Harshith Gowrachari

PhD in Applied Mathematics,
Master of Science in Aerospace Engineering,
with Major in Advanced Aerodynamics and Propulsion.

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Education

- **PhD program in Mathematical Analysis, Modelling and Applications** *2022-2025*
  Mathematics area, SISSA - International School for Advanced Studies, Trieste, Italy.
  - Applied Mathematics: Numerical Analysis and Scientific Computing, Numerical solutions for PDEs, Numerical methods for Fluid-Structure Interaction, Advanced topics in CFD, Advanced reduced order methods and applications in CFD, Theory of Neural Networks, Machine Learning for Fluid Mechanics, SciML.

- **Master of Science in Aerospace Engineering | Major in Advanced Aerodynamics and Propulsion** *2018-2020*
  ISAE SUPAERO - Institut Supérieur de l'Aéronautique et de l'Espace, Toulouse, France.
  - Multiphase flows and Combustion, Physics and Modelling of Turbulence, Aero-acoustics, Acoustics, Numerical methods for Fluid Mechanics, Aeroelasticity, Applied Aerodynamics, Experimental approach in Fluid Mechanics, Optimization, Algorithm and computing, Mathematics I (PDEs) & Mathematics II (FEM).

- **Bachelor of Engineering in Aeronautical Engineering** *2014-2018*
  Nitte Meenakshi Institute of Technology, Bengaluru, India.
  - Gas turbines, Aircraft propulsion, Turbomachinery, Boundary layer theory, Flight vehicle design, Aircraft performance, Aerodynamics, Aircraft structures, Aircraft stability and control, Avionics, Finite Element Method, Aeroelasticity and Vibration, Engineering Mathematics I, II, III, IV.

Experience

- **Towards Real-Time Digital Twins of Multiphase Steelmaking Continuous Casting Tundish System**
  mathLab, Mathematics area, SISSA | Industrial collaboration with Danieli & C. S.p.A. PhD Thesis
  Supervisor: Prof. Gianluigi Rozza ; Co-supervisor: Assoc. Prof. Giovanni Stabile Jan 2022 - June 2025
  - Mathematical modelling of industrial continuous casting tundish system.
  - Modelling of multiphase, species transport, heat transfer, buoyancy-driven & turbulent flow physics in tundish.
  - Development of reduced order models of tundish metallurgical operations.
  - Reduced order methods for advection-dominated flows, inherently exhibiting non-linear solution manifolds.
  - Projection-based reduced order model, Data-driven models and Scientific Machine Learning.

- **Visiting PhD candidate - Team MEMPHIS** *July - Sept 2024*
  INRIA Bordeaux Sud-Ouest and IMB, University of Bordeaux, Talence, France
  Hosts : Dr. Tommaso Taddei and Prof. Angelo Iollo
  - Investigated registration methods and non-linear model order reduction approaches for the construction of efficient and accurate reduced order models for advection-dominated problems.
  - Visit was supported by ARIA - Accurate ROMs for Industrial Applications grant financed by H2020-MSCA-RISE-2019 of the European Commission under Grant Agreement No 872442.

- **Engine and Nacelle Multiphysics Simulation** *April - Nov 2020*
  AIRBUS OPERATIONS SAS, Toulouse, France. Master Thesis
  Supervisor : Dr. Yannick SOMMERER ; Co-supervisor : Dr. Thomas LIVEBARDON
  - Numerical simulations of the fire extinguishing system of the A350 XWB Rolls-Royce Engine fan zone.
  - Modelling of fire extinguishing agent jet: atomization, evaporation, turbulent mixing & gaseous phase evolution.
  - Strong knowledge and hands-on experience in Discrete Phase Model (DPM), uncoupled and coupled DPM approaches for particle tracking, heat & mass transfer, species transport and boundary conditions for discrete phase.
  - Sensitivity study on quantifying the influence of boundary conditions on fire extinguishing agent evolution.

- **Aero-acoustic Predictions for Turbomachinery Applications** *Jan 2019 - March 2020*
  DAEP, ISAE SUPAERO, Toulouse, France. Research project
  - Assessment of the in-house Finite Volume LES code - CharLES^X for turbomachinery aero-acoustic applications.
  - Addressed the accuracy and stability of the solver, by performing benchmark test cases: isentropic convective vortex, cavity noise mechanisms - by exhibiting both aero-acoustic feedback loop and resonance.

- **Analysis of Aircraft Environmental Control System** *Dec 2017 - April 2018*
  IISc - Indian Institute of Science, Bengaluru, India. Bachelor thesis
  Supervisor : Dr G.S.V.L. Narasimham
  - Thermodynamic modelling of aircraft environmental control system.
  - Analyzing the performance of the ECS for different flight scenarios.

