Track 7: Multiphase Flows

Sponsor: Fluids Engineering Division

Topic 7-1: Heat and Mass Transfer in Multiphase Flows (MFTC)

Organizers:

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Descriptions:

Heat and Mass Transfer in Multiphase Flows topic focuses on reviewing and discussing the latest advancements in analytical, numerical, and experimental research to enhance the understanding of heat and mass transport phenomena in multiphase flows. These phenomena are crucial in processes such as chemical and sorption heat pumps, heat and cold storage, drying of granular materials in fluidized beds, and thermal and chemical reactors. Applications also extend to spray flows in turbines, biomass pyrolysis, heat treatment of metals, and nanofluid microchannels. Research methods are primarily categorized into Eulerian–Eulerian and Lagrangian–Eulerian approaches. Central to these applications is the analysis of interactions at phase interfaces, characterized by multiphase impulse, heat, and mass transfer. This area remains vital and attractive to the multiphase flow community.

Topic 7-2: Cavitation (MFTC)

Organizers:

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Descriptions:

Authors and presenters are invited to contribute to fostering discussion, understanding, and information exchange on cavitation-related topics. Submissions can include both completed studies suitable for formal presentations or archival publication and works in progress. Papers are sought on a variety of cavitation research areas, with particular interest in cavitation in rotating machines, propellers, valves, injectors, foils, and bodies, as well as studies on nucleation, inception, and cavitation-induced erosion. Contributions may cover theoretical, computational, and experimental research, including related instrumentation and practical experiences in these areas.

Topic 7-3: Gas-Liquid flows (MFTC)

Organizers:

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Descriptions:

Gas-Liquid Flows topic explores the diverse and complex field of gas-liquid flows, which are crucial in various industrial applications such as energy, nuclear, chemical, geothermal, oil and gas, and refrigeration.

These flows can take many forms, including transitions from liquid to vapor due to external heating, separated flows, and dispersed two-phase flows where one phase appears as droplets or bubbles within a continuous fluid phase. These turbulent flows involve significant interfacial interactions, making theoretical prediction of their hydrodynamics highly challenging. Due to this complexity, empirical data often supplements theoretical models, requiring assumptions and approximations. Accurate prediction hinges on understanding phase distribution and its impact on local hydrodynamics, as well as the fundamental phenomena of gas-liquid flow systems. This topic aims to review recent advancements, assess the current research landscape, and identify future research directions.

Topic 7-4: Fluid-Solid Flows (MFTC)

Organizers:

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Descriptions:
Fluid-solid flows are prevalent in numerous industrial processes, including pneumatic transport, material processing, particulate pollution control, pulverized coal combustion, food drying, sand-blasting, plasma-arc coating, and fluidized beds. This topic explores the fundamental phenomena of gas/liquid–solid flows, focusing on both dilute and dense dispersed turbulent systems, which are governed by fluid–solid interactions. Understanding and modeling these flows have become increasingly critical, particularly with advancements beyond classical studies of pointwise spherical particles in channels, pipes, and jets. Recent research includes numerical investigations involving non-spherical and finite-size particles, requiring detailed knowledge of the surrounding flow field. These studies often use two-fluid models based on granular flow theory or Euler-Lagrange particle tracking with complex gas-phase coupling. Additionally, advancements in two-phase measurement techniques have fueled experimental progress. This topic will present recent developments in fluid-solid flow research, assessing the current state and future directions.

Topic 7-5: Erosion, Slurry Flow and Sedimentation (MFTC)

Organizers:

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Descriptions:
Erosion, Slurry Flow and Sedimentation topic welcomes contributions covering theoretical studies, experimental results, computational methods, erosion wear, and fluid machinery. Emphasis is placed on new concepts and innovative investigative techniques. Liquid-solid flows are crucial in industries like mechanical, chemical, mining, slurry transportation, paper production, and nuclear reactors, requiring specialized experimental and computational approaches. Topics include particle dynamics, phase interactions, direct numerical simulation, flow visualization, high-resolution measurements, particle-wall interactions, and two-phase flow in fluid machinery. Abstracts (300-500 words) should be submitted via the conference website, including the lead author's contact details. Final paper acceptance will follow a comprehensive manuscript review, with accepted papers available for download at the meeting and potential submission to the Journal of Fluids Engineering.

