Arpit Babbar

Numerical Mathematics
Johannes Gutenberg University
Mainz 55128
Rhineland-Palatinate, Germany

arpit@babbar.dev, ababbar@uni-mainz.de
babbar.dev

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	`Trixi.jl`, `git`, Linux, TEXMACS, LATEX, Windows, macOS
Intermediate	C++	DEAL.II, `DifferentialEquations.jl`, Paraview, VisIt, `HOHQMesh`, `MPI.jl`
Basic	Fortran	TensorFlow, `CUDA.jl`, `clawpack`

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

Talks

2024 Admissibility preserving Lax-Wendroff Flux Reconstruction schemes for compressible flows, IGHASC: **Indo-german Workshop on Hardware-aware Scientific Computing 2024**, 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

2018-2024 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 Eligiblity 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

10^{th} 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.jl` 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