

Arpit Babbar

Numerical Mathematics
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Education

- 2024-Present **Postdoctoral researcher** Numerical Mathematics, Johannes Gutenberg University, Mainz.
Supervisor: Prof. Hendrik Ranocha
- 2020-2024 **Ph.D.** Tata Institute of Fundamental Research - Centre for Applicable Mathematics
Supervisor: Prof. Praveen Chandrashekar
- 2018–2020 **M.Sc. in Mathematics** Tata Institute of Fundamental Research - Centre for Applicable Mathematics
Percentage - 87.25
First class with distinction
- 2014-2017 **B.Sc. (Honours) in Mathematics** Sri Venkateswara College, Delhi University
Percentage - 83
- 2012-2014 **CBSE, AISSCE** Nosegay Public School
Percentage - 92.4
- 2010-12 **CBSE, AISSCE** Nosegay Public School
CGPA - 9.6/10

Publications

- 2022 *Lax-wendroff flux reconstruction method for hyperbolic conservation laws*, Arpit Babbar, Sudarshan Kumar Kenettinkara, and Praveen Chandrashekar, *Journal of Computational Physics (JCP)* 467 (2022)
<https://doi.org/10.1016/j.jcp.2022.111423>
- 2023 *Admissibility preserving subcell limiter for Lax-Wendroff flux reconstruction*, Arpit Babbar, Sudarshan Kumar Kenettinkara, and Praveen Chandrashekar, accepted in *Springer Journal of Scientific Computing*,
<https://link.springer.com/article/10.1007/s10915-024-02482-9>
- 2024 *Generalized framework for admissibility preserving Lax-Wendroff Flux Reconstruction for hyperbolic conservation laws with source terms*, Arpit Babbar, Praveen Chandrashekar, ICOSAHOM2023,
<https://arxiv.org/abs/2402.01442>
- 2024 *Lax-Wendroff Flux Reconstruction for advection-diffusion equations*, Arpit Babbar, Praveen Chandrashekar, ICOSAHOM2023, <https://arxiv.org/abs/2402.12669>
- 2024 *Multiderivative Runge-Kutta (MDRK) Flux Reconstruction schemes for hyperbolic conservation laws*, Arpit Babbar, Praveen Chandrashekar, *Communications on Applied Mathematics and Computation*,
<https://arxiv.org/abs/2403.02141>

Working papers

- *Lax-Wendroff Flux Reconstruction on adaptive curvilinear meshes with error based time stepping for hyperbolic conservation laws*, Arpit Babbar, Praveen Chandrashekar, **submitted to JCP**, <https://arxiv.org/abs/2402.11926>
- *Equivalence of ADER and Lax-Wendroff in DG / FR framework for linear problems*, Arpit Babbar, Praveen Chandrashekar, <https://arxiv.org/abs/2402.18937>
- *Bound preserving Lax-Wendroff flux reconstruction method for special relativistic hydrodynamics*, Sujoy Basak, Arpit Babbar, Harish Kumar and Praveen Chandrashekar, <https://arxiv.org/abs/2409.15805>

Works in Progress

- *Neural network based smoothness indicator for subcell based blending schemes*, Deep Ray, Praveen Chandrashekar, Vaishnavi Sharma, Arpit Babbar
- *MDRK schemes on curvilinear meshes with adaptive time stepping*, Praveen Chandrashekar, Arpit Babbar

Technical skills

Level	Languages	Operating systems, software and packages
Advanced	Julia, Python	<code>Trixi.jl</code> , <code>git</code> , Linux, $\text{\TeX}_{\text{MACS}}$, \LaTeX , Windows
Intermediate	C++	<code>DEAL.II</code> , <code>DifferentialEquations.jl</code> , Paraview, VisIt
Basic	Fortran	TensorFlow, <code>CUDA.jl</code> , <code>MPI.jl</code> , <code>clawpack</code> , <code>HOHQMesh</code> , macOS

Software

- `Tenkai.jl` Single step hyperbolic conservation law solver with novel admissibility preserving subcell based shock capturing scheme on Cartesian meshes
<https://github.com/arpit-babbar/Tenkai.jl>
- `TrixiLW.jl` Hyperbolic conservation law solver on adaptively refined curvilinear meshes with novel error-based time stepping with Lax-Wendroff and Multi-Derivative Runge-Kutta space-time discretization in Flux Reconstruction framework
<https://github.com/arpit-babbar/TrixiLW.jl> (currently private)

