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A hierarchical modelling approach for the active control of thin liquid film flows RADU CIMPEANU, SUSANA GOMES, University of Warwick, DEMETRIOS PAPAGEORGIOU, Imperial College London — The ability to robustly and efficiently control liquid film dynamics is a challenging topic which lies at the heart of applications such as coating (where the liquid-gas interface should ideally be close to flat) and heat or mass transfer (where an increase in interfacial area is desirable). Mathematically this is a framework in which progress can be made based on reduced-order modelling and asymptotic analysis. This leads to an extended range of long-wave models incorporating levels of simplification that balance our theoretical interrogation abilities with access into a wider practical parameter space. Our goal here is to develop powerful feedback strategies at lower (and more cost-effective) levels of the modelling hierarchy and investigate/extend their ability to translate into real-life solutions by using direct numerical simulations (DNS) of the multi-phase Navier-Stokes equations as an in silico experimental platform. We discuss both distributed and point-actuated mechanisms in a unified analytically-informed high performance computing context in which the DNS can accurately capture the relevant nonlinearities and put the rigorously developed control strategies to the test, even beyond their traditional ranges of applicability.

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