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Nonlinear Stability of Rotating Channel Flow

M. Nagata, D.P. Wall, T. Mitsumoji

Dept. of Aeronautics & Astronautics, Graduate School of Engineering, Kyoto, Japan

The stability of Poiseuille flow in a channel subject to a system rotation about a spanwise axis has been considered. Linear stability results show that the basic flow first loses its stability to a two-dimensional streamwise-independent disturbance. We have found two-dimensional nonlinear secondary flows, and have analysed their stability. The secondary flow may lose stability to a variety of secondary disturbance modes including two-dimensional steady Eckhaus modes, and three-dimensional travelling-wave modes, which do not exist for the equivalent Couette problem. We proceed to find three-dimensional nonlinear travelling-wave tertiary flows which bifurcate from the secondary flows upon the loss of their stability. We succeeded in finding three distinct classes of these flows, including flows which resemble the twisting vortex flows observed in previous experimental and direct numerical simulation (DNS) studies.

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