Topic 7-6: Experimental Methods for Multiphase Flows (MFTC)

Organizers:

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Descriptions:
This topic focuses on a wide range of experimental research and methods in multiphase flows. Submissions are welcome for studies spanning from foundational research to novel applications and experiments in multiphase flows, including those not covered by other multiphase flow tracks. Sample topics include advancements in test facilities, new or enhanced instrumentation, diagnostics for novel systems, and unique measurements in multiphase flow applications. Both software and hardware developments are of interest. However, experimental results using traditional diagnostics covered by other tracks (e.g., cavitation or gas-solid flows) should be submitted accordingly. Submissions should clearly highlight the novelty and specific contributions to experimental fluid mechanics in multiphase flows.

Topic 7-7: Numerical Methods for Multiphase Flows (MFTC, CFDTC)

Organizers:

Michael Kinzel: Embry Riddle Aeronautical University, michael.kinzel@erau.edu
Douglas Fontes: Westmont College, dfontes@westmont.edu
Leitao Chen: Embry Riddle Aeronautical University, CHENL12@erau.edu

Descriptions:
We invite submissions for the topic on Numerical Methods in Multiphase Flows. We encourage innovative developments that improve accuracy, efficiency, and stability in simulations of interfaciual flows and multiphase flows. Submissions on interface methods (e.g. VOF, Level-set, Phase field, Front tracking) and multiphase methods (Eulerian-Lagrangian method and Eulerian-Eulerian method) are particularly welcome. We are interested in contributions related to multiphase systems such as gas-liquid and liquid-solid flows, focusing on new modeling techniques, experimental validation, and applications in areas like energy, environment, and manufacturing. Subtopics including turbulence modeling, adaptive mesh refinement, large-scale simulations, and fluid-structure interaction are of high interest. Papers emphasizing V&V with case studies, new methodologies, or best practices are also encouraged. We welcome complete works and works in progress from both academia and industry. This topic offers an opportunity to engage with leading experts and receive critical feedback.

Topic 7-8: Multiphase Challenges Addressed by Modeling and Experiments (MFTC, CFDTC)

Organizers:

Donna Post Guillen: Donna.Guillen@inl.gov
Victor Coppo Leite: Victor.Leite@inl.gov

Descriptions:
This session centers on the comprehensive study of multiphase flow, incorporating both experimental and computational approaches to liquid-gas, liquid-solid, gas-solid, and three-phase flows. Key topics include the transport of fuel droplets, particles, and bubbles in turbulent flows, acoustics and vibrations in bubbly flows, cavitation dynamics, slurry jets, and multiphase flows involving heat and mass transfer. The session

will highlight experimental studies, data acquisition techniques, algorithm development for Computational Multiphase Fluid Dynamics (CMFD), and advanced numerical methods for fluid flow representation. This multifaceted field is crucial across various industries, including power generation, nuclear technology, food production, chemical processing, aerospace, and automotive sectors. Papers that explore the synergy between computational and physical models, emphasizing software tools, laboratory capabilities, and advanced sensors for high-fidelity data, are especially encouraged.

Topic 7-9: Multiphase Flow & Phase Change in Advanced Manufacturing (MFTC)

Organizers:

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Donna Post Guillen, Idaho NL, Donna.Guillen@inl.gov

Descriptions:

This topic focuses on critical challenges in investment casting, a sophisticated manufacturing process. It involves multiphase flow and phase change phenomena, which significantly impact the final product. Key areas include: Multiphase Flow Dynamics: Understanding the interactions between liquid metals, solid molds, and gases, Phase Change Phenomena: Modeling the transition between liquid and solid states, Advanced Manufacturing Techniques: Exploring the integration of new technologies, Defect Formation and Mitigation: Insights into common casting defects and their prevention, Innovative Technologies: Overview of emerging technologies for casting, Modeling and Simulation: Developing accurate computational models for casting processes. By addressing these areas, we aim to optimize casting processes, reduce defects, and enhance the overall efficiency and quality of the final product.

Topic 7-10: Multiphase Flows in Environmental and Industrial Applications (MFTC)

Organizers:

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Yangqing (Suby) Dou, Johnson & Johnson, suby828@gmail.com

Descriptions:

This topic focuses on a wide range of environmental and industrial applications, including energy transportation and conversion, power generation, water treatment, oil production, desalination, refrigeration, air conditioning, fluidized beds, slurry transport, fuel injection, cyclone separators, and plasma coating. Environmental multiphase flows including volcanic eruptions, rain formation, snow avalanches, sediment transport, CO2 sequestration, and dust storms are also of interest. The macroscopic behavior of these systems relies on fundamental processes such as heat and mass transfer, combustion, and chemical reactions. Bridging basic and applied research is essential for technological advancement and societal well-being. Recent advances in experimental diagnostics and high-fidelity simulations have enhanced our ability to predict and model multiphase flows, and this session aims to share the latest research, innovative modeling techniques, and comprehensive computational studies.