

Atilla Saadat

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Education

M.A.Sc. - Aerospace Science & Engineering

Sept 2020 – Aug 2022

University of Toronto

Toronto, Ontario

- Spacecraft Systems Engineering and Attitude Determination & Control Systems (ADCS) research and development at the [UTIAS Space Flight Laboratory \(SFL\)](#)
- Thesis: [Design and Test Optimizations for Spacecraft Attitude Determination and Control Subsystems](#)
- Awarded Research Fellowship & Internal Student Fellowship
- Research Supervisor: [Dr. Robert E. Zee](#)

B.A.Sc. - Honour's Mechanical Engineering w/ Aerospace Option

Sept 2015 - Aug 2020

University of Windsor

Windsor, Ontario

- Dean's List - 2016, 2017, 2020
- Research Supervisor: [Dr. Afshin Rahimi](#)

Research Experience

Graduate Researcher

Sept 2020 – Sept 2022

UTIAS Space Flight Laboratory

University of Toronto

- Conducted and automated spacecraft ADCS hardware testing (Rate Sensors, Magnetometers, Magnetorquers, Fine Sun Sensors, Reaction Wheels), creating procedural optimizations for hardware functional tests, thermal acceptance, and data analysis. Developed Python software, networking features, power supply APIs, and novel hardware to decrease overall testing time by over 63% on 13+ satellites for the [HawkEye 360 constellation missions](#), while simultaneously standardizing tests, increasing collected test data quality, and performing Verification and Validation (V&V) of the ADCS hardware
- Researched and developed a novel Earth Horizon Sensor from a repurposed spacecraft inspection camera. Custom python algorithms were created for nadir vector estimation with OpenCV image preprocessing. The software has been validated through simulation with STK Electro-Optical & Infrared (EOIR) images and in-orbit [NorSat-2](#) images, resulting in a simulation Nadir vector estimate with a $\sim 1^\circ$ RSME. [Conference paper awarded 1st place in the Small Satellite Conference 2022 Frank J. Redd Student Competition](#)
- Researched and developed an in-situ inertia tensor estimation method for on-orbit satellites and validated through MATLAB/Simulink ADCS simulation software. Constructed novel reaction-wheel C++ attitude commands in flight code for the HawkEye 360 constellation mission. Conference paper was chosen by the [Canadian Space Agency \(CSA\)](#) as one of two Canadian delegates to attend the [IAC 2022 E2 Student Competition](#)
- Developed a novel model-based Solar Power Generation Analysis software with Python & STK for the [NASA StarBurst mission](#), accounting for photo-voltaic shadowing effects using the SolidEdge CAD model of the satellite. The software produces an accurate, higher-fidelity power generation analysis report for the spacecraft's power budget with shadowed string thresholding, automating the analysis of over 135 attitude/orbital cases

Undergraduate Researcher

Mar 2019 – Oct 2020

Intelligent Control, Analysis, and Modeling (iCAM) Laboratory

University of Windsor

- Researched and developed a novel ensemble-based machine learning (ML) algorithm for fault detection and isolation of fault states for reaction wheels on in-orbit satellites
- Determined optimal approaches for data-set generation, handling, and analysis methods for fault cases. Time-series feature extraction for ML classifier input was also researched and various features and extraction packages were determined optimal for time-series classification
- Implemented various machine learning classification techniques from Scikit-learn, TensorFlow, and Keras for comparison, utilizing Hyperopt for ML hyperparameter optimization and cross-validation techniques
- Collaborated with iCAM research team members to produce an effective ML-based fault detection method for a high-quality research publication (referenced below) and various conference papers/presentations

Relevant Coursework

- Microsatellite Design I & II
- Spacecraft Dynamics & Control
- Computational Optimization
- Control Theory
- Flight Dynamics & Control
- Aerospace Structures
- Aerodynamics & Performance
- Aerospace Propulsion
- Aerospace Materials & Mfg.

