RECENT ADVANCEMENTS IN NUMERICAL METHODS AND PHYSICAL MODELLING OF MULTI-MATERIAL FLOWS

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ABSTRACT

The modeling, analysis, and numerical treatment of multiphase flows present numerous challenging problems that have been extensively studied in both classical and modern literature. Addressing these complex problems requires a comprehensive approach that considers all aspects of modeling. Physical applications of bubble- and drop-laden flows span a wide range of topics, from geophysical processes to high-speed propulsion. Accurately modeling vastly different flow conditions (e.g., hypersonic vs. subsonic, laminar vs. turbulent) is crucial for predicting complex scenarios with high fidelity. Equally important is the development of numerical schemes tailored to these applications, as specific techniques are often designed for particular sets of equations (e.g., hyperbolic vs. parabolic equations, Allen-Cahn vs. Cahn-Hilliard formulations).

This minisymposium aims to bring together diverse expertise in the expansive field of multiphase flow simulation, ranging from specialists in classical numerical analysis to practitioners tackling realistic configurations of complex multiphase flows.

Topics of interest include, but are not limited to:

- **Novel interface capturing techniques for multiphase flows** (Phase-Field, Volume-of-Fluid, Level-Set, Immersed Boundary)
- **Complex physical modeling in multiphase flows** (atomization, turbulence, phase change)
- **Innovative discretization techniques for multiphase flows** (high-order, entropy-stable, structure-preserving)
- **Surrogate modelling for multi-phase flows** (Reduced-order models, PINNs, Neural operators)