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Analysis of bubble departure and lift-off boiling model using computational intelligence techniques and hybrid algorithms

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Abstract
The bubble departure and lift-off boiling (BDL) model was studied using computational intelligence techniques and hybrid algorithms. Quite a few studies have predicted the relationship between wall heat fluxes and wall temperature in the form of flow boiling curves. The output wall temperature is a performance indicator that depends on many operating parameters. The current study, therefore, analyses the predictability of the wall temperature in terms of operating pressure, bulk flow velocity, and wall heat flux, based on the BDL model developed by Zenginer, which included two suppression factors namely, flow-induced and subcooling factors, respectively. The soft computing techniques used for prediction were - the artificial neural network (ANN), and the Fuzzy Mamdani model, and the hybrid algorithms were adaptive neuro-fuzzy inference system (ANFIS) and artificial neural network trained particle swarm optimization (ANN-PSO). In addition, the ANN-PSO conducted a parametric analysis to evaluate the best model configuration by considering various factors. The comparison of all four techniques showed that the ANFIS model exhibited the prediction performance for wall temperature. Moreover, the results obtained from the ANFIS model have been compared with the different flow boiling curves from the literature and observed that the curve fitted well for higher bulk flow velocities with an MSE and R2 was found to be 0.85 % and 0.9933, respectively. © 2023 Elsevier Masson SAS

Author Keywords
ANFIS; ANN; ANN-PSO; BDL model; FMM; Wall temperature

Index Keywords
Flow velocity, Fuzzy inference, Fuzzy neural networks, Fuzzy systems, Heat flux, Particle swarm optimization (PSO), Soft computing; Adaptive neuro-fuzzy inference, Adaptive neuro-fuzzy inference system, Artificial neural network-PSO, Boiling models, Bubble departure and lift-off boiling model, FMM, Hybrid algorithms, Lift offs, Neuro-fuzzy inference systems, Wall temperatures; Factor analysis

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