

Miguel A. Nunes, *Curriculum Vitæ*

CONTACT INFORMATION

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GENERAL INFORMATION

Current Position(s): Assistant Specialist Faculty at the Hawaii Institute of Geophysics and Planetology, University of Hawaii at Manoa. Deputy Director of the Hawaii Space Flight Laboratory (HSFL); Deputy-PI and Systems Engineer for the NASA Hyperspectral Imager (HyTI) Mission.

Languages:

- English, proficient in oral and writing skills
 - Portuguese, proficient in oral and writing skills
 - French, good in oral skills and good in writing skills
 - Spanish, fair in oral and reading skills
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EDUCATION

Ph.D Mechanical Engineering, University of Hawaii at Manoa. 2016
Research in multi-agent robotic systems to control small satellites and large satellite constellations optimization. Major in Mechanics, Systems, and Controls, minor in Thermal and Fluid sciences.

M.Sc. Mechanical Engineering, University of Hawaii at Manoa. 2010
Research in multidisciplinary design optimization for automatic optimal generation of small satellite structures using biologically inspired methods.

B.Sc. Aerospace Engineering, Technical University of Lisbon, Portugal. 2009
Focus area in avionics and control systems.

WORK EXPERIENCE

Deputy Director HSFL, Assistant Specialist Faculty HIGP 2017/07 -
Hawaii Institute of Geophysics and Planetology at the University of Hawaii at Manoa

- Deputy-PI and Systems Engineer for the NASA HyTI CubeSat Mission.
- Assistant Project Manager and Systems Engineer for Neutron-1 CubeSat Mission.
- PI and Project Manager for various other satellite-related projects.
- Research and development for small satellites, unnamed aerial systems and remote sensing instruments.

Post-Doctoral Research Fellow 2016/05 - 2017/06
Hawaii Institute of Geophysics and Planetology at the University of Hawaii at Manoa

- Research and development for small satellites, unnamed aerial systems and remote sensing instruments. Support on project management activities for HSFL and HIGP projects.

Research Assistant, TIRCIS Project 2016/01 - 2016/05
Hawaii Space Flight Laboratory at the University of Hawaii at Manoa

- Lead on software development and testing of the data processing algorithm on a satellite computer for the Thermal InfraRed Compact Imaging Spectrometer (TIRCIS) instrument. Support on project management activities.

Research Assistant, HawaiiSat-1 Mission 2013/09 - 2015/12
Hawaii Space Flight Laboratory at the University of Hawaii at Manoa

- Lead engineer for the attitude determination and control subsystem (ADCS) and the on-board computer subsystem (OBCS) for the HiakaSat satellite as part of the HawaiiSat-1 mission. Developed 6DoF dynamic simulator using COSMOS for HiakaSat ADCS testing and validation. Research in multi-agent systems and guidance, navigation and control methods for cooperative small satellites.

Research Assistant, COSMOS Project 2010/09 - 2013/08
Hawaii Space Flight Laboratory at the University of Hawaii at Manoa

- Co-founder and developer of the Comprehensive Open-architecture Solution for Mission Operations Systems (COSMOS), which is the primary satellite flight software and mission operations suite for HSFL (see <http://cosmos-project.org/>). Lead engineer for the research and development of the satellite operations test bed (OTB) for HSFL enabling complete satellite system testing and in particular the attitude control system (ADCS). Research on optimization of satellite constellations configurations with large numbers.

Research Assistant, LEONIDAS Program 2009/02 - 2010/08
Hawaii Space Flight Laboratory at the University of Hawaii at Manoa, Honolulu, Hawaii USA

- Thermal Design Lead of the LEO-1 satellite. Supported the design and development of different satellite subsystems: attitude determination and control subsystem (ADCS), on board computer system (OBCS), flight software, orbit and launch segment analysis. Research on multidisciplinary design optimization (MDO) for satellite structures, developed a new method for automatic generation of optimized structures based on Map-L system theory and genetic algorithms.

Project Manager, SSETI-IST ESEO Project 2006/09 - 2007/09
Instituto Superior Técnico, Technical University of Lisbon, Portugal

- Project manager and coordinator of the attitude and orbit control subsystem (AOCS) team at the Instituto Superior Técnico, with up to 30 students working on the ESEO satellite. Responsible for the interface of the Portuguese team with the Student Space Exploration and Technology Initiative (SSETI) association, the European Space Agency (ESA) Education Office project managers and the Carlo Gavazzi Space company engineers. The team successfully developed attitude sensors and actuators for space flight usage, including real time software implementation for the AOCS.

