Dara Rahmat Samii

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September 2026

Summary

- M.Sc. student in Mechanical Engineering integrating machine learning with CFD for thermal spray coating analysis.
- Delivered 100× speedup over traditional solvers using Graph Neural Networks; published in IEEE Access.
- Executed RANS, DDES, and aeroacoustic simulations on HPC clusters (400+ CPU cores, Compute Canada).
- Led CFD analysis for two high-power rockets at SpaceConcordia; L3-certified rocketeer (Canadian Association of Rocketry).

Research Interests

- Computational Fluid Dynamics
- Multiphase & Particle Flow
- Numerical Modeling
- Compressible & Supersonic Flow
- Mesh-Based Graph Neural Networks
- Reacting Flow Simulation
- Scientific Machine Learning
- High Performance Computing
- Turbulent Modeling

Education

- **Doctor of Philosophy, Mechanical Engineering** — Jan 2027 – Dec 2030 (Expected)
  McGill University — Montréal, Canada
  Advisor: Prof. Hendrik Nicolai | ASEC Lab
  Research: *DNS/LES of Hydrogen-Methane Flames*

- **Master of Applied Science, Mechanical Engineering** — Sep 2023 – Jun 2026
  Concordia University — Montréal, Canada
  Advisor: Prof. Moussa Tembely
  Thesis: *Thermofluid Simulation of Thermal Spray Processes*
  GPA: **4.23 / 4.3** | Thesis Grade: **Outstanding**

- **Bachelor of Science, Chemical Engineering** — Sep 2018 – Sep 2022
  Iran University of Science and Technology (IUST) — Tehran, Iran
  Advisor: Prof. HashemAbadi
  Thesis: *Design and Manufacturing of a Gas Rotameter Using CFD*
  GPA: **3.58 / 4.0** (17.01 / 20)

Research Experience

- **Research Assistant** – Concordia University — Sep 2023 – Jun 2026
  Multiphase Thermofluid Learning Lab — Montréal, Canada
  - Simulate cold spray process at 35–65 bar and 707–807 K using high-fidelity CFD methods.
  - Develop analytical model for preliminary aeroacoustic analysis of supersonic jets.
  - Extend `sonicFoam` to `sonicDPMFoam` with Lagrangian particle tracking for two-phase flow modeling.
  - Execute RANS → DDES workflows on Compute Canada HPC clusters (400+ cores).

- **CFD Team Lead** – SpaceConcordia, Solid Rocketry Team — Dec 2024 – Present
  Montréal, Canada
  - Execute OpenFOAM aerodynamic simulations for CR25 and CR26 (Icarus & Daedalus two-stage rockets).
  - Compute drag, lift, center of pressure, thermal loads, and bending moments across Mach 0.8–2.5 and angles of attack ±5°.
  - Perform mesh sensitivity studies via Richardson extrapolation; implement multi-step numerical scheme progression from stable to high-accuracy schemes.
  - Contribute to CR25 manufacturing, composite infusion, assembly, and Launch Canada 2025 field operations.

- **Research Intern** – JSPM Imperial College of Engineering — Oct 2021 – Jan 2022
  Department of Mechanical Engineering — Pune, India (Remote)
  - Investigated multiphase solvers in OpenFOAM; collaborated with international research team on systematic solver benchmarking across flow regimes.

- **Engineering Intern** – Partian Battery — Jun 2021 – Oct 2021
  R&D Department — Tehran, Iran
  - Designed and optimized a stirred mixer using COMSOL Multiphysics; validated simulation results against experimental measurements.
  - Developed a parametric simulation application using COMSOL Application Builder (Java-based GUI) to enable rapid design iteration across mixing configurations.

Teaching Experience

- **Teaching Assistant** – Concordia University — Sep 2023 – Jun 2026
  Department of Mechanical, Industrial & Aerospace Engineering — Montréal, Canada
  Recognition: ***Teaching Excellence Award for Teaching Assistants****, May 2026*
  - Accumulated 1,200+ TA hours across lab demonstration and tutorial leadership roles over 2 years.
  - Conducted lab sessions for undergraduate courses in Fluid Mechanics, Heat Transfer, and Thermodynamics.
  - Led tutorial sections for C++/Arduino Programming, Statics, Advanced Calculus, and CFD for Aerospace Engineering.
- **Teaching Assistant** – Iran University of Science and Technology — Feb 2022 – Jul 2022
  Department of Chemical Engineering — Tehran, Iran
  - Delivered weekly tutorial sessions and graded assignments for undergraduate Fluid Mechanics (∼30 students).
- **Private Tutor** – Independent — 2020 – Present
  - Tutored undergraduate students in Ordinary Differential Equations, Transform Calculus, Fluid Mechanics, and C++ Programming.

