

SHANTHOSH KV

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EDUCATION

RV College of Engineering

Bengaluru, Karnataka

B.E. in Aerospace Engineering, GPA 9.12/10

2023 – 2027

- Completed challenging coursework in Materials Science, Electrical & Electronic Systems, Avionics, and Advanced Manufacturing Processes, gaining a solid technical foundation for advanced aerospace and AI-driven innovation.

EXPERIENCE

Indian Institute of Space Science and Technology (IIST)

July 2025 – Oct 2025

Research Intern

Thiruvananthapuram, Kerala

- Engineered a Gaussian Process Regression-based ML solution to predict combustion flame species from TDLAS spectral data, achieving less than 1.5% mean error across a wide temperature spectrum.
- Developed evaluation metrics for fuel-air mixing performance using advanced Planar Laser Mie Scattering diagnostics, yielding valuable new insights for high-speed propulsion and combustor research.
- Designed and deployed an experimental setup to generate precise near 2D laser sheets via Galilean beam expander optics, enabling accurate spatial mapping of mixing dynamics.
- Captured and processed time-resolved Mie-scattered signals with a high-speed imaging system, and automated post-processing workflows in MATLAB to analyze mixing homogeneity.
- Introduced and calculated unmixedness factor, quantitatively characterizing injector-driven mixing efficiency and informing data-driven combustor improvement.

BOCK SPACE

Dec 2024 – Jun 2025

Liquid Rocket Engine Design Intern

- Designed a MOC-based nozzle contour generator in Python with coordinate export and interactive 3D visualization.
- Developed coaxial bi-swirl injectors via parametric modeling for staged combustion engines.
- Designed two-stage centrifugal turbopump for RP-1 delivery and validated smooth flows via ANSYS/CFX.
- Engineered single-stage gas generator turbine for RP-1 and LOX combustion products; conducted structural, modal analysis for assembly ensuring thermal and structural margins.
- Produced CAD assemblies and rotordynamics studies for high-speed turbopump/turbine systems integrating real-world constraints.

PRESENTATIONS

AI-Powered CubeSat Constellation for Microplastic Detection

Oral presentation

National Space Science Symposium (NSSS)

Feb 2026, Umiam, Shillong

- Fused Sentinel-1 SAR and Sentinel-2 multispectral imagery via AI-driven sensor fusion for precise ocean microplastic pollution mapping.

PROJECTS

Turbo Forge

- Built a preliminary design suite for liquid rocket turbopumps covering pump meanline, inducer cavitation, axial/radial turbines, and shaft rotordynamics, driven by real NASA CEA/CoolProp/Cantera thermophysical data with NSGA-II optimization and Monte Carlo tolerance analysis; validated with 379 passing tests and 10 hand-worked engineering cases.

Regen · Cooling · Design

- Built a first-principles tool for regeneratively-cooled rocket chambers, coupling Cantera real-gas combustion, Bartz/Gnielinski/Chen heat transfer, and implicit axial wall conduction into a 7-margin structural check per station; ran a differential-evolution + Monte Carlo optimizer across 4,113 candidate geometries to identify passing channel designs.

COPV Design Suite

- Built a deterministic structural-mechanics tool for Type I–V composite overwrapped pressure vessel design, chaining real-gas pressurant sizing, netting analysis, classical laminate theory, liner autofrettage, and 5 failure criteria into 4 independent burst-prediction methods; validated with 13/13 worked examples against 26 cited sources, catching and documenting 2 real physics bugs during development.

Injector Forge

- Developed a full-stack web app for first-principles liquid rocket injector design across 10 element families (doublet, triplet, pentad, coaxial, swirl, pintle), implementing an 8-stage physics pipeline from thermochemistry through manufacturability with parametric sweep, sensitivity analysis, and DXF/PDF report export.

Cryo Tank Thermal Suite

- Developed a full-stack web app for transient thermal analysis of LOX/LH₂/LCH₄/LN₂ tanks, implementing chilldown (Bromley/Rohsenow/Zuber boiling), boil-off, self-pressurization, and stratification via SciPy ODE solvers with live-streaming results; validated against 8 automated NIST/Barron-referenced test cases.

rockmoc

- Built a Python library for supersonic rocket nozzle design via the method of characteristics, supporting six contour families (MLN, ideal, TIC, Rao TOP/TOC, conical, aerospike); validated against 12 literature sources across 43 test cases.

propwrap

- Built an SI-native Python wrapper unifying NASA CEA (RocketCEA), CoolProp, and Cantera for liquid bipropellant thermochemistry, computing Isp, c^* , and density impulse with per-pair O/F optimization for fair propellant trades; validated with 132+ tests matched to published CEA goldens.

Team Antariksh

Chief Subsystem Engineer for Rocket Propulsion, Student Club

- Conducted multiple static fire tests on solid rocket motors, validating thrust with load cells.
- Designed and manufactured propulsion components, running stress analysis to validate structural integrity.

Physics-Informed ML for EHD Ionic Wind Thruster

- Co-developed a closed-loop ionic thruster research platform (4-person IDP team) combining a ZVS flyback/Cockcroft-Walton HV supply, a two-stage ML pipeline (Random Forest corona classifier, XGBoost regressor, $R^2 = 0.997$) for real-time performance prediction, and a SciPy SLSQP auto-tuner validated via SIL/HIL against a physical prototype achieving 2.1 mN peak thrust.

