-Stokes equations reduce to the boundary region equations (BRE) in a transverse region that scales on the local boundary layer thickness, they are parabolic in the streamwise direction, and may be solved by marching downstream. Wall deformations are introduced into the BREs via a Prandtl transformation for an arbitrary streamwise/spanwise wall surface shape. The vortex energy is then controlled using an optimal control algorithm formulated in the framework of the Lagrange multipliers method, wherein the solution to the adjoint equations are determined by an arbitrary variation in the Lagrangian, in which the cost functional is associated with the local energy of the Gortler vortices. Our numerical results indicate that the optimal control algorithm is very effective in reducing the amplitude of the Gortler vortices.

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