Research Papers and Publications

Saadat, A. Attitude Determination with Self-Inspection Cameras Repurposed as Earth Horizon Sensors. *Frank J. Redd Student Competition - Small Satellite Conference 2022*, Utah State University, Logan, Utah. (1st Place Paper and Presentation) [PDF]

Saadat, A. On-orbit Spacecraft Inertia Tensor Estimation. *International Astronautical Congress 2022*, Paris, France. [PDF]

Rahimi, A., & **Saadat, A.** (March, 2020). Fault isolation of reaction wheels onboard three-axis controlled in-orbit satellite using ensemble machine learning. *Aerospace Systems*, 3(2), 119-126. doi.org/10.1007/s42401-020-00046-x

Folami, F.O., Rahimi, A. & **Saadat, A.** (March, 2020). Fault Isolation of Reaction Wheels on-board 3-axis Controlled in-orbit Satellite Using Machine Learning Techniques. IAC-20.B4.9-GTS.5.10, *International Astronautical Congress 2020*, Dubai (Online), United Arab Emirates, [PDF]

Rahimi, A., & **Saadat, A.** (July, 2019). Fault isolation of reaction wheels on-board 3-axis controlled in-orbit satellite using ensemble machine learning techniques. *The International Conference on Aerospace System Science and Engineering*, Toronto, ON, [PDF]

Patents

Saadat, A., & Usui, K. (May, 2020). Method And Computing System For Estimating Parameter For Robot Operation. Patent application in USA ([Pending](#)), Japan ([Active](#)), and China ([Pending](#))

Saadat, A., & Usui, K. (May, 2020). Method And Computing System For Determining A Value Of An Error Parameter Indicative Of Quality Of Robot Calibration. Patent application in USA ([Pending](#)), Japan ([Active](#)), and China ([Pending](#))

Poster Presentations

Saadat, A. (March, 2019). [CryoRoute - Generating Globally-Optimized Naval Routes in Arctic Ocean](#). *UWillDiscover Conference*, University of Windsor, Windsor, ON

Saadat, A. (January, 2019). [CryoRoute - Generating Globally-Optimized Naval Routes in the Arctic Ocean](#). *ESA's Atlantic from Space Workshop*, National Oceanographic Centre, South Hampton, UK

Industry Experience

Guidance, Navigation, & Control (GNC) Engineer Oct 2022 – present
Turion Space Corp. Irvine, CA

- Developing pointing budgets and AIT procedures for GNC hardware, ensuring Droid-1 can achieve the 2' pointing accuracy requirement for its Space Situational Awareness (SSA) mission
- Designing Verification & Validation (V&V) of the Droid-1 GNC simulations through novel software development and CU Boulder's [Basilisk](#) simulation environment

Hardware Functional Safety Tools Engineering Intern May 2022 – Sept 2022
NVIDIA Corp. Santa Clara, CA

- Developing Python software to create, scale, and automate Fault Tree Analysis (FTA) from Failure Mode, Effects, and Diagnostic Analysis (FMEDA) with over 100k failure modes. Primarily developed for the world's most complex Systems on a Chip (SoC), eg. Jetson AGX Orin, used for Mercedes-Benz × NVIDIA autonomous vehicle computer functional safety
- Ensured functional safety engineering standards are maintained via FTA for autonomous vehicle development at NVIDIA, following ISO 26262 Road Vehicles Functional Safety standards

Robotic Systems Engineering Intern II

Sept 2019 – Jan 2020

Mujin Inc.

Tokyo, Japan

- Designed a novel torque model validation algorithm with custom metrics and fault detection for torque coefficient estimates, improving estimate confidence by over 70%
- Completed development of a novel dynamics identification method for the Mujin Controller to calculate torque model coefficients for Mujin-supported industrial robots
- Collaborated with Mujin patent lawyers to submit 2 software patent applications in USA (pending), Japan (active), & China (pending)

Robotic Systems Engineering Intern I

May 2017 – May 2018

Mujin Inc.

Tokyo, Japan

- Developed a novel dynamics identification method for the Mujin Controller to calculate Friction, Center of Mass, and Inertia tensor coefficients. The results are used to improve the robot's torque model
- Validated experimental test results and developed production code for the feature, currently shipped on Mujin controllers for use by industry, improving robot performance during high accelerations by over 85%
- Integrated robot armature trajectory generation, data analysis tools, and localized UX/UI data visualization

Space Systems Engineering Intern (Lunar Exploration)

May 2016 – Sept 2016

Canadensys Aerospace Corp.