Software Developer 2005/Summer
LusoSpace, Lisbon, Portugal

- Optimization of spacecraft rendezvous simulation software (Matlab and c-code) for European Space Agency (ESA) space missions.

Task Force 2002/Summer, 2003/Summer
Mipro Oy, Mikkeli, Finland

- Software development (real-time UNIX environments), hardware integration and soldering parts on Printed Circuit Boards (PCBs). Worked on various tasks as necessary (computer repair and assembly, office organization, etc.)

Freelancer, Web Page Designer & Programmer 1998 - 2008
Portugal

- Developed several web projects with full stack (html, css, php, javascript, asp, etc.), of which one has a complex decision-taking algorithm based on social science theories. The software IP for this portal is registered and copyright protected. Worked on database design and management.

EXPERIENCE HIGHLIGHTS

Space Mission Systems Design

- Design of small satellite mechanical, electrical and software systems subject to tight budgets like mass, power and volume under monetary constraints. Experienced with different phases of mission design (from conceptual studies on *Pre-Phase A* through operations *Phase F*)
- Satellite constellations comprehensive study, including cost, development and system production analysis.
- Design of interplanetary missions.

Astrodynamics

- Orbital analysis for satellites (launch and orbital insertion segments, orbital lifetime, orbit param-

eters validation, etc.) using orbital models. Also experienced with orbital analysis software such Systems Tool Kit (STK) and also development of orbital and attitude propagators in C/C++ and Python and implemented in the COSMOS software.

Satellite Attitude Control and Avionics integration

- Attitude Determination and Control subsystem design with hardware and software development of sensors and main control unit. Testing, development and integration on ADCS/AOCS components such as gyroscopes, magnetometers, sun sensors, star trackers, reaction and momentum wheels, magnetic torque rods. Test procedures and specifications definition. ADCS/AOCS full 6DoF dynamic simulator development. Attitude Estimation, Orbit Determination and Control software for satellite missions. Special Algorithms: Estimation algorithms such as Kalman Filter and Extended Kalman Filter, Control algorithms from PID type to non-linear and geometric control, Genetic Algorithms for Optimization, Markov Chain Monte Carlo simulations of Bayesian distributions.

Satellite Attitude Control Test Bed

- Design and implementation of a complete satellite attitude control test bed and corresponding physical simulators. Integration of air-bearing platform, Helmholtz chamber (magnetic field generator), GPS simulator (SPIRENT), motion tracking cameras and other related equipment for implementation of complete ADCS simulations, software development for driving and monitor the simulations.

Software Development

- Development of software for embedded systems for satellites and mission operations.
- Software development of 6DoF orbit and attitude propagation in C/C++, Matlab and Python.
- Mission Operations software development for the COSMOS software.

Unmanned Aerial Systems (UAS)

- Experience with UAV autopilots hardware and software: Pixhawk and Aerocore. Autopilot software ArduPilot and PX4. Experience with the MAVLink – the Micro Air Vehicle Communications Protocol.
- Designed and developed own hardware and software for quadcopters. Developed own control algorithms.
- *FAA PART 107 a.k.a Remote Pilot Certificate*. FAA certified with the FAA part 107 remote pilot license which enables me to fly and operate a UAV withing the FAA requirements for legally flying drones for an organization such as the university.

Engineering Software

- Matlab, Simulink, Mathematica, COMSOL Multiphysics, Satellite Systems Toolkit (STK), Solidworks, Autocad, FreeCad, Thermal Desktop. Management software: JIRA, Redmine.

IT

- Programming Languages: C/C++, Python, Matlab, JAVA, Arduino, Processing, Assembly and some knowledge of Artificial Intelligence languages such as Prolog and Lisp. Web based: HTML, CSS, JavaScript, PHP, ASP. Database: MySQL, SQL Server. Frameworks/APIs: Qt, ROS, Eigen, OdeInt, COSMOS, OpenGL, L^AT_EX. Programing tools: Git, Subversion, Visual Studio, Qt Creator.
- Operative systems: Linux/Unix (command-line), macOS, Microsoft Windows and some knowledge of embedded real time operative systems (NuttX, RTEMS, QNX). Embedded environments: Gumstix, Aerocore, Raspberry PI, Beagle Bone, Teensy, Arduino.