Publications

[1] *Investigation of Aeroacoustics and In-flight Particle Transport in Thermal Spray Supersonic Jets.*
D. Rahmat Samii, M. Tembely (2026). *arXiv preprint.* [Link]

[2] *Accelerating Thermal Homann Flow Simulation With Mesh-Based Graph Neural Networks.*
D. Rahmat Samii, M. Tembely (2025). *IEEE Access.* [Link]

[3] *CFD Based Design Gas Rotameters: Dynamic Mesh Transient Simulation.*
D. Rahmat Samii, S. H. HashemAbadi, P. Margan (2023). *Flow Measurement and Instrumentation.* [Link]

Conferences

[1] *Computational Fluid Dynamics (CFD) Analysis of a Supersonic Rocket.*
Conférence annuelle de fuséologie d'Oronos 2026 — March 2026
Polytechnique Montréal

[2] *Numerical Simulation and Prediction of Particle Distribution Based on Aeroacoustic Signals Emitted by the HVAF Process.*
32nd Annual CSME–CFDSC–CSR 2025 (abstract) — May 2025
École de technologie supérieure (ÉTS), Montréal

[3] *Accelerating Simulations of Plasma Flow and Substrate Interaction in Thermal Spray.*
31st Annual CSME/CFD 2024 (abstract) — May 2024
University of Toronto

Honors & Awards

- **Teaching Excellence Award for Teaching Assistants**, Concordia University — *May 2026*
- **Mitacs Globalink Research Award** – $6,000 CAD for international research collaboration (France–Canada) — *Feb 2025*
- **Concordia Conference Scholarship** – $750 CAD travel support for CSME/CSCFD 2024 — *May 2024*
- **Concordia Merit Scholarship** – $5,000 CAD for academic excellence — *Sep 2023*
- **8th Place**, 27th National Chemical Engineering Olympiad, Iran — *Oct 2022*
- **Direct M.Sc. Admission Qualification** – Top 10% of 2018 cohort; waived entrance exam in Thermo-Kinetics — *May 2022*
- **2nd Place**, Internship Poster Competition (80 participants) — *Sep 2021*
- **1st Place**, "Rahneshan" National Competition (Team Lead) – CFD modeling of particle crystallization and growth — *Feb 2021*

Selected Projects

- **Aeroacoustic CFD Simulation of Thermal Spray (Master's Thesis)** — Ongoing
  Extended `sonicFoam` with DPM to create `sonicDPMFoam`; validated particle–shock interaction against literature. Executed RANS-to-DDES workflow with field mapping; verified turbulence via Kolmogorov energy cascade. Applied FW-H acoustic analogy (`libAcoustics`) to link particle distribution with aeroacoustic signatures.

- **CR25 Rocket Aerodynamics – SpaceConcordia** Ongoing
  Simulated Launch Canada 2025 rocket (CR25, Aether) using OpenFOAM. Evaluated fin sizes, design changes, and flight performance across Mach 0.8–2.5. Documented performance metrics and failure points from CFD analysis.

- **Mesh-Based GNN for Accelerating CFD** – GitHub Published, IEEE Access 2025
  Generated large-scale CFD dataset via parameterized CAD, meshing, and OpenFOAM simulation. Converted `polyMesh` to graph inputs; tuned GNN architectures with Optuna. Achieved **100× speedup** over traditional solvers.

- **Gas Rotameter Design and Manufacturing with CFD (Bachelor's Final Project)** – Article
  Performed transient ANSYS Fluent simulations with dynamic mesh; validated against experimental data. Compared triangular vs. quadratic mesh deformation schemes; published in *Flow Measurement and Instrumentation*.

