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Large-eddy simulations of flow around a circulation control airfoil SEONGHYEON HAHN, Center for Turbulence Research, Stanford University, KARIM SHARIFF, NASA Ames — Circulation control, proposed in NASA's Cruise Efficient Short Take-off and Landing (CESTOL) concept, has the potential to increase air-traffic throughput and reduce the noise footprint. Circulation control obtains a substantial increase in lift coefficient by using a wall-jet that blows tangentially on a rounded (Coanda) surface deflected at the trailing edge. The flow has proven to be difficult to reliably predict using Reynolds-averaged models. We undertake large-eddy simulations to better understand underlying mechanisms and create a database for modelers. Simulations are patterned after Novak et al.'s (1987) experiment, which, despite its faults, is the best documented to date. A Reynolds number of 10ˆ6 and two cases with low and high blowing are considered using Stanford's unstructured solver CDP. The upper surface begins with laminar to turbulent transition following a region of weak shear stress. Then strong favorable pressure gradient as the jet slot is approached leads to a raised log-law. There exists a region over the Coanda surface where the mean flow development collapses very well in wall-jet similarity coordinates, indicating that a portion of the near-wall region maintains classical wall-jet characteristics. At the present time, the lower surface has delayed transition due to lack of tripping in the simulations and considerable discrepancies with the experiments for second-order statistics.

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