



INVERSE METHODS IN HEAT TRANSFER

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PRE-REQUISITES : Undergraduate course in Heat Transfer would be useful. Knowledge of probability, calculus and matrix algebra.

INTENDED AUDIENCE : UG/PG

INDUSTRY SUPPORT : Thermal Engineers in the industry. Professionals interested in inverse methods (including in medical imaging)

COURSE OUTLINE :

The principal objective of the course is to give the students an overview of inverse problems in heat transfer and ways of formulating and solving them through examples. A wide range of inverse techniques including classical techniques, probabilistic techniques as well as modern techniques involving Machine Learning will be covered.

ABOUT INSTRUCTOR :

Prof. Balaji Srinivasan is currently a Professor in Mechanical Engineering at IIT-Madras. He finished his PhD from Stanford University in 2006. His current research interests are in Computational Heat Transfer, Numerical Analysis, Inverse Methods and Scientific Machine Learning.

COURSE PLAN :

Week 1: Introduction to inverse problems

Week 2: Statistical description of errors, Inverse problems as optimization problems

Week 3: Classical Techniques, Calculation of sensitivity coefficients

Week 4: Parameter and Function estimation. Introduction to Nonlinear Techniques

Week 5: The Levenberg-Marquardt method, Tikhonov regularization

Week 6: Probability Theory, Bayesian Framework,

Week 7: Markov Chain Monte Carlo Methods (MCMC)

Week 8: Metropolis-Hastings algorithm (MH), Computational Implementation

Week 9: Introduction to Machine Learning

Week 10: Deep Learning - ANNs, CNNs, RNNs

Week 11: Surrogate Models for Inverse problems, Genetic Algorithms

Week 12: Physics Informed Neural Networks for forward and inverse problems