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Sub-Optimal Control of Unsteady Separation in a Channel KEVIN CASSEL, CHETAN SARDESAI, Illinois Institute of Technology, FLUID DYNAMICS RESEARCH CENTER TEAM — Incompressible flow through a two-dimensional channel with localized suction from the upper surface is considered as a framework within which to consider the control of unsteady separation within the context of boundary-layer theory. Control is implemented through a body force throughout the boundary layer at the lower surface where the unsteady separation takes place. The control objective is to suppress the onset of unsteady separation by minimizing a cost functional that retards the separation process while minimizing the energy input required to accomplish the control. In the present investigation, sub-optimal control is considered in which the control, i.e. adjoint, equation is solved in a quasi-steady manner as the unsteady boundary-layer equations evolve in time. Without control the unsteady boundary layer forms a recirculation region and terminates in a separation singularity for suction values above a critical value. Although cases in which recirculation forms for the no- control case always result in unsteady separation, it is possible to eliminate unsteady separation without eliminating recirculation using the domain-based control employed here. The controlling body force is found to concentrate primarily in the reattachment region for cases in which unsteady separation is suppressed.

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