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Intensification of heat transfer across falling liquid films[1] CHRISTIAN RUYER-QUIL, NICOLAS CELLIER, BENOIT STUTZ, Université Savoie Mont-Blanc, NADIA CANEY, Université Grenoble Alpes, PHILIPPE BANDELIER, CEA-Liten, LOCIE TEAM, LEGI TEAM — The wavy motion of a liquid film is well known to intensify heat or mass transfers. Yet, if film thinning and wave merging are generally invoked, the physical mechanisms which enable this intensification are still unclear. We propose a systematic investigation of the impact of wavy motions on the heat transfer across 2D falling films on hot plates as a function of the inlet frequency and flow parameters. Computations over extended domains and for sufficient durations to achieve statistically established flows have been made possible by low-dimensional modeling and the development of a fast temporal solver based on graph optimizations. Heat transfer has been modeled using the weighted residual technique as a set of two evolution equations for the free-surface temperature and the wall heat flux. This new model solves the shortcomings of previous attempts, namely their inability to capture the onset of thermal boundary layers in large-amplitude waves and their limitation to low Prandtl numbers. Our study reveals that heat transfer is enhanced at the crests of the waves and that heat transfer intensification is maximum at the maximum of density of wave crests, which does not correspond to the natural wavy regime (no inlet forcing).

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