Toronto, Ontario

- Developed a remotely-controlled lunar rover prototype with various camera modules (3D, stereo camera, fisheye) and interactive software features, managing a budget of >\$10k
- Designed the concept of the rover, with a successful build and test campaign
- Constructed a companion ground station GUI with vehicle controls and live camera feed



Co-Curricular Experience and Projects

President / Founder / Lead Space Systems Engineer

2018 – 2020

University of Windsor Space & Aeronautics Team (WinSAT)

- Founded and managed a university engineering design team competing in the [Canadian Satellite Design Challenge \(CSDC\)](#) against 15+ top university teams across Canada. [WinSAT achieved 1st place in the CSDC-5 Critical Design Review \(CDR\)](#)
- Led the project management and systems engineering of WinSAT's Space Systems division to design a 3U Cube Satellite for Low Earth Orbit, encompassing over 20 recruited interdisciplinary graduate & undergraduate students, with a total awarded funding of over \$40k
- Coordinated the development and engineering of all satellite subsystem teams: Attitude Determination & Control Systems, Radio Communications, Structural & Thermal, Command & Data Handling, Electrical Power Systems, Payload, Business, & Earth Observation analysis
- Hosted multiple satellite engineering and Amateur Radio Operator (ARO) certificate workshops to over 30+ students to teach satellite engineering practices and ARO exam preparation

Lead Avionics Engineering - Sounding Rocket

2015 – 2019

WinSAT Rocketry Payload Division for UWindsor Rocketry Team

- Designed a [custom aerodynamics data acquisition module](#), using a Raspberry Pi and various sensors, for aerodynamic analysis and performance verification
- Designed the circuit board, programmed the software, and parsed large data volumes with software redundancy modes for rocket acceleration, angular rates, barometric pressure, temperature, and altitude data

CryoRoute - Globally Optimized Naval Routes in North Arctic Ocean

Nov 2019

Self-interest Research Project

- [Developed a novel software implementation to generate globally-optimized naval routes in the North Arctic ocean](#)
- Programmed a python script using CryoSat-2's sea ice thickness data from the Center for Polar Observation and Modelling ([CPOM](#)). The script uses a specialized A* path-finding algorithm to optimize for minimal sea ice thickness, distance, and travel time
- Presented research outcomes at NASA Space Apps Waterloo, UWillDiscover conference, and ESA's Atlantic from Space Workshop

Demo. Inertial Electrostatic Confinement (IEC) Nuclear Fusion Reactor

Aug 2015

Self-interest Research Project

- Developed a vacuum chamber capable of atmospheric gas ionization and plasma synthesis, simulating a deuterium-fueled IEC nuclear fusion reaction
- Handled the safe operation of a high-voltage power supply (15kV)
- Designed and tested the correlation between inner grid geometry and plasma synthesis rates using visual luminescence, simulating neutron radiation production for future fusion verification

Electrical Lead / Safety Captain

2014 – 2015

FIRST Robotic's Competition (FRC) - Team 4903

Vincent Massey Secondary School

- Led a team of 8 students to design, test, and build the electrical and power distribution subsystem for the FRC
- Enforced safe engineering practices across the entire FRC team as the team's safety captain and held presentation teaching safe practices related to robotics
- Awarded 1st place team at FRC Windsor-Essex Great Lakes Regional 2015, accepted into and competed in the FRC World Championship 2015 in St. Louis, MO

Technical Skills

Languages: Python, MATLAB, Java, C/C++, JavaScript, PHP, HTML/CSS, MySQL, PostgreSQL

Engineering Tools: AGI STK, SolidEdge, Siemens NX including Space Systems Thermal, SolidWorks, Catia V5, Simulink, KiCad, Altium

Frameworks/Packages: Numpy, Scipy, Matplotlib, Scikit-learn, OpenCV, Node.js, TensorFlow, Keras, TSfresh, Hyperopt, Django

Developer Tools/APIs: Google Cloud Platform, AWS, Docker, Twilio, Wit.ai, DigitalOcean, MongoDB, VS Code, Eclipse, Android Studio, SublimeText

Technologies/Other: Linux, Windows, Mac OSX, Git, Bash, Raspi/Arduino/BBB, Office Suite, Latex

Awards

1st place in **Frank J. Redd Student Competition** | *Small Satellite Conference* Aug 2022

- Awarded \$10k for best paper and presentation in international student competition

Canadian Delegate in IAC Student Competition | *Canadian Space Agency (CSA)* Aug 2022

- Selected as one of two Canadian delegates for the IAC student competition by the CSA

Research Fellowship & Internal Student Fellowship | *University of Toronto* Sept 2020

- Awarded fully-funded tuition and stipend for admittance into **UTIAS Space Flight Laboratory**

First place team in Critical Design Review | *Canadian Satellite Design Challenge* Oct 2019

- Presented CDR-level designs for a 3U Cube Satellite to CSA, MDA, and ABB spacecraft engineers

