Curriculum Vitae

Name Deep Ray

Affiliation Computational and Applied Mathematics (CAAM)
Rice University
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Employment

Postdoctoral researcher, CAAM, Rice University
- July, 2019 to present
- Developed high-resolution numerical methods to simulate flow through porous media.

Postdoctoral researcher, MCSS, EPFL
- July, 2017 to June 2019
- Involved in the development of machine learning strategies to resolve existing bottle-necks in numerical methods.

Education

Ph.D. in Mathematics, Tata Institute of Fundamental Research (TIFR-CAM)
- September, 2013 to May, 2017
- Advisors: Dr. Praveen Chandrashekar (TIFR-CAM) and Prof. Siddhartha Mishra (ETH Zurich and adjunct faculty TIFR-CAM)
- Developed and analysed a high-order entropy stable parallelized finite volume solver for the compressible Euler and Navier-Stokes equations on unstructured meshes.
- Awarded the Harish Chandra Memorial Award for the best Ph.D. thesis.

M.Phil in Mathematics, TIFR-CAM
- July, 2012 to September, 2013
- Advisor: Dr. Praveen Chandrashekar
- Worked on numerical schemes for the Euler and Navier-Stokes Equations that preserve entropy, kinetic-energy and vorticity, and performed multi-dimensional simulations for the same.

M.Sc in Mathematics, TIFR-CAM
- August, 2010 to May, 2012

B.Sc (Honours) in Mathematics, Hindu College, University of Delhi
- July, 2007 to June, 2010

Research Visits

Visiting Research Student, Seminar for Applied Mathematics, ETH Zurich
- May to October, 2014 and August 2015 to May 2016
- Visited Prof. Siddhartha Mishra to work with him and his research group.

Publications

Publication in Journals
- *An artificial neural network as a troubled-cell indicator.*
  D. Ray and J. S. Hesthaven.
  Journal of Computational Physics, Vol. 367 (15), pp 166-191 (2018).

- *An entropy stable finite volume scheme for the two dimensional Navier-Stokes equations on triangular grids.*
  D. Ray and P. Chandrashekar.
  Applied Mathematics and Computation, Vol. 314, pp. 257-286 (2017).
- *Convergence of fully discrete schemes for diffusive-dispersive conservation laws with discontinuous flux.*
  U. Koley, R, Dutta and D. Ray.
  ESAIM: Mathematical Modelling and Numerical Analysis, Vol. 50(5), pp.1289-1331, (2016).
- *Entropy stable schemes on two-dimensional unstructured grids for Euler equations.*
  D. Ray, P. Chandrashekar, U. S. Fjordholm, S. Mishra.
  Communications in Computational Physics, Vol. 19(5), pp. 1111-1140, (2016).
- *A sign preserving WENO reconstruction method.*
  U. S. Fjordholm, D. Ray.
  Journal of Scientific Computing, Vol. 68(1), pp. 42-63, (2015).
- *Entropy stable schemes for compressible Euler equations.*
  D. Ray and P. Chandrashekar.
  Int. J. Numer. Anal. Model. Ser. B, no. 4, p. 335-352 (2013).

Publication in Conference Proceedings

- *A Third-Order Entropy Stable Scheme for the Compressible Euler Equations.*
  D. Ray.
  Theory, Numerics and Applications of Hyperbolic Problems II. HYP 2016. Springer Proceedings in Mathematics and Statistics, vol 237., 2018
- *Kinetic energy preserving and entropy stable finite volume schemes for compressible Euler and Navier-Stokes equations.*
  D. Ray and P. Chandrashekar.
  14th Annual CFD Symposium - Aeronautical Society of India, IISc, Bangalore, 10-11 August, 2012.

Submitted for publication

- *Constraint-Aware Neural Networks for Riemann Problems.* (submitted, 2019)
  J. Magiera, D. Ray, J. S. Hesthaven, C. Rohde.
- *Deep learning observables in computational fluid dynamics.* (submitted, 2019)
  K. O. Lye, S. Mishra and D. Ray.
- *Controlling oscillations in high-order Discontinuous Galerkin schemes using artificial viscosity tuned by neural networks.* (submitted, 2019)
  N. Discacciati, J. S. Hesthaven and D. Ray.
- *Detecting troubled-cells on two-dimensional unstructured grids using a neural network.* (submitted, 2018)
  D. Ray and J. S. Hesthaven.
- *Non-intrusive reduced order modelling of unsteady flows using artificial neural networks with application to a combustion problem.* (submitted, 2018)
  Q. Wang, J. S. Hesthaven and D.Ray.
- *Multi-level Monte Carlo finite difference methods for fractional conservation laws with random data.* (submitted, 2018)
  U. Koley, D. Ray and T. Sarkar.

Selected Talks

Using deep learning to overcome algorithmic bottlenecks (18 June, 2019)
Invited speaker at NumHyp 2019, Malaga

Controlling Oscillations in High-order Accurate Methods Through Artificial Neural Networks (28 February, 2019)
SIAM-CSE 2019, Spokane

A fully-discrete kinetic energy preserving and entropy conservative scheme for compressible flows (27 February, 2019)
SIAM-CSE 2019, Spokane

An artificial neural network as a troubled-cell indicator (10th July, 2018)
SIAM Annual Meeting 2018, Portland

An artificial neural network for detecting discontinuities (11th March, 2018)
7th International Conference on High Performance Scientific Computing, Hanoi

A high-resolution energy preserving method for the rotating shallow water equation (27th September, 2017)
European Conference on Numerical Mathematics and Advanced Applications (ENUMATH-2017), Voss

A third order entropy stable scheme for the compressible Euler equations (4th August, 2016)
XVI International Conference on Hyperbolic Problems (HYP2016), Aachen

A sign preserving WENO reconstruction (14th August, 2015)
International Conference on Industrial and Applied Mathematics, Beijing

Entropy stable schemes for compressible flows on unstructured meshes (20th December, 2014)
Conference on Computational PDEs, Finite Element Meet, TIFR-CAM

Entropy stable schemes for compressible flows on unstructured meshes (9th November, 2014)
The 5th International Conference on Scientific Computing and Partial Differential Equations, HKBU, Hong Kong

Teaching Experience

- Teaching Assistant for graduate course on Numerical Methods for Conservation Laws, at EPFL (September - December, 2018)
- Teaching Assistant for graduate course on Numerical Methods for Conservation Laws, at EPFL (September - December, 2017)
- Teaching Assistant for graduate course on Computational Partial Differential Equations, at TIFR-CAM (January - May, 2015)
- Teaching Assistant for graduate course on Numerical Analysis, at TIFR-CAM (August - December, 2013)
- Organised numerical sessions for optimal control at the IFCAM Summer School on Numerics and Control of PDEs-2013, at the Indian Institute of Science, Bangalore.
- Teaching Assistant for graduate course on Numerical Analysis, at TIFR-CAM (August - December, 2012)

Mentoring Experience

Master thesis co-supervision:

Niccolò Discacciati	EPFL/Politecnico di Milano	2018	Curr: PhD, EPFL
Andrea Romani	EPFL/Politecnico di Milano	2019	ongoing
Lukas Schwander	ETH	2019	ongoing

Computer Skills

Languages:	C++, Fortran, Python
Programming Software:	MATLAB
Visualisation Software:	Tecplot, Paraview, Gnuplot, VisIt, Gmsh
Machine-Learning Software:	TensorFlow