Harish Ragul Rajaramaduraikarthik

PhD Applicant — Thermal Management, CFD & Numerical Simulation

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Education

M.E. Thermal Engineering

2023 – 2025

JJ College of Engineering and Technology — Anna University, India — CGPA: 8.33 / 10

Thesis: Development of a Web-Based Application for Solving Steady-State Thermal Conduction and Convection Problems Using FEniCS and Django

- Discretised the 2D steady-state heat conduction equation using the finite element method; solved with FEniCS handling spatially varying thermal conductivity and mixed boundary conditions (Dirichlet, Neumann, Robin) — directly applicable to conjugate heat transfer modelling in electronics cooling geometries.
- Conducted steady-state and transient thermal simulations using ANSYS Thermal and Fluent; performed structural analysis using ANSYS Mechanical; used ICEM CFD, Fluent Meshing, and SpaceClaim within ANSYS Workbench — directly relevant to the simulation component of direct oil cooling research.
- Packaged the solver into a Django web application — boundary conditions and material parameters configurable through a browser interface; results plotted inline.
- Coursework: heat transfer, fluid mechanics, turbomachinery, computational methods, thermal system design.

B.E. Aerospace Engineering

2019 – 2023

Dhanalakshmi Srinivasan Engineering College — Anna University, India — CGPA: 8.37 / 10

Thesis: Integration of Inertial Navigation System in a Quadcopter

- Fused accelerometer and gyroscope data from an MPU-6050 IMU for real-time attitude estimation; implemented IMU driver from scratch in MicroPython for Raspberry Pi Pico (published on GitHub).
- Interfaced navigation output with a Pixhawk flight controller to close the stabilisation loop.

Publications

- Rajaramaduraikarthik, H. (2026). *Lid-Driven Cavity Flow: A Python Projection Method Solver Validated Against Ghia et al. (1982).* Zenodo. doi.org/10.5281/zenodo.20623227
- Rajaramaduraikarthik, H. (2026). *CFD from Scratch: A Self-Paced Python Course from Finite Differences to Turbulence.* Journal of Open Source Education. Under review. jose.theoj.org

Research Experience

Incompressible Flow Solver Suite — Python

2025 – Present

Independent research — github.com/harishragul/cfd

- Built a complete FVM pipeline from scratch: control volume discretisation, face flux assembly, pressure-velocity coupling via projection method and SIMPLE algorithm on staggered grids.
- Implemented and validated a 2D lid-driven cavity solver (129×129 grid, $\mathrm{Re} = 100$) against Ghia et al. (1982) — u- and v-velocity centreline profiles in close agreement with benchmark data; results published as a Zenodo technical note.
- Studied RANS turbulence modelling from first principles: Reynolds decomposition, closure problem, k-ε transport equations, k-ω SST blending functions and stress limiter; validated turbulent channel flow against the log-law at multiple Re_τ.
- Built mesh generation tools: y^+ estimation workflow, geometric and tanh clustering, mesh quality metrics (skewness, aspect ratio, non-orthogonality) — directly applicable to RANS boundary layer meshing.
- Currently implementing TVD schemes (van Leer, minmod, superbee, MC) on a MAC staggered grid to eliminate checkerboard pressure modes and improve accuracy near sharp velocity gradients.

OpenFOAM — Case Setup, Meshing & Simulation

2026 – Present

Independent research project — github.com/harishragul/openfoam-learning

- Completed icoFoam lid-driven cavity simulation at Re = 10 and Re = 100; independently diagnosed and resolved a Courant number instability (Co > 1).
- Completed mesh generation: blockMesh 2D channel (8,000 cells, y^+-graded), mesh independence study, snappyHexMesh sphere in channel (28,292 cells, non-orthogonality max 36°, all three phases complete).
- Completed boundary condition setup and solver selection; extending to turbulent cases — k-ω SST backward-facing step validation is the current focus.

FEniCS Thermal Solver — M.E. Thesis

2024 – 2025

JJ College of Engineering and Technology, Anna University

- Solved the 2D steady-state heat conduction PDE using FEM with spatially non-uniform thermal conductivity and mixed boundary conditions — the same class of conjugate heat transfer problem that governs heat dissipation in power electronics packages.
- Applied ANSYS Thermal and Fluent for complementary steady-state and transient thermal simulations during thesis validation, gaining direct experience with temperature field analysis and thermal boundary condition setup.
- Django web interface allows interactive boundary condition and material parameter input with inline result visualisation — demonstrating ability to build practical tools around numerical solvers.

Technical Skills

Thermal Simulation	Steady-state & transient heat conduction, conjugate heat transfer, ANSYS Thermal & Fluent (temperature field analysis, boundary conditions, material properties), FEM (FEniCS), mixed BCs, non-uniform thermal conductivity
CFD & Numerics	FDM, FVM, projection method, SIMPLE, TVD schemes (van Leer, minmod, superbee, MC), QUICK, MUSCL, pressure-velocity coupling
Turbulence	RANS, k-ε, k-ω SST (Menter 1994), wall functions, y^+ estimation, turbulent channel flow validation
CFD & Thermal Tools	ANSYS (Fluent, CFX, Thermal, Structural, ICEM CFD, Workbench, SpaceClaim), OpenFOAM (icoFoam, simpleFoam, blockMesh, snappyHexMesh, ParaView), FEniCS, Python/NumPy solvers
Programming	Python (NumPy, SciPy, Matplotlib, Pandas, Django), C/C++ (basic reading & modification), Git, Linux

Professional Experience

Software Developer — Python

Jun 2023 – Present

Telebillz Solutions LLP (Remote, Bangalore, India)

- Built and maintained production backend services in Django and Flask: REST APIs, PostgreSQL/MySQL database design, payment integrations, analytics pipelines (Pandas + SQL).
- Developed clean, reviewed, production-quality code in an agile team — practices directly transferable to simulation scripting and reproducible research workflows.

Writing & Outreach

- **Technical blog** — *"How I Taught Myself CFD Using an AI Code Agent"* harishragul.com/blog
  Published on harishragul.com and dev.to; describes the Socratic + Feynman AI-tutored learning methodology behind the CFD curriculum.
- **Portfolio site** — CFD project write-ups, solver documentation, validated results, and research notes. harishragul.com