Reconstruction of Aerodynamic Forces from Surface Strain Measurements

- Conducted two-way FSI simulations using ANSYS System Coupling across pre-flutter (45 m/s), critical flutter (51.012 m/s), and post-flutter (57 m/s) regimes for a cantilever-mounted Al 6061-T6 plate, with flutter speed determined via MSC Patran/Nastran modal analysis.
- Extracted strain tensor, displacement, and acceleration data at 16 distributed locations using 48 probes over 175 time steps; identified 1150% transient acceleration amplification at the flutter boundary and 81% post-flutter reduction, confirming nonlinear limit cycle stabilization contradicting classical linear flutter theory.
- Established a comprehensive three-regime aeroelastic database to support development of inverse algorithms for reconstructing time-varying aerodynamic loads from surface strain distributions, with applications in structural health monitoring and real-time flutter detection.

Industry-Standard Single-Stage Water Pump

- Designed volute casing from 6061-T6 aluminum and stainless steel rotor, optimizing for lightweight, corrosion resistance, and efficiency in water service.
- Validated design with CFD analysis, determining rotor blade forces and moments for reliable high-speed operation.
- Target performance: 10 kg/s mass flow rate, power input 3.15 HP, at 2900RPM

Variable Pitch Propeller Mechanism Development

- Built a variable pitch propeller system; developed and tested automated pitch control for aerodynamic efficiency across operating conditions.

Advanced Y^+ Calculator for CFD Boundary Layer Mesh Design

- Developed a browser-based CFD engineering tool for automated first-cell height estimation using target Y^+ methodology across laminar and turbulent flow regimes.
- Implemented support for subsonic laminar, subsonic turbulent, supersonic laminar, and supersonic turbulent external aerodynamic flows, incorporating boundary-layer theory and wall-function requirements.
- Integrated SI and Imperial unit systems, real-time parameter updates, friction velocity calculations, Reynolds number evaluation, and boundary layer thickness estimation for mesh generation workflows.

Automated OpenFOAM Case Generator and Validation Platform

- Developed a web-based automation platform capable of generating complete OpenFOAM case structures from user-defined simulation parameters, significantly reducing pre-processing time.
- Implemented automated creation of solver dictionaries, boundary conditions, turbulence model configurations and numerical schemes
- Built case validation and correction utilities to identify missing entries, inconsistent solver settings, boundary-condition conflicts, and common OpenFOAM configuration errors prior to execution.
- Integrated downloadable case packaging, parameter consistency checks, and workflow automation features to improve simulation reliability and reduce setup failures.

Aerospace Automation Tools

- Programmed modular Python utilities with the ANSA API to streamline geometry refinement and automated mesh quality checks, while building a logging and debugging suite that improved mesh workflow transparency, error detection, and overall CFD and FEA model readiness for solver integration.

Voxel-Based Python Framework for Additive Manufacturing

Under development

- Developing a Python-based framework utilizing voxel-based modeling techniques to generate 3D geometries optimized for additive manufacturing
- Currently designing and implementing computational models for rocket engine components, including coaxial bi-swirl injector plates

AI-Powered Research Productivity Systems

- Built oePDF, a local RAG-based document Q&A tool for STEM literature, combining an embedding model and cross-encoder reranker for high-precision semantic retrieval with significantly improved answer relevance.
- Implemented a hybrid LLM/VLM inference strategy where the vision model is invoked only for image-heavy or formula-dense pages, reducing latency while preserving multimodal coverage.
- Persisted processed document chunks in a vector database with file-level caching, eliminating redundant re-processing of previously ingested documents and cutting repeated load times.

High-Quality Dataset Generation for LLM Fine-Tuning

- Developed a Python pipeline to extract and structure text, formulas, and tables from technical documents into ChatML and Alpaca formats, with modular parsers supporting multiple file types and robust error handling.
- Achieved 3x higher throughput with vLLM compared to Ollama, enabling faster multi-turn conversation synthesis with semantic parsing and JSON validation.
- Generated 1500+ domain-specific QA pairs from a 100-page aerospace textbook and created an aligned image-metadata dataset for vision-language model training with comprehensive technical coverage.
- Extended the pipeline with Chain-of-Thought reasoning traces, DPO preference pairs with typed negative samples, and cross-chunk multi-hop questions, producing 6 output formats covering SFT, DPO, and reasoning model training.
- Integrated semantic deduplication via BGE-M3 embeddings, a 6-point QA quality validator, and tiktoken-aware smart truncation, improving dataset cleanliness and alignment with industry fine-tuning standards.

TECHNICAL SKILLS

Rocket Propulsion & Turbomachinery: ANSYS Fluent, rotordynamic analysis, Method of Characteristics (MOC) nozzle/engine contour design, regenerative & film cooling analysis, turbopump meanline sizing

CFD and Simulation: ANSYS Workbench, ParaView, OpenFOAM, ANSA

Programming and Machine Learning: Python, MATLAB, NumPy, SciPy

CAD and Design: SolidWorks, Fusion 360, CFTurbo