

# Curriculum Vitae

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<b>Name</b>	Deep Ray
<b>Affiliation</b>	Computational Mathematics and Simulation Science (MCSS) École Polytechnique Fédérale de Lausanne CH-1015 Lausanne, Switzerland E-mail: deep.ray@epfl.ch Webpage: deeppray.github.io
<b>Employment</b>	<i>Postdoctoral researcher</i> , MCSS, EPFL <ul style="list-style-type: none"><li>• July, 2017 to present</li><li>• Involved in the development of machine learning strategies to resolve existing bottle-necks in numerical methods.</li></ul>
<b>Education</b>	<i>Ph.D. in Mathematics</i> , Tata Institute of Fundamental Research (TIFR-CAM) <ul style="list-style-type: none"><li>• September, 2013 to May, 2017</li><li>• Advisors: Dr. Praveen Chandrashekar (TIFR-CAM) and Prof. Siddhartha Mishra (ETH Zurich and adjunct faculty TIFR-CAM)</li><li>• Developed and analysed a high-order entropy stable parallelized finite volume solver for the compressible Euler and Navier-Stokes equations on unstructured meshes.</li><li>• Awarded the Harish Chandra Memorial Award for the best Ph.D. thesis.</li></ul> <i>M.Phil in Mathematics</i> , TIFR-CAM <ul style="list-style-type: none"><li>• July, 2012 to September, 2013</li><li>• Advisor: Dr. Praveen Chandrashekar</li><li>• 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.</li></ul> <i>M.Sc in Mathematics</i> , TIFR-CAM <ul style="list-style-type: none"><li>• August, 2010 to May, 2012</li></ul> <i>B.Sc (Honours) in Mathematics</i> , Hindu College, University of Delhi <ul style="list-style-type: none"><li>• July, 2007 to June, 2010</li></ul>
<b>Research Visits</b>	<i>Visiting Research Student</i> , Seminar for Applied Mathematics, ETH Zurich <ul style="list-style-type: none"><li>• May to October, 2014 and August 2015 to May 2016</li><li>• Visited Prof. Siddhartha Mishra to work with him and his research group.</li></ul>
<b>Publications</b>	<b>Publication in Journals</b> <ul style="list-style-type: none"><li>• <i>An artificial neural network as a troubled-cell indicator.</i> D. Ray and J. S. Hesthaven. Journal of Computational Physics, Vol. 367 (15), pp 166-191 (2018).</li><li>• <i>An entropy stable finite volume scheme for the two dimensional Navier-Stokes equations on triangular grids.</i> D. Ray and P. Chandrashekar. Applied Mathematics and Computation, Vol. 314, pp. 257-286 (2017).</li></ul>

- *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

*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:

Niccolo 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