Ontario Aerospace Council scholarship | *Ontario Aerospace Council* May 2019

- Awarded 1 of 4 awards to Ontario aerospace engineering students for academic and extra-curricular achievements related to aerospace studies

ESA CryoSat-2 Science Meeting Student award | *Canadian Space Agency (CSA)* Mar 2017

- Awarded to select students across Canada to attend ESA CryoSat-2 meeting as a student representative for the CSA, used for research and resources for **CryoRoute**

P.E.O. Windsor-Essex Chapter Bursary | *Professional Engineers of Ontario (P.E.O)* Mar 2016

- Awarded to 1st year engineering students who have demonstrated excellent academic achievement

Dean of Engineering Conference Grant | *University of Windsor - Dean of Engineering* Jan 2019

- Awarded directly by the Dean of Engineering to attend the ESA Atlantic from Space Workshop

Various University of Windsor Scholarships & Bursaries

Awarded for undergraduate academic achievement and/or extra-curricular activities, unless otherwise stated:

- Student Access Bursary | Jun 2020 & Jun 2019

- Ontario First Generation Bursary | Jun 2019 & Sept 2018
- UWindsor In-Course Bursary | Jun 2019
- Student Life Enhancement Fund | Jan 2019 | Awarded to attend ESA Atlantic from Space Workshop
- Helen Norma Laframboise Scholarship | Sept 2018
- Faculty Retirees' Scholarship | Sept 2018
- Ontario Student Opportunity Trust Fund (OSOTF) Scholarship | Sept 2018
- Marian McLean Campus Spirit Scholarship | Sept 2018 | Awarded for WinSAT event's held on campus
- International COOP Bursary | Jan 2018 | Awarded for having a COOP Internship in a foreign country (Japan)
- Duronio Family Scholarship | Jan 2017
- Golden Key International Honour Society (Nomination) | Sept 2016
- University of Windsor Entrance Scholarship | Sept 2015

🌟 Professional Training & Certification

Canadian Amateur Radio Operator Certificate - Callsign: VA3UWS Jan 2019

Industry Canada - Government of Canada

- Basic with Honours - Access to all amateur radio frequency bands

Siemens NX Space Systems Thermal Training Feb 2019

CSDC Structural & Thermal Analysis Workshop

Magellan Aerospace, Winnipeg, Manitoba

- Learned state-of-the-art Structural and Thermal analysis techniques for small satellites in Siemens NX

🔗 Hackathon Projects & Awards

Gateway 2015

Facebook Global Hackathon

Facebook HQ, Menlo Park, California

- Improved developments on an iOS Messaging App with embedded API search query responses and natural language processing

Gateway 2015

MHacks 6

University of Michigan, Ann Arbor, Michigan

- Developed an iOS Messaging App with embedded API search query responses and natural language processing
- **Awards: Best Use of Facebook Parse API (Invitation to Facebook Global Hackathon), Best iOS App (sponsored by Apple Inc.), Best Use of Expedia API**

Lubdub 2017

SpartaHacks III

Michigan State University, East Lansing, Michigan

- Programmed a web application to records and detect heart defect using a novel audio wave analysis algorithm and a stethoscope as audio input
- **Awards: SpartaHacks 2nd Place Winner, ThoughtWorks Honorable Mention**

GeoRisk 2017

Winter Hackathon

University of Windsor, Windsor, Ontario

- Developed a Google Maps web-based application to analyze client data for a sponsoring insurance company
- **Awards: EpiCentre Startup Series-A Funding (\$6000) – Funds diverted to WinSAT**

📰 Media Coverage

[Small Satellite Student Competition Award](#) | *University of Toronto Engineering Dept.* Aug 2022

[UWindsor satellite design leading student competition](#) | *University of Windsor Engineering Dept.* Nov 2019

[WinSAT wins critical satellite design review](#) | *Windsor Star – News Outlet* Nov 2019

[Aerospace engineering student aiming high](#) | *University of Windsor Engineering Dept.* Aug 2019

[Mujin Inc. Internship - Student Spotlight](#) | *University of Windsor Co-operative Education Dept.* Oct 2018

[CryoRoute Feature - NASA Space Apps Challenge Waterloo](#) | *SkyWatch Youtube Ch.* Aug 2018

References

- Dr. Robert E. Zee, Ph.D.
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Microsatellite Science and Technology Center (MSTC)
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- Dr. Afshin Rahimi, Ph.D., P.Eng.
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