Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Elastohydrodynamics of Lubricated Viscoelastic Contacts ARASH KARGAR-ESTAHBANATI, BHARGAV RALLABANDI, Department of Mechanical Engineering, University of California, Riverside, FLOWLAB TEAM — The deformability of a soft substrate breaks the reversibility of Stokes flow and produces a lift force on a nearby moving surface. Focusing on small deformations, we employ perturbation theory to find analytically the lift force on a surface translating relative to a nearby viscoelastic layer. This is achieved by using Lorentz's reciprocal theorem along with Parseval's integral identity, which circumvents the detailed calculations of pressure and displacement fields in previous works. The formulation is developed for an arbitrary Poisson's ratio, substrate thickness, and viscoelastic relaxation times and recovers known results in the appropriate limits. Our results show that the value of Poisson's ratio changes the scaling of the lift force with respect to the layer's depth. Additionally, we discuss the effect of viscoelastic loss on the lift force. Extendable to arbitrary linear (generally non-elastic) response, our approach provides a powerful tool to probe the mechanical properties of soft materials.

Arash Kargar-Estahbanati
Department of Mechanical Engineering, University of California, Riverside

Date submitted: 31 Jul 2020 Electronic form version 1.4