

Venkata Sai Swetha Kolluru

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Education

- Aug 2018–Nov 2024 **Doctorate of Philosophy**, *Department of Physical Sciences, Indian Institute of Science, Bengaluru, India*,
Doctoral thesis: ***Spectral methods for the investigation of singularities in hydrodynamical PDEs*** supervised by Prof. Rahul Pandit.
- Aug 2016–Aug 2018 **Master's degree in Physics**, *Department of Physical Sciences, Indian Institute of Science, Bengaluru, India*, CGPA: 7.7/10
Masters thesis: ***DNS studies of turbulent mixing of two passive scalars*** supervised by Prof. Rahul Pandit.
- 2013–2016 **Bachelor's degree in Mathematics, Physics, Chemistry**, *St. Francis Degree College affil. Osmania University, Hyderabad, India*, GPA: 3.2/4.0

Positions

- Feb 2024–Present **Postdoctoral researcher (CNRS CDD)**, *DRF/IRAMIS/SPEC/SPHYNX, CEA-Saclay, Paris, France*.

Research mobility

- Dec 2023–Feb 2024 **Visiting doctoral student programme**, *Observatoire de la Côte d'Azur, Nice, France*
Worked with Prof. Nicolas Besse on *Numerical investigations of novel spectral schemes* Funded by L'Académie "Systèmes Complexes", Université Côte d'Azur-JEDI.
- Feb 2023–Mar 2023 **Abroad research period**, *Observatoire de la Côte d'Azur, Nice, France*
Worked with Prof. Nicolas Besse on *Suppression of tygers in pseudospectral methods* Funded by the Indo- French Center for Applied Mathematics (IFCAM)

Grants

- 2023–2024 **Programme De Visites Doctorales 2023**, *L'Académie Systèmes Complexes, Université de la Côte d'Azur, Nice, France*.
Co-author: Nicolas Besse
Budget (€) : 7500
This proposal was to facilitate my visit to Nice from December 2023 to February 2024 for 3 months, to work on novel spectral methods for shock-capture. I was involved in drafting and performing the research required to write a portion of the proposal. Prof. Besse was the main contributor for the drafting of the proposal and managing deadlines and logistics.
Link: [UCA-JEDI](#).

Software development

3DAxEuler **Direct numerical simulation | 3D axisymmetric Euler equation**

Authors: SSKV and Puneet Sharma (UG 2018, IISc Bengaluru)

This code was developed from scratch.

Methods: 2/3 dealiased Fourier-Chebyshev pseudospectral methods in space, and adaptive time-step 4th order Runge–Kutta scheme for time marching.

Modules: I have built, tested and deployed 2 Poisson solvers based on Shen-Galerkin method and Tau method which invert the axisymmetric Poisson equation in Fourier-Chebyshev spectral space and implement boundary conditions.

Dependencies: Fortran, Python, MPICH, BLAS-LAPACK, FFTW-3.

Parallelisation: Slab-decomposition with MPICH. Production runs with 30+ cores have been carried out on CRAY-XC40 SahasraT machine at SERC, IISc Bengaluru.

Capability: Highest resolution probed 512×8096 resolution over 3 weeks on 30+ cores.

3DAxIMHD **Direct numerical simulation | 3D axisymmetric Ideal MHD equation**

Authors: SSKV

This code was developed *from scratch*/ branched from 3DAxEuler.

Methods: 2/3 dealiased Fourier-Chebyshev pseudospectral methods in space, and adaptive time-step 4th order Runge–Kutta scheme for time marching, Tau solver for the magnetic helicity computation and $\omega - \psi$ and pressure Poisson problems.

Dependencies: Fortran, Python, MPICH, BLAS-LAPACK, FFTW-3.

Parallelisation: Slab-decomposition with MPICH. Production runs with 30+ cores have been carried out on CRAY-XC40 SahasraT machine at SERC, IISc Bengaluru.

Capability: Highest resolution probed 256×512 on 16 cores.

SRSP **Spectral relaxation and purging methods**

Authors: SSKV and Nicolas Besse

These codes were developed *from scratch*.

Models: 1D inviscid Burgers, 1D shallow water, 1D compressible Euler equations, 1D HL model.

Methods: Fourier(or) Chebyshev pseudospectral methods in space, and 4th order Runge–Kutta scheme for time marching. We employ characteristic methods to handle the sensitive boundary conditions at the domain edges for compressible Euler equation.

Modules: Spectral relaxation and spectral purging terms are built into the solver.

Dependencies: Fortran, Python, FFTW-3.

CTSN-3DAE **Numerical computation and asymptotic analysis of time series**

Authors: SSKV

These codes were developed *from scratch*.

