Megala Anandan

Postdoc

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Current position

Postdoctoral Researcher

Institut für Mathematik, Johannes Gutenberg Universität Mainz, Germany *October 2024 - Present*

- Advisor: Prof. Dr. Mária Lukáčová-Medvid'ová
- Research: Asymptotic-preserving and energy-stable numerical methods

Education

Ph.D., M. Tech (Research) in Aerospace engineering - Prime Minister's Research Fellow

Indian Institute of Science, Bangalore, India *2019 - 2024*

- Advisor: Prof. S. V. Raghurama Rao
- Thesis title: On structure preserving numerical schemes for hyperbolic partial differential equations and multiscale kinetic equations
- CGPA: 9.4/10

B.E. in Mechanical engineering

PSG College of Technology, Coimbatore, India *2014 - 2018*

- Thesis advisors: Prof. P. R. Thyla, Dr. D. Martin Suresh Babu, Prof. S. Syath Abuthakeer
- Thesis title: Design of homogeneous epoxy granite mixer (a part of the project sponsored by Department of Science and Technology (DST), India)
- Minor project: Design of Geneva wheel mechanism and its implementation in table indexing
- CGPA: 9.15/10

Publications

Journal Articles

Megala Anandan, Benjamin Boutin, Nicolas Crouseilles. Uniformly higher order accurate schemes for dynamics of charged particles under fast oscillating magnetic fields. *IMA Journal of Numerical Analysis*, https://doi.org/10.1093/imanum/draf048, 2025.
arXiv url: https://arxiv.org/abs/2503.07284.

Megala Anandan, Mária Lukácová-Medvidová, S. V. Raghurama Rao. An asymptotic preserving scheme satisfying entropy stability for the barotropic Euler system. *SeMA Journal*, https://link.springer.com/article/10.1007/s40324-025-00395-7, 2025.
arXiv url: https://arxiv.org/abs/2503.07284.

Megala Anandan, S. V. Raghurama Rao. On Lattice Boltzmann Methods based on vector-kinetic models for hyperbolic partial differential equations. *Computers and Fluids*, https://doi.org/10.1016/j.compfluid.2024.106348, 15 August 2024.
arXiv url: https://arxiv.org/abs/2401.03952. Jan 2024.

Megala Anandan, Benjamin Boutin, Nicolas Crouseilles. High order asymptotic preserving scheme for diffusive scaled linear kinetic equations with general initial conditions. *ESAIM: Mathematical Modelling and Numerical Analysis*, https://doi.org/10.1051/m2an/2024028, 26 June 2024.
arXiv url: https://arxiv.org/abs/2305.13393. May 2023.

Megala Anandan, S. V. Raghurama Rao. Entropy conserving/stable schemes for a vector-kinetic model of hyperbolic systems. *Applied Mathematics and Computation*, https://doi.org/10.1016/j.amc.2023.128410, 15 March 2024.
arXiv url: https://arxiv.org/abs/2302.08014. February 2023.

Conference Proceedings

Megala A, S. V. Raghurama Rao. D2Q9 model of upwind lattice Boltzmann scheme for hyperbolic scalar conservation laws. 8^{th} *European Congress on Computational Methods in Applied Sciences and Engineering*, Scipedia, `https://doi.org/10.23967/eccomas.2022.074`, 05-09 June 2022 at Oslo, Norway.

Preprints

Megala Anandan, Mária Lukácová-Medvidová. Provably fully discrete energy-stable and asymptotic-preserving scheme for barotropic Euler equations. arXiv url: `https://arxiv.org/abs/2511.19679`, November 2025.

Journal articles published during undergrad

S. Udhayakumar, K. Sadesh, **A. Megala**, R. A. Sindhu. Sensing characteristics of ultrasonic sensors used in robots: A study. International Journal of Innovative Research in Engineering Science and Technology. ISSN 2320-981X. 3(3):64-70. September 2015.

