Curriculum Vitae

Name Deep Ray

Affiliation Computational Mathematics and Simulation Science (MCSS)
École Polytechnique Fédérale de Lausanne
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Employment

Postdoctoral researcher, MCSS, EPFL
- July, 2017 to present
- Inolved in the development of artificial neural networks to resolve exisiting bottlenecks 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.

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 NavierStokes 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.
  In *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

- Non-intrusive reduced order modeling 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.

Posters and Talks

Talk: *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

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

Talk: *A sign preserving WENO reconstruction* (23rd November, 2015)
Department of Mathematics, University of Würzburg

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

Talk: *A sign preserving WENO reconstruction* (11th June, 2015)
Department of Applied Mathematics, University of Washington, Seattle

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

Talk: *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

Poster: *Entropy stable schemes for compressible flows on unstructured meshes* (9th September, 2014)
Workshop on the Analysis and Numerical Approximation of PDEs, ETH Zurich

Talk: *Entropy stable schemes for compressible flows* (9th July, 2014)
Department of Mathematics, University of Würzburg

Teaching Experience

- 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.
  - Participants were given a crash course on MATLAB coding and ODE-solvers.
  - The models considered were the inverted pendulum, Burgers equation the heat equation in both 1D and 2D set-up.
  - Numerical evaluation of feedback control and solving the estimation problem for noisy partial observations were discussed and implemented.
- Teaching Assistant for graduate course on Numerical Analysis, at TIFR-CAM (August - December, 2012)

Additional Activities

- Member of the Students Seminar Series (S^3) committee (August 2012 - December 2013). The purpose of this committee was to organise and oversee talks by motivated students, on mathematical or other science oriented topics.
- Participation with Souvik Roy in *Join the spirit: Find me if you can*, a competition organized by EADS.
  - Cleared the first phase, which required the developed a code for human detection. The code uses the theory of locally normalized Histograms of Gradients (HOG), proposed by N. Dalal and W. J. Triggs. The code is also capable of capturing moving people in videos. The basic algorithm is available in the C opencv library.
  - Currently working on the second and final phase, which requires teams to suggest an algorithm to compare two images containing human figures and assess whether both images contain the same person, within acceptable confidence levels.
- Founding member of *Science Forum*, a society created in 2009 at Hindu College, University of Delhi. The mandate of this society was to bring together the students from various science departments, so that they could share the knowledge gathered in their respective fields and gain insights into other associated areas.
- Founding member of *Caucus*, a society created in 2008 at Hindu College, University of Delhi. The society served as a forum for discussing various burning national and global issues, and training students for the Model United Nations Conferences.

Computer Skills

Languages:	C++, Fortran, Python
Proramming Software:	FENICS, Deal-II, MATLAB
Visualisation Software:	Tecplot, Paraview, Gnuplot, VisIt, Gmsh
Machine-Learning Software:	TensorFlow