Business

- Co-Inventor of the Comprehensive Open-architecture Solution for Mission Operations Systems (COSMOS) software and Co-founder of Interstel Technologies Inc., a spin off company of the

University of Hawaii to commercialize COSMOS for proprietary/defense applications. Interstel is part owned by the University of Hawaii.

- First place winner on the Breakthrough Innovation Challenge, organized by the Pacific Asian Center for Entrepreneurship, 2010.

RESEARCH
PROPOSALS AND
AWARDS

DoD, Space and Naval Warfare Systems Center Pacific. Co-I in the awarded proposal “Space-Based Calibration Platform System Requirements Review Study: Phase 2”. Total award \$125k. 2021.

State of Hawaii . Co-I in the awarded proposal “HAWAII GEER Innovation Grant Application: “CUBESat” Design Challenge ”. Total award \$450k. 2021.

NASA Artemis Program. Co-I in the awarded proposal “Low-Cost Cubesat Kit and Course Development for Undergraduate Research Projects in the Public Domain”. Total award \$500k. 2020.

Defense University Research Instrumentation Program (DURIP). Co-PI in the awarded proposal “Star Field Simulator for Spacecraft Attitude Determination and Control System Test Bed”. Total award \$325k. 2019.

Space and Naval Warfare Systems Center Pacific. UH PI in the awarded proposal “Mission Adaptable Software Defined Radio (Phase 2)”. Total award \$60k. 2019.

NASA In-Space Validation of Earth Science Technologies (InVEST). Deputy-PI in the selected proposal “HyTI 6U Cubesat-based Hyperspectral Thermal Imager”. Total award ~\$6M. 2018.

Space and Naval Warfare Systems Center Pacific. Co-I in the selected proposal “Feasibility Study into Radar Performance Validation Platforms”. Total award ~\$150k. 2018.

Space and Naval Warfare Systems Center Pacific. PI in the awarded proposal “Mission Adaptable Software Defined Radio (Phase 1)”. Total award \$50k. 2018.

NASA STTR Phase I Solicitation 2017. UH PI in the selected proposal “Accurate, Miniature Attitude Determination System” for testing Small Satellite Star Tracker. Proposal submitted with Create, Inc. for the NASA STTR Phase I Solicitation 2017. Total award approx \$50k. 2017.

Space and Naval Warfare Systems Center Pacific. PI in the awarded proposal “Nanosatellite Attitude Determination and Control System Procurement & Testing”. Total award approx \$125k. 2016.

NASA’s CubeSat Launch Initiative program. Key person in the selected “Low Earth Orbit Neutron Flux Detection And Cosmos Mission Operations Technology Demo” (NEUTRON-1) CubeSat mission by NASA’s CubeSat Launch Initiative program.

Defense University Research Instrumentation Program (DURIP) grant. Key person in successful grant award (approx. \$765k) from the Defense University Research Instrumentation Program (DURIP) program. Title: “An Attitude Control System Test Bed to Enhance the Ability of the University of Hawaii in the Development and Testing of Small Satellites and Technology for the DoD”, 2012-2013.

University of Hawaii, Graduate Student Organization, Recipient of a University of Hawaii Graduate Student Organization grant for research on Optimal Satellite Constellation design, including travel for paper presentation, 2012.

Canadian Space Agency (CSA) grant. Key person in the “Canadian American British Lunar Explorer (CABLE) Mission Study Support” MPB Communications, Inc., Canada. Approx \$32k,

2011-2012.

NASA Experimental Program to Stimulate Competitive Research (EPSCoR) grant. Key person in successful research grant award (approx. \$745k) from the NASA Experimental Program to Stimulate Competitive Research (EPSCoR) program. Title: “Development of an Open-architecture Mission Operations System to Support Multiple Small Spacecraft Missions”. Principal-PI Dr. Luke Flynn and Science-PI Dr. Trevor Sorensen. EPSCoR research funded in FY 2010 for three years.

PERSONAL AWARDS **Best Student Paper Award** in Ph.D. level (recipient of the Gold Award) at the 13th International Space Conference of Pacific-basin Societies (ISCOPS), Kyoto, Japan, 2012. The selected paper is “*Satellite Constellation Optimization Method for Future Earth Observation Missions Using Small Satellites*” and was Published in “Advances in the Astronautical Sciences”, 146:159–179, 2013.

