Track 1: Artificial Intelligence (AI) for Fluids

Sponsors: Fluids Engineering Division

Topic 1-1: Data readiness for AI: revisiting historical experimental data (FMITC)

Organizers:

Jun Zhang: jun-zhang@utulsa.edu
Jingjing Yao: jingjing.yao@ttu.edu

Descriptions:

The proposed topic focuses on revisiting and consolidating historical fluid dynamics and multi-physics experimental data scattered across the literature. Despite the richness of these experiments, there's been little effort to systematically organize and analyze them. The initiative aims to examine these historical datasets, quantify uncertainties, and assess data reliability. It also seeks to apply advanced analysis tools, including AI, to uncover new insights and enhance fluid dynamics understanding. This dual approach—organizing historical data and applying modern techniques—is crucial for advancing fluid measurement and instrumentation, benefiting researchers and the broader ASME FED community.

Topic 1-2: Machine Learning, Reduced Order Modeling in CFD and Design Optimization (CFDTC, FMTC)

Organizers:

Shanti Bhushan: bhushan@me.msstate.edu
Leitao Chen: leitao.chen@erau.edu
Aytekin Gel: aike@alpemi.com
Justin Weber: justin.weber@netl.doe.gov
Javid Bayandor: bayandor@buffalo.edu

Descriptions:

Data-based simulations, including reduced order modeling approaches have a long history in Fluid Mechanics. For example Proper Orthogonal Decomposition (POD) methods have been in use for decades. Nonetheless, interest in data-based applications and simulations methodologies is increasing greatly in recent years. Machine learning methods in particular, are being applied to model development as well as a variety of applications including design optimization. Automated design optimization algorithms that do not use machine learning techniques are also evolving rapidly. This topic seeks original contributions at the nexus of optimization, data-based simulations and machine learning.

Topic 1-3: Machine Learning and AI in Fluid Measurement (FMITC)

Organizers:

Haiyang Hu: hh0084@uah.edu
Yang Liu: yliu7@ccny.cuny.edu

Descriptions:

The integration of Machine Learning (ML) and Artificial Intelligence (AI) in fluid measurement techniques has gained significant traction in recent years. Fluid measurement plays a crucial role in various industrial sectors and research areas, including aerospace engineering, automobile engineering, energy, environmental sciences, chemical engineering, biomedical engineering, and manufacturing. It involves monitoring and diagnosing parameters like flow rate, velocity, density, pressure, and viscosity. Traditionally, fluid measurement techniques in both industry application and academic research relied heavily on the detection of physical sensors, manual data collection, and labor-intensive processes, often leading to complicated setup, time delays due to the long time postprocessing, and potential inaccuracies due to the low resolution of the sensors. With the advent of AI and ML, there are now opportunities to enhance the precision, efficiency, and real-time analysis of fluid systems. This Topic aims to explore the potential, challenges, and future directions of applying AI and ML to fluid measurement. By bringing together experts from multiple fields, such as engineering, data science, physics, and industry, this event will create an interdisciplinary platform for sharing knowledge and innovative solutions.

Topic 1-4: Data-Driven and Machine Learning for Multiphase Flows (MFTC)

Organizers:

S. Balachandar: bala1s@ufl.edu
Cristian Marchioli: marchioli@uniud.it
Prashant.Khare: Prashant.Khare@uc.edu

Descriptions:

The main focus of this topic is the use of emerging machine learning techniques for the simulation of multiphase flows, discussing how deep learning can be applied to train algorithms for predicting such flows. The field of fluid mechanics is rapidly advancing, driven by unprecedented volumes of data from experiments, field measurements, and large-scale simulations at multiple spatio-temporal scales. Machine learning provides a powerful information-processing framework that can augment, and possibly even transform, current lines of multiphase flow research and industrial applications. For instance, machine learning techniques are currently used for physics-informed generation of dispersed multiphase flow using generative adversarial networks and have been shown effective in providing physical insights into the averaging processes involved in the Eulerian-Lagrangian and Eulerian-Eulerian techniques can yield closures that recover fully-resolved-like accuracy at orders of magnitude lower cost. In addition, machine learning provides a modular and agile modeling framework that can be tailored to address many challenges in multiphase flows, such as reduced-order modeling and data processing. In this respect, the importance and attractiveness of the topic are rather obvious and it appears timely to discuss the most recent advancements related to the application of machine learning to multiphase flows.

Topic 1-5: Machine Learning and AI in Industrial Fluid Systems (FASTC)

Organizers:

Isaac Bernabe Perez Raya: ibpeme@rit.edu
Ernesto Primera: eprimera@udel.edu
Ravinder Yerram: ravinder1.yerram@ge.com

Descriptions:

This topic will focus on the development and use of machine learning and artificial intelligence algorithms and approaches in fluid systems applications. Industrial fluid systems include fluids pump, turbomachinery, and other fluids enginerring systems in aerospace and defense, petroleum and chemical, and energy industries. This topic will explore how AI and machine learning techniques can revolutionize the design, control, maintenance and optimization of fluids systems in industrial applications, by analyizng large amount of experimental and computational data.

Topic 1-6: Machine Learning and AI for Microfluidics (MNFDTC)

Organizers:

Mehdi Salek: msalek@mit.edu
Sangjin Ryu: sangjin.ryu@unl.edu
Jalal Ahamed: m.ahamed@uwindsor.ca

Descriptions:

The recent, impressive development of AI has drawn attention and interest of the micro/nanofluidics community. This topic will explore how AI and machine learning can revolutionize the design, control, and optimization of microfluidic systems, enhancing precision and enabling new functionalities. This topic invites presenters to share their innovative ideas and challenges of using AI and machien learning for microfluidics.