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Energy budget analysis of plane Poiseuille-Couette flow over a permeable surface[1] SAMAN HOOSHYAR, University of Illinois at Chicago, HARUNORI N. YOSHIKAWA, Universite Cote d'Azure, PARISA MIRBOD, University of Illinois at Chicago — The stability of Poiseuille flow over a permeable surface has been studied extensively over the past years due to its vast range of engineering applications. We previously investigated how imposing a Couette flow could impact the stability of such a system by performing a linear stability analysis. It was observed that the Couette flow exerts destabilizing or stabilizing effects depending on the permeable surface properties. This study, using the energy budget analysis, aims to provide a physical interpretation of the behavior of the system. The results show that for unstable wavenumbers, the production term from the Reynolds shear stresses produces the required energy which allows the disturbances to grow. For stable wavenumbers, the disturbances are dampened since the rate of energy loss due to viscous dissipation and Darcy drag becomes greater than the production term. In general, increasing both the Couette component and the porous permeability, as well as decreasing the fluid layer thickness results in a higher production term, which consequently makes the flow less stable. We were also able to distinguish different modes by computing the kinetic energies of perturbation flows in the fluid and porous layers.

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