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Statistical Characteristics of Falling-Film Flows: A Synergistic Experimental-Computational Approach[1] ALEXANDROS CHAROGIANNIS, FABIAN DENNER, BEREND G.M. VAN WACHEM, SERAFIM KALLIADASIS, CHRISTOS N. MARKIDES, Imperial College London — We undertake an extensive statistical study of the hydrodynamics of gravity-driven falling film-flows based on carefully conducted experiments and advanced direct numerical simulations (DNSs). Specifically, we measure the instantaneous and local film-heights and velocity fields of harmonically excited falling-film flows for a wide range of flow conditions by simultaneous application of planar laser-induced fluorescence and particle tracking velocimetry. A Reynolds decomposition of the time-varying flow-rate into steady and unsteady terms seeks to provide novel statistical relations linking the film-height and bulk-velocity statistics. We observe that the covariance of the film-height and bulk-velocity fluctuations varies near-linearly with the product of the coefficients of variation of the film-height and bulk-velocity while the ratio between the Nusselt height and mean film-height varies linearly with both aforementioned quantities, decreasing as either of the two increases. We also show that the bulk-velocity statistics can be predicted using these relations together with information on the film-height statistics with only moderate errors ($\leq 5\%$ for the DNSs and $\leq 10\%$ for the experiments).

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