INDIAN INSTITUTE OF TECHNOLOGY MADRAS

DEPARTMENT OF MECHANICAL ENGINEERING |

Ph.D. Seminar Talk 1

Title of the Seminar: Modified Inverse Physics-Informed Neural Network for Inverse Heat Conduction Problems.

Speaker: Mr. G. Sai Krishna (ME22D019)

Ph.D. Research Scholar, Department of Mechanical Engineering, IIT Madras.

DATE & TIME	VENUE	ONLINE
11 November 2026, Wednesday, 03:00 PM - 04:00 PM	Online.	Join via Google Meet https://meet.google.com/edb-tvbq-ufo

Guide: Dr. Chakravarthy Balaji, ME.

Co-Guide: Dr. Balaji Srinivasan, ME.

SCAN TO JOIN

ABSTRACT

This study proposes a modified inverse physics-informed neural network (MIPINN) framework for accurate and efficient simultaneous multi-parameter identification in three-dimensional heat conduction problems under sparse experimental data conditions.

The proposed MIPINN framework enhances conventional inverse-PINN formulations by integrating finite difference-based pseudo gradient descent optimization within the physics-informed architecture. The methodology is systematically validated through five configurations:

- **(i) two-dimensional numerical simulation considering temperature as the exact solution for strict comparison and methodological assessment,**
- (ii) **Three-dimensional synthetic temperature field reconstruction with prescribed orthotropic thermal conductivity parameters,**
- (iii) **Isotropic thermal conductivity estimation of AISI 304 stainless steel using experimentally acquired temperature data,**
- (iv) **Orthotropic thermal conductivity tensor identification of a lithium-ion pouch battery (AMP20M1HD-A) through controlled thermal characterization experiments and**
- (v) **Extension of the methodology for determination of specific heat capacity of a three-dimensional slab using synthetically generated data.**

Across all investigated cases, the proposed technique demonstrates improved parameter estimation accuracy and computational efficiency compared to conventional inverse-PINN approach. The MIPINN methodology exhibits enhanced robustness, reduced parameter uncertainty, and stable convergence

behavior under sparse data constraints even in three-dimensional multi-parameter inverse heat conduction scenarios.

This study presents a modified inverse-PINN strategy that strengthens constraint enforcement, thereby improving solution stability and convergence under limited observational data for multi-parameter inverse heat conduction problems and demonstrates its effectiveness through comprehensive three-dimensional experimental validation.