- **Lead Aerodynamicist - TEAM ARION** *Oct 2017 - April 2018*
  SAE-INDIA Student Formula team, NMIT, Bengaluru, India. SAE-INDIA students club
  – Design and CFD simulations of 3D Air restrictor for Honda CBR 600cc V4 engine.
  – CFD simulations of airfoils for front and rear wing applications.

- **Finite Element Analysis of Cubesat** *May - July 2018*
  Center for Small Satellite Research, NMIT, Bengaluru, India. Intern
  – Designing of STUDSAT-2 satellite using sandwiched honeycomb structure.
  – Static structural analysis of sandwiched honeycomb structure of STUDSAT-2.

- **Intern at Aircraft Division** *June 2017*
  Hindustan Aeronautics Limited, Bengaluru, India.
  – Industrial training on assembly of aircraft and manufacturing processes in aircraft division.

Publications

- **Non-intrusive model reduction of advection-dominated hyperbolic problems using neural network shift augmented manifold transformation.** H. Gowrachari, N. Demo, G. Stabile, and G. Rozza. *arXiv preprint* arXiv:2407.18419 (Published in *Computers & Fluids*, DOI: 10.1016/j.compfluid.2025.106758).
- **Model reduction for transport-dominated problems via cross-correlation based snapshot registration.** H. Gowrachari, G. Stabile, and G. Rozza. *arXiv preprint* arXiv:2501.01299. (*Appear in SEMA-SIMAI series special volume 2025*)
- **Projection-based model order reduction for residence time distribution analysis of an industrial-scale continuous casting tundish**. H. Gowrachari, M. Barra, M. Khamlich, G. Stabile, G. Bazzaro, and G. Rozza. arXiv:2509.20366
- **Reservoir computing based predictive reduced order model for steel grade intermixing in a continuous casting tundish**. H. Gowrachari, M. Barra, G. Stabile, G. Bazzaro, and G. Rozza. arXiv:2509.26293
- **Data-driven reduced order model for residence time distribution analysis of an industrial-scale continuous casting tundish**. H. Gowrachari, M. Barra, G. Stabile, G. Bazzaro and G. Rozza. (*In preparation*)

Conferences, Talks and workshops

- **CELLO – Climate Exploration in Lively Liaison with the Ocean 2025** *Sept 16-18, 2025*
  Hamburg, Germany.
  – 5th International Conference on Earth System Modelling.

- **3rd IACM Digital Twins in Engineering Conference & 1st AICOMAS 2025** *Feb 17-21, 2025*
  Paris, France.
  – Speaker in MS001 - Scientific Deep Learning Approaches for real-time forecast and calibration of digital models.
  – **Talk Title**: Digital twin technologies for steelmaking continuous casting tundish. (Talk)

- **Cyber-physical Systems and Digital Twins for the Energy-Intensive Industries** *Sept 9-13, 2024*
  organized by Alessandro Parente at CERTH, Thermi, Thessaloniki, Greece.
  – Workshop organized by CYPHER COST Action CA22151
  – I won COST Action travel grant to participate.
  – **Poster**: Reduced order method for multi-phase system of continuous casting tundish. (poster link)

- **9th European Congress on Computational Methods in Applied Sciences and Engineering - 2024** *June 3-7, 2024*
  Lisboa, Portugal.
  – Speaker in MS046 - Cutting-edge model order reduction techniques for CFD at ECCOMAS Congress 2024.
  – **Talk Title**: ROM for interface-capturing of two-phase flow using neural-network shift augmented manifold transformations. (Talk slides)

- **AJS - Analysis Junior Seminars 2023-2024** *April 12, 2024*
  Mathematics area, SISSA - International School for Advanced Studies, Trieste, Italy.
  – **Talk Title**: Non-linear transformation techniques for model reduction of advection-dominated problems. (Talk video)

- **SIAM Conference on Uncertainty Quantification (UQ24)** *27 Feb - 01 March 2024*
  Trieste, Italy.
  – **Poster** at SIAM UQ24 Satellite Event - Power of Diversity in UQ : Data-driven reduced order model for advection-dominated problems using neural network shifted proper orthogonal decomposition. (poster link)

- **MORTech 2023 – 6th International Workshop on Model Reduction Techniques** *Nov 22-24, 2023*
  École Normale Supérieure Paris-Saclay, France.
  – **Poster**: Data-driven reduced order model for advection-dominated problems using neural-network shifted proper orthogonal decomposition. (poster link)

- **Stanford FLAME - Future Learning Approaches for Modeling and Engineering AI Workshop** *Sept 5-15, 2023*
  organized by Matthias Ihme and Wai Tong Chung, Stanford University. Online
  – Participated in the 10-day-long ML challenge, tackling generative modelling in fluid dynamics/turbulence.
  – Talks on cutting-edge trends by AI/ML experts.

