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MACHINE-LEARNING PREDICTION OF MICROSCOPIC BUBBLE-GROWTH CHARACTERISTICS

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During the process of nucleate boiling, vapour bubbles form at a heated surface, they grow and subsequently detach, thereby removing a significant amount of energy from the surface. However, the exact bubble growth configuration is often unknown, complicating the formulation of quantitative predictions about the heat-removal performance. Computational Fluid Dynamics (CFD) methods are often employed to study the bubble growth. In this work, rather than using a numerical approach, we analyse the process using machine learning tools. First, we construct an algorithm to process the experimental data recently measured at the Massachusetts Institute of Technology (MIT) [1] and use it to obtain the geometrical features describing the bubble in all its stages of growth. Second, we use the obtained features to train a machine learning model to predict the position of the triple line of contact among the solid, liquid and gas phases, both in microlayer and contact-line regimes of bubble growth. Very good agreement for the validation set is obtained. By knowing the position of the triple line, the microlayer extent can be subsequently deduced, providing data for heat-transfer calculations. This work thus presents a different approach to quantitative bubble growth analysis, such as [2], and can be used for informing boiling simulations involving the use of reduced-order models (e.g. [3]).

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