

DATA-DRIVEN AND PHYSICS-INFORMED COMPUTATIONAL METHODS FOR THERMAL-FLUID FLOWS

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ABSTRACT

Recent advances in machine learning have created new opportunities for modelling, simulation, and analysis of complex thermal-fluid systems. Data-driven and physics-informed approaches are increasingly being integrated with classical computational methods to enhance predictive accuracy, reduce computational cost, and enable real-time and inverse analyses. This minisymposium builds on recent research activity in data-driven methods for heat transfer and fluid flow [1], and aims to bring together researchers working at the interface of computational fluid dynamics, heat transfer, and modern artificial intelligence.

Topics of interest include, but are not limited to: physics-informed neural networks for forward and inverse problems; deep learning methods such as convolutional and recurrent neural networks for spatio-temporal prediction of flow and thermal fields; data-driven surrogate and reduced-order models; hybrid CFD-machine learning frameworks for turbulence modelling and multiphysics systems; and machine learning approaches for parameter estimation, uncertainty quantification, and flow control. Contributions addressing applications in energy systems, aerospace, manufacturing, environmental flows, and emerging thermal technologies are particularly welcome.

The minisymposium will provide a platform to discuss recent developments, key challenges, and future

directions in data-driven and physics-informed computational methods for thermal-fluid flows. Particular attention will be given to methods that move beyond predictive accuracy alone by incorporating physical consistency, interpretability, robustness under changing operating conditions, and diagnostic assessment of learned models. Emphasis will be placed on scalable approaches that can support reliable deployment in practical engineering simulations and decision-making.

The minisymposium will also be promoted through RAAM 2026, the 4th International Conference on Recent Advances in Applied Mathematics, to be held at IIT Hyderabad, India, 6–8 July 2026 [2].

REFERENCES

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