Numerical Study for the Stability of Flows Induced by Surface Acoustic Waves along a Slab

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The stability of flows of Newtonian fluids induced by a surface acoustic wave (SAW) along the walls in a confined parallel-plane microchannel or slab in the laminar flow regime is investigated. The governing equation which was derived [1] by considering the nonlinear coupling between the deformable or waving interface and viscous fluids is linearized firstly and then the stability problem is solved by a verified code [2] (based on the spectral method [3-4]) together with the associated interface and boundary conditions. We obtain curves of the neutral stability boundary for different cases of interest. The critical Reynolds number for the case with SAW effects is found and near 1439 which is much smaller than the static-wall case: 5772 for conventional pressure-driven flows [3] without SAW effects.

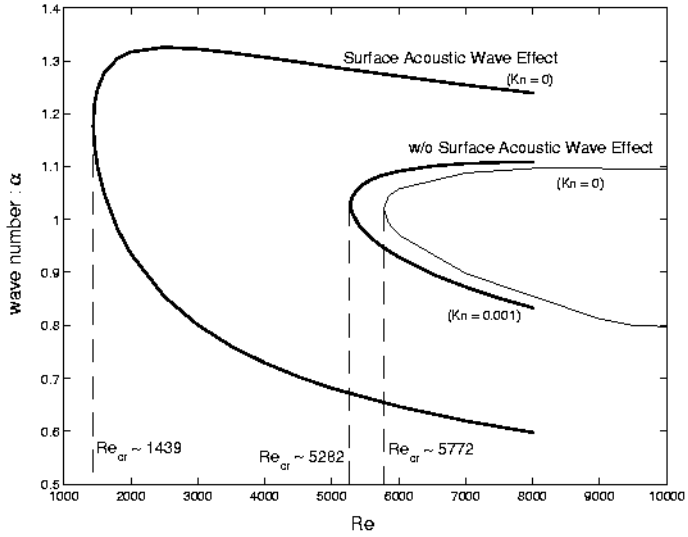

Fig. 1. SAW effects on the neutral stability boundary of the plane Poiseuille flow. Re_{cr} is the critical Reynolds number of the flow. For SAW driven case (with no-slip boundary conditions) $Re_{cr} \sim 1439$.

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References

1. Chu K-H W 2002 Eur. Phys. J. Appl. Phys. **18** 51.
2. Chu W K-H 2000 J. Phys.: Cond. Matter **12** 8065.
3. Chu W K-H 2001 J. Phys. A **34** 3389.
4. Orszag SA 1971 J. Fluid Mech. **50** 689.
5. Gottlieb D and Orszag SA 1977, *Numerical Analysis of Spectral Methods: Theory and Aplications* (NSF-CBMS Monograph No. 26, SIAM).

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