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Instability analysis of Poiseuille flow between two parallel walls partially obstructed by porous surfaces[1] NAMRATA ACHARYA, Naperville Central High School, SAMAN HOOSHYAR, PARISA MIRBOD, University of Illinois at Chicago — Plane Poiseuille flow is widely encountered in studies of diverse fields such as filtration, biomechanics, and geological problems. This work explores the effect of porous geometrical parameters, namely depth ratio and porous resistivity on the stability of Poiseuille flow over various porous surfaces. The most unstable mode is determined by numerically solving the eigenvalue problem derived from coupling between Navier-Stokes and Brinkman equations. Comparison of critical Reynolds number versus porous resistivity graphs for different depth ratios shows that there is an instability mode shift from the porous to the fluid with increasing the depth ratio. Also, the most stable mode occurs at smaller porous resistivity as the depth ratio becomes larger. To validate the theoretical analysis, we performed a set of experiments in which a Water-Glycerin solution flows through a channel partially obstructed by porous medium. The porous medium is modeled as square arrays of cylinders and is installed on the bottom wall of the channel. We found a good agreement between the steady-state and perturbed velocity profiles obtained analytically and experimentally.

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