S. Syath Abuthakeer, U Sachin Ganesh, **A Megala**, Nowfal N. Design of Geneva wheel mechanism and its implementation in the table indexing of drilling machine. National Journal of Technology. ISSN 0973-1334. 14(1). March 2018.

Technical skills

Programming languages: Python, Julia, Matlab, C (basic).

Packages: NumPy, SciPy, mpi4py, ParticleInCell.jl, TensorFlow

Software: LaTeX, Mathematica, Paraview, ANSYS, OpenFOAM (basic).

Operating systems: Linux, Windows, macOS.

Academic Achievements

2019-2024	**Prime Minister's Research Fellowship (PMRF)**, Ministry of Education, Government of India	*INR 70000-80000/month*
2019-2024	**PMRF contingency research grant**, Ministry of Education, Government of India	*INR 200000/year*
2014-2018	**Proficiency Award**, for the best Academic performance at PSG College of Technology	
2014	**Certification by the Academic Council of Matriculation Schools, Tamil Nadu, India**, for securing 99% in Higher Secondary Examination	
2012	**Certification by the Academic Council of Matriculation Schools, Tamil Nadu, India**, for securing 98.4% in Secondary Examination	

Research Visits

University of Rennes - Institut de Recherche Mathematique de Rennes (IRMAR) *Rennes, France*

Collaborators: Dr. Nicolas Crouseilles, Dr. Benjamin Boutin, Dr. Adrien Laurent *Jun-Jul 2022, Jan-Mar 2023, Feb-May 2024, May 2025*

- Project: Higher order asymptotic preserving schemes for kinetic equations with boundary layers
- Project: High order uniformly accurate and energy preserving schemes for fast oscillating magnetic fields
- Project: Uniformly accurate schemes in the guiding center limit

Indian Institute of Science, Bangalore *Bangalore, India*

Collaborators: Prof. Dr. Mária Lukáčová-Medvid'ová, Prof. S. V. Raghurama Rao *March 2025*

- Project: Numerical studies of the Kelvin-Helmholtz instability problem

School of Mathematics, Indian Institute of Science Education and Research *Thiruvananthapuram, India*

Collaborators: Prof. Dr. Mária Lukáčová-Medvid'ová, Dr. K. R. Arun *March 2025*

- Project: Error estimates for velocity-stabilized asymptotic preserving finite volume method

Talks

Invited Talks

Megala Anandan. Asymptotic preserving and energy stable methods for barotropic Euler system - error estimates in the low Mach number limit. Oberseminar Mathematische Strömungsmechanik, Institut für Mathematik der Julius-Maximilians-Universität Würzburg, Germany, Jan 2026.

Megala Anandan. An entropy conservative and exact discontinuity capturing discrete kinetic scheme for scalar conservation laws. Oberseminar Numerik: Institut für Mathematik, Johannes Gutenberg Universität Mainz, Germany, 2022.

Contributed Talks

Megala Anandan. Error estimates of an asymptotic preserving finite volume method for the barotropic Euler system. *Kompaktseminar 2025 of Numerik-JGU Mainz,* at Oberwesel, Germany.

Megala Anandan, Mária Lukácová-Medvidová. Structure preserving schemes for barotropic Euler system in the low Mach number limit. 17^{th} *Hirschegg Workshop on conservation laws, September 2025*. Hirschegg, Austria.

Megala Anandan, Mária Lukácová-Medvidová, S. V. Raghurama Rao. Asymptotic preserving and energy stable numerical schemes for barotropic Euler equations. *ENUMATH 2025*. Heidelberg, Germany.

Megala Anandan, Mária Lukácová-Medvidová, S. V. Raghurama Rao. Asymptotic preserving and energy stable numerical schemes for barotropic Euler equations. *numhyp25: Numerical Methods for Hyperbolic Problems*. 09-18 June 2025 at Darmstadt, Germany.

Megala Anandan, S. V. Raghurama Rao. Entropy conserving and stable schemes for vector-kinetic and macroscopic models. *Kompaktseminar 2024 of Numerik-JGU Mainz*, at Prien am Chiemsee, Germany.