Models: 3D axisymmetric Euler equation, 1D HL model.

Methods: Fourier (or) Fourier-Chebyshev pseudospectral methods in space, with **quadruple-precision arithmetic**.

Dependencies: Fortran, Python, BLAS-LAPACK, FFTW-3.

CTSS-1DHL **Symbolic computation and asymptotic analysis of time series**

Authors: SSKV and Cornelius Rampf

These codes were developed *from scratch*.

Model: 1D HL model

Dependencies: Mathematica 12.

Teaching

- Jan 2019 - **Teaching Assistant for PH 202: Statistical Mechanics**, *Department of Physical Sciences, Indian Institute of Science, Bengaluru, India*
May 2019
Aug 2019 - **Teaching Assistant for PH 325: Advanced Statistical Mechanics**, *Department of Physical Sciences, Indian Institute of Science, Bengaluru, India*
Dec 2019

Conferences, Meetings, Workshops and Schools

Oral presentations

- Feb 2024 Laboratoire de Mathématique, J.A.Dieudonné, Nice, France
Aug 2023 '200 years of Navier-Stokes and Turbulences' in Ecole de Physique des Houches, Les Houches, France
Mar 2023 Observatoire de la Côte d'Azur, Nice, France
Nov 2022 APS DFD 75th Annual Meeting, Indianapolis

Poster presentations

- July 2025 STATPHYS-29, Florence, Italy
Aug 2023 '200 years of Navier-Stokes and Turbulences' in Ecole de Physique des Houches, Les Houches, France
Nov 2019 Inhouse Symposium at Department of Physical Sciences, IISc Bengaluru, India

Outreach

- Sep 2021 Invited talk on "Higher education and research in physics for women - II", St. Francis Degree College, Hyderabad, India
Feb 2019 Invited talk on "Higher education and research in physics for women", St. Francis Degree College, Hyderabad, India
Mar 2018 Open day - Kids zone at IISc Bengaluru, India
May 2013 Voluntary teaching at Sarvodaya High School, Gautam Nagar, Hyderabad, India

Computer skills

- **Programming Languages:** Fortran-90 with double and quadruple precision; Python, MATLAB, Mathematica, Bash scripting.
- **Scientific Computing Libraries:** FFTW3, BLAS-LAPACK, CLAWPACK for Finite Volume methods.
- **High Performance Supercomputing:** MPICH parallelism, extensive work experience on CRAY XC40 SahasraT machine, GPU programming on single core, and optimisation with NsightSystems from nvidia-hpcsdk.
- **Machine Learning:** Keras Python
- **Workflow Management:** Docker, git and Github.
- **Publication and media tools:** Microsoft Office Tools, \LaTeX , Adobe Flash CS, VisIt, ParaView, GIMP, Kdenlive, Audacity.

Languages

English Full professional proficiency

Telugu Primary fluency
Hindi Full professional proficiency
French Good comprehension, conversational ability

Publications

Published:

1. **Insights from a pseudospectral study of a potentially singular solution of the three-dimensional axisymmetric incompressible Euler equation.**
Sai Swetha Kolluru Venkata, Puneet Sharma, and Rahul Pandit. *Physical Review E* 105.6 (2022): 065107. <https://doi.org/10.1103/PhysRevE.105.065107>
2. **Novel spectral methods for shock capturing and the removal of tygers in computational fluid dynamics**
Sai Swetha Kolluru Venkata, Nicolas Besse, and Rahul Pandit. *Journal of Computational Physics* 519 (2024): 113446. <https://doi.org/10.1016/j.jcp.2024.113446>
3. **Early time resonances in the three-dimensional axisymmetric Euler equations and their one-dimensional wall approximation.**
Sai Swetha Kolluru Venkata, and Rahul Pandit. *Physics of Fluids* 36.9 (2024). <https://doi.org/10.1063/5.0222257>

Submitted:

4. **Ideal incompressible axisymmetric MHD: Uncovering finite-time singularities**
Sai Swetha Kolluru Venkata, and Rahul Pandit.
Preprint: <https://arxiv.org/abs/2507.06842>
Submitted to APS Physical Review Fluids.
5. **Complex-time singular structure of the 1D Hou-Luo model**
Cornelius Rampf and **Sai Swetha Kolluru Venkata**.
Preprint: <https://arxiv.org/abs/2601.02464>
Submitted to APS Physical Review Fluids.

In preparation:

6. **Log Lattice studies of two-dimensional flows**
Sai Swetha Kolluru Venkata and Bérengère Dubrulle.

Referrals

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