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Global stability analysis of flow in eccentric annular channels[1]
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A temporal linear stability analysis of laminar flow in eccentric annular channels has been performed. Spectrally-accurate algorithms using Fourier and Chebyshev series have been applied to solve the Navier-Stokes equations for fully developed laminar flow in annular channels with various eccentricities. Time-dependent, three-dimensional (radial, axial and azimuthal) perturbations were superimposed to the basic flow and the resulting linearised perturbation equations were also solved using spectrally-accurate techniques. For concentric annuli, the most unstable modes of instability were found to be axisymmetric travelling waves, when the diameter ratio was larger than 0.771 or smaller than 0.115, and spiral travelling waves otherwise; the critical Reynolds number was in all cases larger than 11544, in agreement with the literature. Unlike previous work, the present eccentric annulus analysis took into account the effect of azimuthal variation of the base flow. The critical Reynolds number for flow in eccentric annuli was much smaller than the concentric value and its value depended on the diameter ratio and the eccentricity; the streamwise wavenumber of the most unstable disturbances was much smaller than values in concentric annuli.

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