

Mohammed S. Al-Mahrouqi

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U.S. work-authorized (3-year OPT)

Summary

Aerospace Engineering graduate (Georgia Tech) working across flight dynamics & controls, aerodynamics, propulsion, and structures, backed by deep computational-physics tooling: open-source compressible-CFD development, HPC benchmarking, FEA, parametric CAD, and scientific machine learning. I take analysis end-to-end: build the tools, validate them, and deliver hardware that flies.

Education

Georgia Institute of Technology

B.S. in Aerospace Engineering, Minor in Mathematics

May 2026

Atlanta, GA

Coursework: Flight Dynamics, Rotorcraft Aeromechanics, Aerothermodynamics, Jet & Rocket Propulsion, Control Systems, Scientific Machine Learning (SciML), Prob & Stats for Computing & ML, Differential Geometry.

Experience

RocketPy

Developer (Open-Source)

Jan 2026–Present

Remote

- Developing the control architecture and Monte Carlo flight simulations for RocketPy, an open-source 6-DoF high-power rocket trajectory simulator.

Computational Physics at GT

Undergraduate Researcher (PI: Prof. Spencer Bryngelson)

May 2025–Dec 2025

Atlanta, GA

- Contributed commits/PRs to MFC, an open-source exascale compressible multiphase CFD solver: refactored and verified Riemann solvers (HLL, HLLC, HLLD) and benchmarking utilities, strengthening GitHub CI to improve numerical code-review rigor.
- Benchmarked 20+ releases across heterogeneous CPU/GPU architectures (OpenACC, OpenMP) on HPC clusters (OLCF Frontier, PSC Bridges2, NCSA Delta, GT Phoenix) to quantify solver scalability and regression.
- Automated Docker/Singularity containerization of pre-compiled images, cutting environment setup from ~30 min to ~5 min; built hypersonic boundary-layer (Mach 30) case files for immersed-boundary runs.

Space Generation Advisory Council (SGAC)

Space Law & Policy Researcher

Jan 2025–Jul 2025

Remote

- Synthesized international treaties, national legislation, and academic/policy literature into deliverables on cybersecurity and dual-use risk for space systems, identifying gaps in existing space-law frameworks.

Yellow Jacket Space Program (YJSP)

Flight Dynamics & Structures Engineer

Aug 2023–May 2024

Atlanta, GA

- Built a Barrowman-method stability tool in MATLAB producing stability derivatives and flight-performance predictions for trajectory correlation.
- Designed the engine thrust-structure CAD assembly and ran FEA validating stress distributions and margins under 1,000 lbf peak thrust.
- Co-authored the Structure Concept Design Review (CDR) and machined critical components; all hardware cleared 10 consecutive hotfire tests in Spring 2024.

Projects

Erodius Hybrid-Electric Tiltrotor (Stability & Control Lead)

VFS Student Design Competition (Leonardo)

2026

- Built a state-space XV-15 tiltrotor flight-dynamics model from VSPAERO derivatives; synthesized LQR gains driving all closed-loop poles into the left-half plane and rejecting 30 ft/s gusts within 5 s under FAR §25/§29 discrete and von Kármán turbulence.
- Developed a MATLAB c.g./static-margin tool (validated against SolidWorks & VSPAERO) and an LPV gain-scheduled Simulink controller completing a 12 s helicopter-to-airplane nacelle conversion inside the XV-15 corridor.

Aerodynamic Coefficient Surrogate (NASA CRM)

Scientific Machine Learning

2026

- Trained neural-network surrogates for $C_L/C_D/C_M/C_N/C_A$ from 115 transonic wind-tunnel polars; a physics-by-construction axis-rotation layer cut the inter-coefficient identity residual from 5×10^{-3} to $\sim 10^{-8}$ at no accuracy

cost, outperforming soft (PINN) penalties.

- Used per-polar GroupShuffleSplit with multi-seed evaluation to isolate Mach extrapolation as the dominant accuracy limit (R^2 0.999 $\rightarrow$ 0.98 on a held-out Mach band).

Geometric Flows for CFD Mesh Repair

2026

Independent Research

- Built differential-geometry mesh-repair filters (mean-curvature, Willmore, conformal) on the cotangent Laplace–Beltrami operator for immersed-boundary CFD pipelines (MFC, PeleLMeX, CharLES); accelerated SPD sparse solves with pre-conditioned CG and algebraic multigrid (PETSc/Hypre) under hybrid MPI+OpenMP.

Re-Entry Vehicle Thermal Analysis

2024

Aerothermodynamics

- Cross-correlated Fay-Riddell, Sutton-Graves, and Tauber-Sutton stagnation-heating models over an 8 km/s MATLAB re-entry trajectory and sized the TPS via finite-difference analysis (Carbon-Carbon 0.95 cm, PICA 9.68 cm) to hold the bondline below 250°C.

Turbojet Engine Design & GAP Solver

2025

Jet & Rocket Propulsion

- Designed a turbojet (intake, compressor, burner, turbine, nozzle) to thrust/performance requirements and built GAP (General Aerospace Propulsion), a Python turbomachinery performance-prediction tool (compute on PSC Bridges2 & Azure HB VMs).

LEOJet Liquid Rocket Booster

2025

Jet & Rocket Propulsion

- Designed a LOX/LH2 liquid bi-propellant booster as an alternative to solid boosters, sizing nozzle geometry and regenerative cooling in MATLAB.

Wing Flexing on 3D Prints

2024

Fluid & Solid Mechanics Lab

- Generated parametric NACA-2412 wings in Siemens NX and compared FEA stress gradients against strain-gauge (LabJack T4 DAQ) tip-deflection measurements under loading to 1.3 kg across 5 materials and print orientations.

Parametric CAD Automation (NXOpen)

2025

Geometry Tooling

- Wrote Python that emits Siemens NX expression files driving the position/orientation/scale of every control point, regenerating full geometry from a single parameter; parametrized 4 nosecone families (Haack, elliptical, parabolic, power) for scriptable sweeps.

Skills

CAD & Design: SolidWorks, Siemens NX, Autodesk (Fusion/Inventor); parametric/surface modeling, GD&T, FEA (Ansys).

CFD & Simulation: Compressible multiphase (MFC), Riemann/Godunov solvers (HLL/HLLC/HLLD), Ansys Fluent, VSPAERO, ParaView, MATLAB/Simulink.

Flight Dynamics & Controls: State-space modeling, LQR, LPV gain scheduling, stability & control, gust/turbulence (FAR §25/§29) analysis.

Scientific ML & Numerics: TensorFlow, physics-informed/physics-by-construction NNs, PETSc/Hypre, preconditioned CG, multigrid.

HPC: OpenMP, OpenACC, MPI, Docker/Singularity; OLCF Frontier, GT Phoenix, PSC Bridges2, NCSA Delta, OSG OSPool.

Test & Fabrication: LabVIEW, NI ELVIS, strain gauges, load cells, DAQ; 3D printing, waterjet, laser cutter, mill/lathe.

Programming: C++, Fortran, Python, MATLAB, Bash, Git.

Leadership & Involvement

Officer, School of Aerospace Engineering Student Advisory Council (SAESAC): led the International Student Series (3 events). **Planning Committee,** AIAA Southeastern Regional Student Conference (150+ attendees). **Mentee,** Boeing Forming Leaders in Technology (FLT) & GM Mentor Jacket. **Volunteer:** Hands On Atlanta (150 hrs), FIFA World Cup Atlanta, Dad's Garage Theatre.