Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Stability of gravity-driven free-surface flow past a deformable solid: The role of depth-dependent modulus SHRADDHA MANDLOI, V SHANKAR, Indian Institute of Technology Kanpur (IIT) — The linear stability of a Newtonian liquid layer flowing down an inclined plane lined with a deformable linear elastic solid characterized by a continuously varying modulus is analyzed in this work. A low-k asymptotic analysis is performed to obtain an expression for the wavespeed, which shows striking similarity with the earlier results of Sahu and Shankar [Phys. Rev. E **94**, 013111(2016)] for gravity-driven flow of Newtonian fluid past solid bilayer having constant shear modulus in each layer. This shows that a deformable solid layer having a continuously varying shear modulus can be treated as a generalization of a system having multiple solid layers of constant shear modulus. Also, in the low-k limit, we show that the stability of the free surface is governed by the value of effective shear modulus G_{eff} and not by the detailed spatial variation of the modulus. For finite-wavenumbers, we analyzed different configurations of the modulus function that have the same spatially-averaged modulus but have different values at the interface and found the systems having higher shear modulus at the liquid-solid interface are more stable as compared to other configurations. Thus, the depth-dependent modulus offers more control to passively manipulate the instabilities.

Shraddha Mandloi
Indian Institute of Technology Kanpur (IIT)

Date submitted: 10 Aug 2020 Electronic form version 1.4