UH Graduate Student Organization grant, Recipient of a University of Hawaii Graduate Student Organization grant for research on Optimal Satellite Constellation design, including travel for paper presentation, 2012.

Co-author in SpaceOps 2012 Conference paper with honorable mention for AIAA Post-Conference Book publication in 2013, “Space Operations: Experience, Mission Systems & Advanced Concepts – AIAA 2013”. Paper titled “*A University-developed Comprehensive Open-architecture Space Mission Operations System (COSMOS) to Operate Multiple Space Vehicles.*”

EE Black Scholarship award, Merit scholarship for high GPA, 2012.

Breakthrough Innovation Challenge award with the “Flycopter” project - a UAV platform for outdoor and indoor surveying in disaster situations. Event organized by the Pacific Asian Center for Entrepreneurship. 2010.

The Kotaro Kodama Scholarship award, Merit scholarship for high GPA, 2009-2010.

AEIST award for development of sensors and actuators for the Attitude Determination Subsystem of the ESEO satellite on the SSETI-IST program, Instituto Superior Técnico, 2006.

**SYNERGETIC
ACTIVITIES**

Small Satellite Technical Committee (SmSTC) of the AIAA 2013.08 - Present
Active member of the SmSTC Technical Affairs subcommittee since Aug. 2013. Lead of the SmSTC Technical Affairs subcommittee from Jan. 2015 to Dec. 2015 and again from Fall 2018 through Spring 2020. The SmSTC is a new Technical Committees formed in the summer of 2013 within the American Institute of Aeronautics and Astronautics (AIAA) to further support the small satellite community. The SmSTC brings together experts from around the world to conduct technical assessments, professional development training courses, formulate technology assessment packages, setting standards, awards selection etc. All in the area of Small Satellites.

Student Space Exploration and Technology Initiative Association 2002 - 2008
Active member of the Student Space Exploration and Technology Initiative (SSETI), for the development of the satellite project ESEO (European Student Earth Orbiter) promoted by the ESA Education Office. Participated as a regular member of the AOCS (Attitude and Orbit Control Subsystem) engineering team developing and designing the AOCS and AEC (Attitude, Estimation and Control Subsystem) including control and estimation algorithms, sensors and actuators, AOCS simulator and real-time software development with CAN (Controller Area Network), according to the ECSS standards.

Space Engineering Workshops

Participated in several European Student Earth Orbiter (ESEO) satellite project workshops at European Space Research and Technology Centre (ESTEC), the European Space Agency’s main technology development and test centre for spacecraft located in the Netherlands, and at Carlo

TEACHING /
MENTORING /
STEM OUTREACH

I have had the privilege to participate in various mentoring programs at the Technical University of Lisbon as part of the SSETI association and at the University of Hawaii at Manoa in different settings, from the CoE high school summer internship program to the senior design classes. Many of the high school interns I have mentored have decided to pursue engineering degrees. Also several of the undergraduate students I've mentored have found exceptional jobs in Aerospace Engineering companies such as SpaceX, Boeing, Lockheed Martin, etc. The following are some examples of the student leadership and mentorship programs I have been involved.

Teaching:

- **2022, Spring:** ENGR 196 / 296 / 396 / 496 “VIP Aerospace Technologies” class. 24 students. 1-3 credits. 'Ke Ao' CubeSat design class.
- **2021, Fall:** “EPET 401 Capstone Project: Producing a Science Satellite”. 5 students. 3 credits. Team taught.
<https://www.higp.hawaii.edu/index.php/teaching/epet-certificate-program/>
- **2021, Fall:** ENGR 196/296/396/496 “VIP Aerospace Technologies”. 28 students. 1-3 credits. 'Ke Ao' CubeSat design class.
- **2021, Spring:** ENGR 196/296/396/496 “VIP Aerospace Technologies”. 25 students. 1-3 credits. 'Ke Ao' CubeSat design class.
- **2020, Fall:** ENGR 196/296/396/496 “VIP Aerospace Technologies”. 14 students. 1-3 credits. 'Ke Ao' CubeSat design class.
- **2020, Spring:** ENGR 196/296/396/496 “VIP Aerospace Technologies”. 20 students. 1-3 credits. 'Ke Ao' CubeSat design class.
- **2019, Fall:** ENGR 196/296/396/496 “VIP Aerospace Technologies”. 14 students. 1-3 credits. 'Ke Ao' CubeSat design class.
- **2019, Spring:** ENGR 296/396/496 “VIP Aerospace Technologies”. 12 students. 1-3 credits. CubeSat and UAS design.
- **2018, Fall:** ENGR 396/496 Aerospace Technologies Vertically Integrated Project to give undergraduates the experience of designing, building and launching a CubeSat by the time of graduation. 8 students. 1-3 credits. CubeSat and UAS design.
- **2018, Spring:** ME213 “Introduction to Engineering Design” to a class of 40 students (a mix of pre-engineering, juniors, sophomores). The class had a theoretical component and 4 hours labs every week. The class syllabus approached introductory material in mechanical and aerospace topics. The class project focused on the design of a drone to carry a CubeSat as a payload. The project was successfully completed and the drone was able to carry the payload during the test campaigns.

