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On the stability of a solid-body-rotation flow in a finite-length pip SHIXIAO WANG, Auckland University, ZVI RUSAK, Rensselaer Polytechnic Institute, RUI GONG, Auckland University, FENG LIU, University of California at Irvine — The three-dimensional, inviscid and viscous flow instability modes that appear on a solid-body rotation flow in a finite-length, straight, circular pipe are analyzed. This study is a direct extension of the Wang & Rusak (1996) analysis of axisymmetric instabilities on inviscid swirling flows in a pipe. We study a general mode of perturbation that satisfies the inlet, outlet and wall conditions of a flow in a finite-length pipe with a fixed-in-time and in-space vortex generator ahead of it. The eigenvalue problem for the growth rate and the shape of the perturbations for any azimuthal wave number m is solved numerically for all azimuthal wave number m. In the inviscid flow case, the $m = 1$ modes are the first to become unstable as the swirl ratio is increased and dominate the perturbation's growth in a certain range of swirl levels. In the viscous flow case, the neutral stability line is presented in a Reynolds number (Re) versus swirl ratio (ω) diagram and can be used to predict the first appearance of of axisymmetric or spiral instabilities as a function of Re and L. We will discuss and demonstrate the physical mechanism and evidences of the onset of the instability.

Shixiao Wang
Auckland University

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