Megala A, S. V. Raghurama Rao. A study of Lattice Boltzmann methods based on vector-kinetic models. Oral presentation at *the 33rd International Conference on Discrete Simulation of Fluid Dynamics (DSFD)*. 09-12 July 2024 at ETH Zurich, Switzerland.

Megala A, S. V. Raghurama Rao. Entropy conserving/stable schemes for vector-kinetic and macroscopic models. Oral presentation at *the 19th International Conference on Hyperbolic Problems: Theory, Numerics and Applications (HYP2024)*. 01-05 July 2024 at Shanghai, China.

Megala A, S. V. Raghurama Rao. 2022. A discrete-kinetic entropy conserving and exact discontinuity capturing scheme for scalar conservation laws. Oral presentation at *XVIII International Conference on Hyperbolic Problems: Theory, Numerics, Applications*. 20-24 June 2022 at Málaga, Spain.

Megala A, S. V. Raghurama Rao. D2Q9 model of upwind lattice Boltzmann scheme for hyperbolic scalar conservation laws. Oral presentation at 8^{th} *European Congress on Computational Methods in Applied Sciences and Engineering*. 05-09 June 2022 at Oslo, Norway.

Professional Development

Workshops Attended

SPP2410 Summer School: Mathematical Fluid Dynamics - Hyperbolic Balance Laws across the Scales - I learnt some theoretical aspects (like the solution concepts by means of convex integration, and numerical analysis) and also the applied aspects (like kinetic equations and turbulence) of hyperbolic systems. September 7-14, 2025. Kleinwalsertal, Austria.

Fundamentals of Deep Learning - By NVIDIA Deep Learning Institute - I participated in the workshop on Deep learning, took the test involving programming using the library `torch`, and obtained the certification. October 2024.

Geometry of Real Numbers - Indian Institute of Technology, Madras - I attended the lessons conducted by Prof. Venkata Balaji T E, Department of Mathematics, IIT Madras, during the Summer of 2019.

Referee service

Reviewed a research article for **SIAM Journal of Numerical Analysis** in 2024.

Teaching experience

Assistantship: Hauptseminar - Mathematics for machine learning – WS 2025/26 *Mainz, Germany*
Institut für Mathematik, Johannes Gutenberg Universität Mainz *2025*
- clearing students' doubts, evaluation of a seminar module

Instructor: Hyperbolic partial differential equations *Bangalore, India*
Ramaiyah University of Applied Sciences, Bangalore *July 2024*
- course design, lecturing

Teaching Assistant: Fluid Dynamics *Bangalore, India*
Indian Institute of Science, Bangalore *Aug 2023 - Dec 2023*
- tutorials, framing exams and assignments, grading and evaluation

Instructor: Hyperbolic partial differential equations and computational aspects *Bangalore, India*
R.V. College of Engineering, Bangalore *Oct 2022 - June 2023*
- course design, lecturing

Instructor: Hyperbolic problems and computational aspects *Bangalore, India*
Ramaiyah University of Applied Sciences, Bangalore *Jan 2022 - Sep 2022*
- course design, lecturing

Instructor: Hyperbolic partial differential equations - Theory and computation *Bangalore, India*
R.V. College of Engineering, Bangalore *Feb 2021 - Nov 2021*
- course design, lecturing

Mentoring Activity

Supervised the Master's internship thesis titled, '*Theory and Numerics for hyperbolic conservation laws*' by Dushyant Dixit (Indian Institute of Technology (IIT) Kharagpur), in collaboration with Prof. S. V. Raghurama Rao, May 2023 - Jan 2024.

Supervised the Bachelor's degree thesis titled, '*Development of an entropy conserving/stable numerical scheme for Euler equations using vector-kinetic model*' by Naman Manoj Ladhad and Nihal Hebbar (R.V. College of Engineering, Bangalore), in collaboration with Prof. S. V. Raghurama Rao, Jan 2022 - Dec 2023.

Languages

English - Proficient/Fluent

German - B1

Tamil - Native