A Saturated-Interface-Volume Phase Change Model for Simulating Flow Boiling

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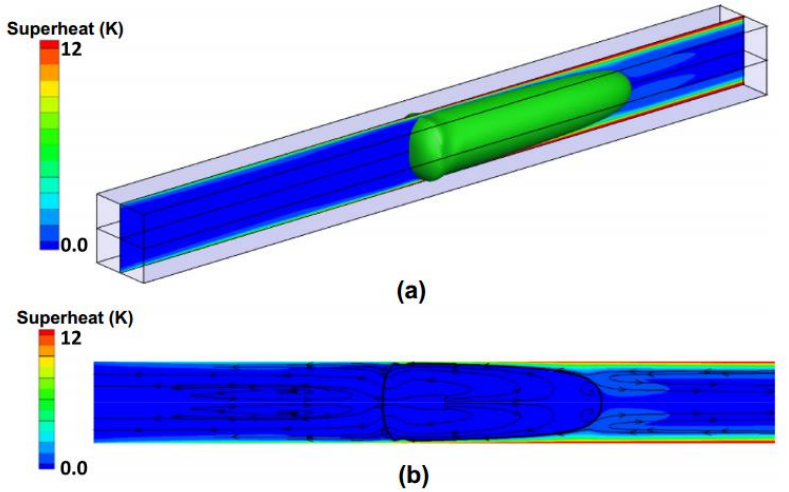
Objective

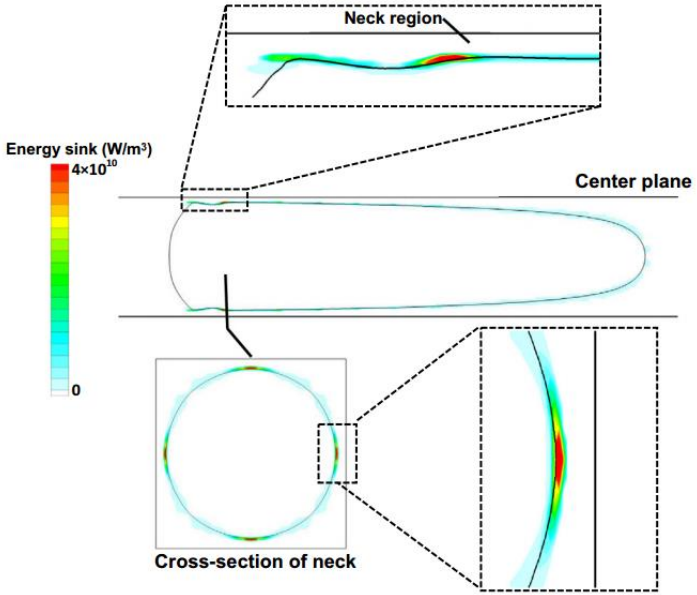
- Develop a physics-based numerical model to study two-phase flow in a microchannel
- Develop expense-saving features to enable cost-effective simulation of 3D channels with complex geometric features

Approach

- Volume of fluid-based model to ensure mass conservation
- A novel saturated-interface-volume model is proposed to calculate phase change accurately and effectively
- The near-interface velocity is artificially increased to suppress unphysical spurious currents



Vapor bubble interface and temperature field in the microchannel: (a) 3D view of the vapor bubble and the temperature field; (b) temperature field and streamlines of the relative velocity of the vapor nose.



Energy sink on the interface due to evaporation

Impact

- Two-phase flow and phase change can be simulated in 3D microchannels at significantly reduced computational expense
- Physical details are captured and important transport mechanisms can be revealed

Selected Publications

- Z. Pan, J.A. Weibel, S. V. Garimella, Spurious Current Suppression in VOF-CSF Simulation of Slug flow through Small channels, Numer. Heat. Trans. A, 67, 1-12, 2015
- Z. Pan, J.A. Weibel, S.V. Garimella, A Saturated-Interface-Volume Phase Change Model for Simulating Flow Boiling, Int. J. Heat Mass Transf. 93, 945-956, 2016

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