- **Design of Mixing Tank using CFD** – Project Link
  Internship project at *Partian Battery Inc.* Designed and optimized a stirred mixer for battery cathode agglomerate production. Investigated the Population Balance Model (PBM) to simulate cathode particle agglomeration within the mixer. Developed a parametric app using COMSOL Application Builder (Java) for rapid design iteration; validated locally and globally against experimental data.

- **py-distillation Package** – GitHub
  Python package for distillation tower calculation. Implements Ponchon-Savarit and McCabe methods; supports open-steam, multiple-feed, and side-stream configurations. Fully documented and installable via standard package repositories.

- **Arduino PID Ball Balancer** – GitHub
  Built a 3D-printed PID controller using Arduino Uno to balance a ping-pong ball. Fine-tuned PID coefficients for improved performance; utilized ultrasonic sensors for position detection and servo-controlled plate adjustments.

- **Poisson Equation with DEAL.II** – GitHub
  Used DEAL.II (FEM, C++) to solve Poisson's equation on circle, ring, and square geometries.

Technical Skills

- **CFD & Simulation**: OpenFOAM (custom solver development), ANSYS Fluent, COMSOL, ParaView
- **CAD & Meshing**: SpaceClaim, DesignModeler, FreeCAD, Salome, Onshape, SolidWorks
- **Programming**: Python (NumPy, Pandas, PyVista, SciPy), C/C++, MATLAB, Bash scripting
- **ML & Scientific Computing**: PyTorch, PyTorch Geometric, scikit-learn, Optuna, fast.ai, Stable-Baselines
- **HPC & DevOps**: Slurm, Linux, Git, Docker, SSH, tmux, vim
- **Visualization & Documentation**: ParaView, PyVista, Manim (mathematical animation), LaTeX

Certifications

- L3, L2, L1 Rocketry Certificate, Canadian Association of Rocketry — May 2026, Oct 2025, May 2025
  Rockets: Darius (L1), Lord Cyrus (L2), Lord Cyrus Modified (L3)
- Game Theory, Stanford & UBC (Credential) — Apr 2023
- From Nand to Tetris, Hebrew University of Jerusalem (Credential) — Aug 2023
- Fundamentals of Reinforcement Learning, University of Alberta (Credential) — Sep 2020
- Deep Learning Specialization, DeepLearning.AI (Credential) — Aug 2020
- Machine Learning, Stanford Online (Credential) — May 2020

Graduate Course Grades

- Advanced Fluid Mechanics: **A+**
  Prof. Ida Karimfazli
- Applied Artificial Intelligence: **A**
  Prof. Rene Witte
- Deep Learning: **A+**
  Prof. Eugene Belilovsky
- Coatings and Surface Engineering: **A+**
  Prof. Christian Moreau

Selected Undergraduate Course Grades

- Fluid Mechanics I: 19.42/20
- Fluid Mechanics II: 19.5/20
- Thermodynamics I: 17/20
- Thermodynamics II: 18.67/20
- Numerical Analysis: 18/20
- Chem. Eng. Mathematics: 19/20
- Computational Fluid Dynamics: 17.5/20
- Statics and Material Strength: 18.41/20

Volunteer Work

- **International Student Office (ISO)**, Concordia University — Sep 2024
  Welcomed and guided new international students during orientation week.
- **International Aerospace Innovation Forum**, Aéro Montréal — May 2024
  Event organizer; welcomed and guided industry attendees.
- **5th National Fluid Flow Measurement Conference & Exhibition**, IUST — Jul 2022
  Event organizer; coordinated logistics and guided participants.

Languages

- **English**: Professional **French**: Intermediate (B1, actively developing) **Persian**: Native

References

Moussa Tembely, Assistant Professor moussa.tembely@concordia.ca
Mechanical, Industrial and Aerospace Engineering Department, Concordia University
Relation: Master's Advisor

Seyed Hassan HashemAbadi, Assistant Professor hashemabadi@iust.ac.ir
Chemical Engineering Department, Iran University of Science and Technology
Relation: Bachelor's Thesis Advisor

Peter Sakaris, Laboratory Specialist peter.sakaris@concordia.ca
Mechanical, Industrial and Aerospace Engineering Department, Concordia University
Relation: Supervisor during Teaching Assistantship in Heat Transfer, Fluid Mechanics, and Thermodynamics Labs