Advanced schools participation

- **22nd European Finite Element Fair EFEF 2025, hosted by SISSA** *May 23–24, 2025*
  – Informal workshop for high-level discussions on current research in finite element approximation.
- **Young ERCOFTAC Graduate School: Data-driven model reduction for dynamical systems** *April 13-19,2025*
  organized by Peter Schmid, Shervin Bagheri, Taraneh Sayadi, Montestigliano, Italy.
  – Lectures on model reduction to spectral submanifolds by Prof. George Haller, ETH Zurich, Switzerland.
- **Training School on Machine Learning Methods for Reacting Flows** *Sept 9-13, 2024*
  organized by Antonio Attili and Anh Khoa Doan at CERTH, Thermi, Thessaloniki, Greece.
  – School was conducted by the CYPHER COST Action CA22151 and I won a travel grant to participate.
- **Introduction to Quantum Computing in Fluid Dynamics** *July 8-12, 2024*
  von Karman Institute for Fluid Dynamics, Sint-Genesius-Rode, Belgium.
  – Lecture series on Quantum computing, Quantum algorithms, Hybrid computing, Quantum machine learning.
- **Advanced course on Machine Learning for Fluid Mechanics** *July 10-14, 2023*
  organized by Steven L. Brunton and Bernd R. Noack at CISM, Udine, Italy.
- **Summer School on Reduced Order Methods in Computational Fluid Dynamics** *July 11–15, 2022*
  organized by Gianluigi Rozza, Giovanni Stabile, and Michele Girfoglio at SISSA, Trieste, Italy.

Software's and Technical skills

CFD codes: OpenFOAM, STAR-CCM+, Ansys - Fluent, CFX, Workbench.
CAD and Mesher: CATIA-V5, SolidWorks, ICEM-CFD, HyperWorks.
Post-processing: Paraview, Ensight.
Programming languages: Python, C++, Matlab, LaTeX, Fortran90.
Libraries: NumPy, SciPy, pandas, scikit-learn, PyTorch.
Dev Tools: VScode, Git, Github.
Operating system: Linux, Microsoft Windows.
Soft Skills: Autonomy, Leadership, Team working, Communication, Flexibility.

Contributions to Opensource Software

- I contributed to the development of EZyRB - a Python library for non-intrusive, data-driven model order reduction of parametrised problems. https://github.com/mathLab/EZyRB.

Awards and Achievements

- **Young ERCOFTAC Montestigliano Spring School for Graduate Students 2025**: Shortlisted to participate in the school and awarded a fellowship to attend.
- **CYPHER COST Action Travel Grant**: To participate in the workshop - Digital twins for the decarbonization of hard-to-abate industries and in the training school - Machine learning for reacting flows: from theory to applications, both held at CERTH, Thermi, Thessaloniki, Greece.
- **SISSA SIAM Student Chapter**: Served as Chapter Secretary, SIAM student member, and part of the local organizing committee for SIAM UQ24 in Trieste, Italy.
- **SAE INDIA Student Formula team**: TEAM ARION - Member and Lead of Aerodynamics subsystem.
- **Aeronautical Society of India (AeSI)**: Student member.
- **Awarded by Mysore District PU Physics Lecturers Forum**: For securing 100/100 in the Second PUC Physics examination 2014.

Online certifications

- Neural Networks and Deep Learning by Andrew Ng. (certificate link)
- Improving Deep Neural Networks: Hyper-parameter Tuning, Regularization and Optimization by Andrew Ng. (certificate link)

Languages

Kannada: Mother tongue;
English: Bilingual;
Hindi, Telugu: Working proficiency;
French, Italian: Beginner (A2).

Signature
Harshith Gowrachari

References

- **Prof. Gianluigi Rozza**,
  Full Professor in Numerical Analysis, Mathematics Area, mathLab,
  SISSA – International School for Advanced Studies,
  SISSA mathLab director,
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  34136 Trieste, Italy.
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- **Prof. Giovanni Stabile**:
  Associate Professor in Numerical Analysis at Biorobotics Institute,
  Sant'Anna School of Advanced Studies, Pisa, Italy.
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