Mentor for HSFL students:

I have helped to mentor most students that have worked with HSFL since 2009. More than 200 students have worked with HSFL during this time. The mentorship activities include teaching best lab practices for satellite development, avionics principles, mechanics, electronics, software, etc. Various projects have driven the mentorship into a vibrant experience for the students such as the development for real space flight hardware such as several satellite parts for HiakaSat and other CubeSats we've been working on. Also COSMOS has been an important motivator for the students to learn more about space mission operations and flight software, many students had never programmed before and after the mentorship program they were able to develop software by their own.

Mentor to HSGC students:

I have helped mentor students from HSGC since 2009. HSGC has averaged 53% of underrepresented students during this time, and I have contributed to mentoring directly more than 20 HSGC students. I am currently working with four HSCG fellowships and traineeship students during the Summer

2020 and continuing in Fall 2022 to develop a Coronagraph with Dr. Shadia Habbal. This effort is supporting experimental measurements for a Heliophysics proposal with Dr. Habbal.

Mentor for the UHM-CoE ME418 Senior Design Class in collaboration with Dr. Trimble:

- **Fall-2016 and Spring-2017:** mentor of a 4 student team developing a 3U CubeSat test platform to validate the attitude determination and control (ADCS) system of HSFL cubesats.
- **Fall-2013 and Spring-2014:** mentor of one team of three students developing a low cost magnetic torque rod for small satellites. Co-mentor of one E.E. design class with three students developing the control unit for the magnetic torque rods being developed by the ME team.
- **Fall-2102 and Spring-2013:** mentor of three teams. One team of three students developed a thermal model for the HiakaSat satellite and also a thermal model for the solar panels of the same satellite. The other team, of three students, developed a Helmholtz chamber for the HiakaSat satellite testbed so the magnetic field of the Earth around the satellite orbit can be replicated using computer simulation. A third team, of three students also, developed a cold gas propulsion system for small satellites. I also was co-mentor of another senior design team developing a solar simulator for satellite solar panels.
- **Fall-2011 and Spring-2012** mentor of seven students working on the project for the design of a portable satellite tracker to support a satellite communications antenna.

Mentor for the UHM-CoE ME419 Astronautics Class in collaboration with Dr. Sorensen:

- **Spring-2016:** mentor for the class project to develop light weight and 3D printed UAV. Trained the students on best practices for UAV development (motors, structure, avionics) and also on the flight software (COSMOS, QGroundControl, Mavlink). Trained the students on the System Tool Kit (STK) to design satellite orbits and compute orbital parameters.
- **Spring-2014:** mentor for the University of Hawaii Advanced BallonSat System Mission #2 (UHABS-2) project. Trained the students on avionics hardware and software development, including practical skills such as soldering and understanding datasheets for electronic components. The mission simulates a small satellite and includes a payload that carries a streaming video camera and other cameras taking pictures for the full duration of the flight. The payload also carries environmental sensors to capture atmospheric data such as pressure, temperature, etc. Trained the students on the System Tool Kit (STK) to design satellite orbits and compute orbital parameters.
- **Spring-2012:** mentor for a lander vehicle prototype project This mission simulates a lunar lander that is dropped from a helium balloon, opens a parachute for soft landing and after landing is detected a rover is deployed and drives automatically. Trained the students on avionics hardware and software development, including practical skills such as soldering and understanding datasheets for electronic components.

