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Velocity streaks in a Blasius boundary layer induced by external streamwise vortices: numerical simulation and linear stability analysis[1]
LORENZO SICONOLFI, SIMONE CAMARRI, Università di Pisa, JENS H.M. FRANSSON, Linne Flow Centre, KTH Mechanics — This work investigates numerically the streamwise velocity streaks generated in a Blasius boundary layer (BL) by an array of counter-rotating vortices. The array is positioned outside the BL and generates the streaks by velocity induction. This investigation is motivated by previous studies demonstrating that stable streamwise streaks can lead to a stabilization of the Tollmien-Schlichting (TS) waves and to a subsequent delay of the transition between laminar and turbulent regime. In most of the previous studies streamwise vortices generating the streaks lie inside the BL. Conversely, the conceptual configuration considered here, with vortices outside the BL, has potential advantages due to the lower dissipation rate of the vortices in the streamwise direction. Direct numerical simulations (DNSs) are carried out to study the flow, where the streamwise vortices are introduced in an idealized form. Interesting configurations are identified by DNS and a reference one is selected and investigated in details. Bi-global stability analysis shows benefic effects on the evolution of TS waves and allows the construction of a modified stability curve for the controlled flow. The resulting transition delay is also demonstrated by DNS.

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