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Stability of a channel flow subject to blowing and suction in the form of a traveling wave CHANGHOON LEE, Yonsei University, TAEGEE MIN, JOHN KIM, UCLA — A recent study by Min et al. (JFM, 558, 2006) showed that drag in a channel could be sustained below that of a laminar flow when the flow was subjected to surface blowing and suction in the form of an upstream traveling wave. It was shown that a positive Reynolds shear stress, normally negative for a positive mean shear, was induced by the traveling wave, thus resulting in the mean drag reduction. In the present study, stability characteristics of a laminar channel flow subject to the same kind of blowing and suction have been investigated by using Floquet analysis and by examining maximum transient growth of initial energy. Unlike the behavior of the mean flow, linear stability characteristics were hardly affected by upstream-traveling waves, implying that the drag reduction was a direct consequence of traveling- wave induced flow fields. A more interesting behavior was found for cases with a downstream-traveling wave. The growth rate of the most unstable 2-D and 3-D disturbances significantly increased when the phase speed of the wave was around 40% of the centerline velocity, while stabilization of 3-D disturbance was observed when the phase speed exceeded the centerline velocity. The destabilization appears to be caused by an otherwise stable Tollmien-Schlichting mode excited by the traveling wave. Detailed results with insights into a physical mechanism will be presented at the meeting.

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