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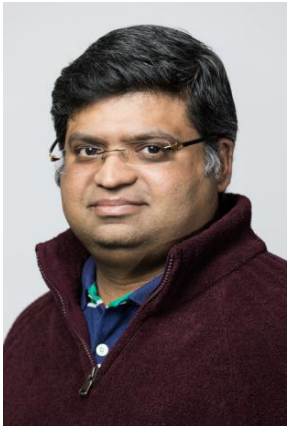

Introduction to Stability Analyses and Direct Numerical Simulations for Two-Phase Flows with/without Phase Change

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Abstract:

This lecture serves to introduce stability analyses and direct numerical simulation methodologies to postgraduate students. These complementary methodologies can tackle complex gas-liquid flows in the absence and the presence of phase-change. The stability analysis is used to explain the origin of waves on an otherwise flat interface, in particular channel flows where the base-state is either laminar or turbulent. However, the theory applies only to situations where the waves have an infinitesimally-small amplitude. As the waves grow over time (corresponding to instability), the theory eventually ceases to be valid. In certain scenarios, it may be possible to extend the theory via weakly nonlinear analysis. However, to obtain a full picture of the eventual fate of the interfacial waves, direct numerical simulation of the full two-phase Navier-Stokes equations is required. This complementary methodology is developed also, and results of the two approaches are compared and contrasted for two specific cases of industrial relevance: channel flows and evaporative systems.

Bio:

Professor Prashant Valluri received his PhD (2004) in Chemical Engineering from Imperial College London. His research focuses on tackling industrially relevant multiphase flows with phase-change using bespoke numerical and theoretical techniques. These include stability analyses to understand interfacial instabilities, and DNS for combined heat-mass-momentum transport such as flows with phase change, and flows with mass-transfer and interfacial reactions. He is a Professor of Fluid Dynamics and the Chair of the UK-wide Multiphase Flows and Transport Phenomena Special Interest Group under the UK Fluids Network. As PI of ARCHER/HECToR eCSE 0804, e174 and e643 projects he led development of the ultra-fast high resolution TPLS 3.0 (Two-Phase Level-Set: https://sourceforge.net/projects/tpls/) and the GIS 1.0 (Gerris Immersed Solid Solver: https://github.com/eessmann/GISS) solvers. These solvers have been employed to gain understanding of fundamental phenomena during phase-change cooling of microelectronics. He is the Coordinator and the PI of the five-continent ThermaSMART project (funded by the European Commission) in which Japan is a major contributor with two participating Universities (Kyushu and Kobe) along with 19 other major international participants.

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Online (Microsoft Teams, Team code: qwa2twu)