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Thermocapillary control of falling liquid films by substrate heating ALICE THOMPSON, Univ of Manchester, SUSANA GOMES, MICHAEL DALLASTON, FABIAN DENNER, SERAFIM KALLIADASIS, Imperial College London — We analyse the problem of controlling a falling liquid film by selective heating of the substrate supporting the flow. Such heating affects the film dynamics through Marangoni stresses, and will be chosen in response to real-time observations of the film height profile. We begin by developing a new low-dimensional (LD) model for the dynamics of a thin film subject to heating which varies in space and time. The model includes the effects of convection and diffusion, so that local heating applied briefly at the substrate can have a long-lasting and wide-ranging effect on the surface temperature. We demonstrate that our LD model is in good agreement with full Navier-Stokes (NS) equations and we use it to develop heating strategies which drive the film towards either a uniform state or into a desired non-uniform profile. We further develop a hierarchy of control strategies subject to realistic limitations, such as having influence over only a few localised heating strips, the ability to sense the height profile at a few fixed locations, and dealing with time delays and uncertainty in observation or application of heating. We test the robustness of our control strategies in closed- and open-domain simulations of the LD model and also in fully coupled NS calculations.

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