Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Optimal electrostatic control of fluid films ALEXANDER WRAY, University of Strathclyde, RADU CIMPEANU, SUSANA GOMES, University of Warwick — Controlling film flows has long been a central target for fluid dynamicists due to its ubiquitous applications, in fields from heat exchangers, to biochemical recovery, to semiconductor manufacture. However, despite its significance in the literature, most analyses have focussed on the forward problem: what effect a given control has on the flow. Often these problems are already complex, incorporating the - generally multiphysical - interplay of hydrodynamic phenomena with the mechanism of control. Indeed many systems still defy meaningful agreement between models and experiments. The inverse problem - determining a suitable control scheme for producing a specified flow - is considerably harder, and much more computationally expensive. Performing such calculations for the full Navier-Stokes problem is generally prohibitive. Using an electric field as a control mechanism, we examine the inverse problem. We derive a low-order model that is accurate even deep into the shortwave regime. A rapid solver allows repeated solution of both the forward and adjoint problems on sub-second timescales, allowing both terminal and regulation optimal control studies to be implemented. We exploit this in a variety of novel ways in combination with direct numerical simulations.

Alexander Wray
University of Strathclyde

Date submitted: 03 Aug 2020 Electronic form version 1.4