 Proceedings of ICCES'08, pp.1399-1399

The effect of through-flow on the stability of Taylor-Couette flow

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Summary

The stability of Taylor Couette flow is altered if the inner and outer cylinders are porous and a radial through-flow is imposed. Linear stability analysis indicates that the flow is stabilized by a radially inward flow or strong radially outward flow, while a weak radially outward flow destabilizes the system slightly. However, the physics underlying the stabilizing and destabilizing effects of radial through-flow is not established. Apart from the fundamental interest in this issue, one practical application of Taylor-Couette flow, rotating filtration, is based on a radial flow through a porous inner cylinder of a Taylor Couette cell. The key advantage of rotating filtration over other types of filtration is that the Taylor vortices constantly wash particles away from the inner cylinder, preventing them from plugging the pores of the membrane.We use direct numerical simulation to examine the impact of through-flow on the the transition from nonvortical flow to two- and three-dimensional vortex flow with particular interest in the details of the flow field and the underlying physics.