Mentor for the Native Hawaiian Science & Engineering Mentorship Program NHSEMP / UHM-CoE High School Summer Internship

- **2019, Summer:** Mentored two students on a CubeSat Simulator with Real-time Ground Control Communications.
- **2018, Summer:** Mentored eight students on different CubeSat related projects: ADCS Test Bed, Star tracker design, nadir sensor stimulator, COSMOS software, and drone project.
- **2016, Summer** Mentored two students on the design and development of a CubeSat reaction wheel controlled by an FPGA board.
- **2015, Summer** Mentored four students on the design and development of a 3D printed UAV (quadcopter) using COSMOS for mission control.
- **2013, Summer** Mentored three students on the design and development of a portable satellite tracker and one other student on thermal design of a satellite.

- **2012, Summer** Mentored three students on the design and development of a low cost reaction wheel for a satellite testbed.
- **2011, Summer** Mentored four students on the design and development of a low cost satellite mockup.

Mentor for the Real World Design Challenge (RWDC) 2011 - 2012

Mentored seven students from Iolani School working on a cost effective Light Sport Aircraft (LSA) a new and innovative class of airplane. The goal of the project was to create an eco-friendly, two-passenger craft.

Mentor for the CanSat competition

Mentored the UH teams for the CanSat competition in 2011 and 2012. The American Astronautical Society (AAS) and American Institute of Aeronautics and Astronautics (AIAA) organize a annual student design-build-launch competition for space-related topics where the teams must design a very small volume payload that is released from a rocket and must land safely without damaging the electronics.

Invited Speaker, Hawaiian Mission Academy K-12, 2005-Spring

I was invited to speak about STEM, in particular about my Engineering experience to pre-college students. Shared about my Aerospace and Mechanical engineering background and the possibilities to study engineering at UHM.

Science Mentor, K-8 Summer School Program, 2009-Summer

Mentor at the Hawaiian Mission Academy K-8 for the Summer School Program with their science activities. Most students were between ages 8 to 10. Taught how to build water rockets and the physics of propulsion. Also taught angular momentum and related concepts of physics using bicycle wheels.

ORGANIZATIONS

- American Institute of Aeronautics and Astronautics (AIAA). Since 2010.
 - Institute of Electrical and Electronics Engineers (IEEE). Since 2012.
 - Student Space Exploration and Technology Initiative (SSETI). 2004-2008.
 - Associação Portuguesa de Aeronáutica e Espaço (APAE), Euroavia, Portugal. 2005-2007.
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MIGUEL A. NUNES PUBLICATIONS

Google Scholar profile: <https://scholar.google.com/citations?user=hC70fY4AAAAJ>
 Research Gate profile: http://www.researchgate.net/profile/Miguel_Nunes6

- [1] **Nunes, Miguel A.**, L. French, P. A. J. Englert, E. J. Pilger, L. Yoneshige, I. Rodrigues, Y. B. Gershom, A. Imai-Hong, K. Hagi, C. Opie, L. P. Flynn, C. Hardgrove, and B. Roebuck, "Neutron-1 Mission: Low Earth Orbit Neutron Flux Detection and COSMOS Mission Operations Technology Demonstration," in *Proceedings of the 33rd Annual AIAA/USU Conference on Small Satellites, August 3-8, 2019*, (Logan, Utah), Aug. 2019.
- [2] **Nunes, Miguel A.**, "On the development of a 6DoF GNC framework for docking multiple small satellites," *AIAA Guidance, Navigation, and Control Conference, AIAA Science and Technology Forum*, pp. 1–14, 2015.
- [3] **Miguel A. Nunes**, T. C. Sorensen, and E. J. Pilger, "6 DoF GNC simulation framework for multiple small satellites using COSMOS," in *10th IAA Symposium on Small Satellites for Earth Observation*, 2015.
- [4] **Nunes, Miguel A.**, T. C. Sorensen, and E. J. Pilger, "Cooperative Control of Multiple Small Satellites using the Comprehensive Open-architecture Space Mission Operations System," in *9th International ESA Conference on Guidance, Navigation & Control Systems, 2 to 6 June 2014, Oporto, Portugal.*, 2014.
- [5] **Nunes, Miguel A.**, T. C. Sorensen, E. J. Pilger, H. M. Garbeil, J. R. Lewis, D. M. Azimov, and M. Wood, "Expanding the Comprehensive Open-architecture Space Mission Operations System (COSMOS) for Integrated Guidance, Navigation and Control of Multiple Small Satellites," in

13th International Conference on Space Operations 2014, (Pasadena, California), American Institute of Aeronautics and Astronautics, May 2014.

