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Robustness of reduced-order observer-based controllers in transitional 2D Blasius boundary layers BRANDT BELSON, Princeton University, ONOFRIO SEMERARO, KTH Royal Institute of Technology, CLARENCE ROWLEY, Princeton University, JAN PRALITS, University of Salerno, DAN HENNINGSON, KTH Royal Institute of Technology — In this work, we seek to delay transition in the Blasius boundary layer. We trip the flow with an upstream disturbance and dampen the growth of the resulting structures downstream. The observer-based controllers use a single sensor and a single localized body force near the wall. To formulate the controllers, we first find a reduced-order model of the system via the Eigensystem Realization Algorithm (ERA), then find the H_2 optimal controller for this reduced-order system. We find the resulting controllers are effective only when the sensor is upstream of the actuator (in a feedforward configuration), but as is expected, are sensitive to model uncertainty. When the sensor is downstream of the actuator (in a feedback configuration), the reduced-order observer-based controllers are not robust and ineffective on the full system. In order to investigate the robustness properties of the system, an iterative technique called the adjoint of the direct adjoint (ADA) is employed to find a full-dimensional H_2 optimal controller. This avoids the reduced-order modelling step and serves as a reference point. ADA is promising for investigating the lack of robustness previously mentioned.

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