World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:12, No:06, 2018

Multi-Modal Film Boiling Simulations on Adaptive Octree Grids

Authors : M. Wasy Akhtar

Abstract : Multi-modal film boiling simulations are carried out on adaptive octree grids. The liquid-vapor interface is captured using the volume-of-fluid framework adjusted to account for exchanges of mass, momentum, and energy across the interface. Surface tension effects are included using a volumetric source term in the momentum equations. The phase change calculations are conducted based on the exact location and orientation of the interface; however, the source terms are calculated using the mixture variables to be consistent with the one field formulation used to represent the entire fluid domain. The numerical model on octree representation of the computational grid is first verified using test cases including advection tests in severely deforming velocity fields, gravity-based instabilities and bubble growth in uniformly superheated liquid under zero gravity. The model is then used to simulate both single and multi-modal film boiling simulations. The octree grid is dynamically adapted in order to maintain the highest grid resolution on the instability fronts using markers of interface location, volume fraction, and thermal gradients. The method thus provides an efficient platform to simulate fluid instabilities with or without phase change in the presence of body forces like gravity or shear layer instabilities.

Keywords : boiling flows, dynamic octree grids, heat transfer, interface capturing, phase change
Conference Title : ICFMHTT 2018 : International Conference on Fluid Mechanics, Heat Transfer and Thermodynamics
Conference Location : Toronto, Canada
Conference Dates : June 21-22, 2018