National Center for Mathematics

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Advanced Training in Mathematics Schools

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Workshop (offline) on

Numerical Methods for Partial Differential Equations

Venue: Indian Institute of Petroleum and Energy (IIPE), Visakhapatnam

(December 16-27, 2024)

This workshop introduces numerical methods for linear and non-linear ordinary and partial differential equations and various numerical discretization techniques like Finite Difference (FDM), Finite Volume Methods (FVM), and Discontinuous Galerkin Methods (DGM). Higher-order methods are essential for wave propagation phenomena, thus we discuss modern methods like WENO and DG for various applications of wave propagation such as hyperbolic conservation laws, Hamilton-Jacobi equation, and Convection-Diffusion-Dispersive type nonlinear PDEs. Machine learning and Deep learning techniques are quite popular nowadays, thus this workshop intends to introduce Machine Learning, Deep Learning, and Physics Informed Neural Networks (PINNs) and their applications to solve partial differential equations.

Chief Patron

Prof. Shalivahan
Director
IIPE, Visakhapatnam

Patron

Prof. Vijaya Kumar K.
Dean (R & D)
IIPE, Visakhapatnam

Conveners

Dr. Samala Rathan
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TIFR-CAM, Bengaluru
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More Details

Application form and other information about the programme are available at https://www.atmschools.org/school/2024/NCMW/nmpde

Last date for receiving the online registration forms: September 30, 2024.

SPEAKERS

G.D.V. Gowda
Professor
TIFR-CAM, Bengaluru

Non-linear hyperbolic conservation laws: Concept of weak solutions and entropy condition. Lax-Wendroff theorem. Finite volume schemes. Monotone schemes: L1 stability, TVD property and their convergence to the entropy solution. Finite volume schemes in higher dimensions.

Praveen C.
Professor
TIFR-CAM, Bengaluru

Discontinuous Galerkin method for PDEs: Introduction to DG methods. Numerical flux, semi-discrete stability, basis functions, limiters, TVD property, and Fourier stability analysis. DG for hyperbolic systems, multi-dimensional scheme, modal and nodal versions.

Harish Kumar
Associate Professor
IIT, Delhi

Entropy stable schemes: Entropy inequality for the conservation laws and entropy stability. Tadmor's condition. Entropy conservative fluxes. Semi-discrete Entropy stable FD scheme. DG schemes: Summation-by-parts property. Entropy conservative and entropy stable DG methods.

Ritesh Kumar Dubey
Associate Professor
SRMIST, Chennai

Introduction to Deep Learning, Multi-layer perceptrons, hyperparameters, optimization, activation functions, regularization techniques. Supervised, Unsupervised, and Reinforcement Learning. Convolutional and residual neural networks. Data-driven and deep learning approach to solve hyperbolic conservation laws and related PDEs

Sudarshan Kumar K.
Assistant Professor
IISER,
Thiruvananthapuram

Numerical Solutions to ODEs: consistency and convergence, Runge-Kutta methods, Linear multistep methods, zero stability and consistency. Numerical methods for Linear PDEs: Linear advection equation, consistency, Von-Neumann stability, convergence, Lax-equivalence theorem, Heat, Poisson, and Wave equation.

Samala Rathan
Assistant Professor
IIPE, Visakhapatnam

Introduction to higher order schemes: Lax-Wendroff scheme, flux and slope limiters, TVD schemes, Semi-discrete formulations, WENO schemes: Analysis of critical points, discontinuities and convergence properties. WENO schemes to Hamilton-Jacobi and convection-diffusion-dispersive type nonlinear PDEs.