- [6] **Nunes, Miguel A.**, “Satellite Constellation Optimization Method for Future Earth Observation Missions Using Small Satellites,” *Advances in the Astronautical Sciences*, vol. 146, pp. 159–179, 2013.
- [7] R. Wright, P. Lucey, **Miguel Nunes**, S. Gunapala, S. Rafol, D. Ting, L. Flynn, C. Ferrari-Wong, A. Soibel, and T. George, “Hyti: High spatial and spectral resolution thermal imaging from a 6u cubesat,” in *4S Symposium*, 2022.
- [8] W. Edmonson and **Miguel Nunes**, “Design platform for multi-agent communication system for resilient cubesat swarms,” in *4S Symposium*, 2022.
- [9] F. C. Bruhn, A. Anlind, **Miguel Nunes**, E. Pilger, I.-H. Amber, M. Wood, R. Wright, P. Lucey, and L. Flynn, “Hyti mission: Raw thermal instrument on-orbit data processing with spacecloud,” in *4S Symposium*, 2022.
- [10] S. D. Gunapala, D. Ting, S. Rafol, A. Soibel, A. Khoshakhlagh, S. Keo, B. Pepper, A. Fisher, C. Hill, T. Wenger, T. Pagano, K.-K. Choi, P. Lucey, R. Wright, **Nunes Miguel**, L. Flynn, S. Babu, and P. Ghuman, “T2sl focal planes for compact remote sensing instruments,” in *SPIE* (N. K. Dhar, A. K. Dutta, and S. R. Babu, eds.), vol. 11723, p. 19, SPIE, 4 2021.
- [11] S. D. Gunapala, D. Z. Ting, S. B. Rafol, A. Soibel, A. Khoshakhlagh, S. A. Keo, B. J. Pepper, A. M. Fisher, C. J. Hill, T. S. Wenger, T. S. Pagano, M. Kelly, J. Baker, C. David, P. Lucey, R. Wright, **Miguel Nunes**, L. Flynn, S. R. Babu, and P. Ghuman, “Digital mid-wavelength and long-wavelength infrared focal planes for smallsat applications,” in *Sensors, Systems, and Next-Generation Satellites XXV* (S. P. Neeck, T. Kimura, S. R. Babu, and A. Hélière, eds.), vol. 11858, p. 27, SPIE, 9 2021.
- [12] S. D. Gunapala, D. Ting, S. Rafol, A. Soibel, A. Khoshakhlagh, S. Keo, B. Pepper, A. Fisher, C. Hill, T. Wenger, T. Pagano, M. Kelly, J. Baker, C. David, P. Lucey, R. Wright, **Miguel A. Nunes**, L. Flynn, S. Babu, and P. Ghuman, “High operating temperature t2sl digital focal plane arrays for earth remote sensing instruments,” in *Infrared Technology and Applications XLVII* (G. F. Fulop, M. Kimata, L. Zheng, B. F. Andresen, and J. L. Miller, eds.), vol. 11741, p. 23, SPIE, 4 2021.
- [13] R. Wright, P. Lucey, **Miguel Nunes**, S. Gunapala, D. Ting, A. Soibel, C. Ferrari-Wong, and T. George, “The hyperspectral thermal imager: high spectral and spatial resolution thermal imaging from a 6u platform,” in *Infrared Sensors, Devices, and Applications XI*, vol. 11831, p. 118310E, International Society for Optics and Photonics, 2021.
- [14] S. D. Gunapala, D. Z. Ting, S. B. Rafol, A. Soibel, A. Khoshakhlagh, S. A. Keo, B. J. Pepper, A. M. Fisher, C. J. Hill, T. S. Pagano, M. W. Kelly, J. J. Baker, C. David, P. G. Lucey, R. Wright, **Miguel A. Nunes**, L. Flynn, S. R. Babu, and P. Ghuman, “Mid-wavelength and long-wavelength infrared focal planes for smallsat applications,” in *Infrared Sensors, Devices, and Applications XI* (A. K. Sood, P. Wijewarnasuriya, and A. I. D’Souza, eds.), vol. 11831, p. 27, SPIE, 8 2021.
- [15] C. S. Kirkconnell, **Nunes, M A**, I. Ruelich, M. V. Zagarola, and S. B. Rafol, “Integration of a Tactical Cryocooler for 6U CubeSat Hyperspectral Thermal Imager,” *submitted for publication in Cryocoolers*, vol. 21, 2021.
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