Abstract Submitted
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Minimal-span direct simulation of transient, accelerating channel flows and application with wall riblets.[1] SAURABH PARGAL, Student, JUNLIN YUAN, Assistant professor, GILES BRERETON, Professor — Minimal-span simulation of wall turbulence is an attractive approach for reducing simulation cost when focusing on near-wall phenomena associated with frictional drag modification due to surface riblets or roughness. We evaluate the capability of such simulations for a periodic smooth-wall channel flow subjected to rapid acceleration from a friction Reynolds number of 180 to one of 420. Compared to a full-span simulation, the single-point statistics, two-point correlations and spectral analyses indicate that the minimal span is sufficient to capture the pseudo-laminarization phenomenon, since the stabilization effect of the increased ensemble-averaged shear is confined to the near-wall region. As the increased shear is relaxed, the retransition to a new equilibrium state, though starting from the wall, is slightly delayed compared to that in a full channel. The wall is then covered with saw-tooth riblets of a uniform height, which is 7.5 wall units at the start of, and 17.5 at the end of acceleration. Lower Reynolds stresses (in wall units) and a slower retransition are observed in the riblet flow, compared to a smooth-wall channel flow. The results demonstrate both advantages and limitations of minimal-span simulations of non-equilibrium wall turbulence.

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