Talks

- 2024 Admissibility preserving Lax-Wendroff Flux Reconstruction schemes for compressible flows, IGHASC: **Indo-german Workshop on Hardware-aware Scientific Computing**, Heidelberg, Germany.
- 2024 Compact Runge-Kutta Flux Reconstruction methods, **Kompaktseminar 2024**, Prien am Chiemsee, Germany.
- 2024 Admissibility preserving Flux Reconstruction / Discontinuous Galerkin methods for compressible flows, **Mathematics Of the Weather 2024**, Bad Orb, Germany.
- 2023 *TrixiLW.jl: A high-order, single stage hyperbolic PDE solver using Trixi.jl*, Arpit Babbar, Praveen Chandrashekar, invited to present in the **Numerical Engine Room Talks**
- 2023 *Domain-invariant subcell-based blending limiter for Lax-Wendroff Flux Reconstruction*, Arpit Babbar, Praveen Chandrashekar, Sudarshan Kumar Kenettinkara, **ICIAM August 20-25, 2023**, Waseda Univ., Tokyo
- 2023 *Embedded error-based time stepping for Lax-Wendroff Flux Reconstruction for compressible flows*, Arpit Babbar, Praveen Chandrashekar, **ICOSAHOM, 14-18 August, 2023**, Yonsei University, Seoul, Korea
- 2023 *Admissibility preserving subcell limiter for Lax-Wendroff flux reconstruction*, Arpit Babbar, Praveen Chandrashekar, Sudarshan Kumar Kenettinkara, in *MS6 Towards Practical High-Order Methods for Unsteady High-Fidelity Computational Fluid Dynamics*, **ICOSAHOM, 14-18 August, 2023**
- 2023 *Error based time stepping for Lax-Wendroff Flux Reconstruction*, Arpit Babbar, Praveen Chandrashekar, **Indo-German conference on Computational Mathematics (IGCM)**, CDS IISc & IWR Heidelberg
- 2022 *Lax-Wendroff Flux Reconstruction for hyperbolic conservation laws*, Arpit Babbar, Praveen Chandrashekar, Sudarshan Kumar Kenettinkara, during **visit at IISER-Trivandrum**

Academic achievements

2018-Present TIFR-CAM Research fellowship

- 2023 National Board of Higher Mathematics (NBHM) travel grant to attend ICIAM-2023, Tokyo
- 2017 Certificate of merit for the best academic performance at IISER Mohali
- 2017 All India Rank (AIR) 55 in Council of Scientific and Industrial Research - National Eligibility Test (CSIR-NET), thus qualifying for Junior Research Fellowship
- 2017 AIR 22 in IIT-JAM, the nationwide M.Sc. entrance exam for IITs

Teaching Experience

- 2023 *NCM - Finite Volume and Spectral Methods for Hyperbolic Problems* (Problem session prescription, software)
- 2023 *Numerical Analysis* (Teaching, tutorials, software support, prescribing assignments and exams, grading)
- 2022 *National Centre for Mathematics (NCM)-Numerical Methods for PDE* (Tutorial, software)
- 2022 *Statistical learning, Summer Workout in Mathematics (SWIM)*, TIFR-CAM (Discussions)
- 2022 *Python programming* (SWIM), TIFR-CAM (Tutorials, recitations, discussions)

2022 *Computational Methods of PDEs* (Tutorials, software support, recitation, discussion)
2021 *Computational Methods of PDEs* (Recitations, software support, assignment evaluation, discussions)
2020 *Real Analysis* (Assignment evaluation, discussions)

Referee Service

10th International Congress on Industrial and Applied Mathematics (ICIAM) 2023, Tokyo

Workshops attended

2022 NCM Workshop - Numerical Methods for Partial Differential Equations, IISER-TVM
2022 Juliacon hackathon - [CUDA . j1 FVM code for 1D Euler's equations](#)
2021 IGP/IWR School on *Hardware aware scientific computing*
Mini project-*Performance analysis of the CFD code HiFlow3*
2019 NCM Advanced Instructional School-Geometric analysis, IIT Bombay
2019 NCM Advanced Instructional School-Geometric measure theory, IIT Madras