

# QUINTIN NELSON

Astrodynamicist

## SKILLS

- C++
- Python
- MATLAB
- Basilisk Astrodynamics Simulation Framework
- STK
- SysML
- LaTeX
- Technical and Proposal Writing (PDR, CDR, Concept of Operations)
- Project Management/Leadership
- Public Speaking and Presentation
- Self-learner

## RELEVANT CLASSWORK

- Astrodynamics/celestial mechanics
  - Interplanetary mission design
- Optimal Control
- Systems analysis
- Space-based modeling, simulation, and analysis
- Spacecraft dynamics and control
- Optimization theory and numerical optimization
- Aerospace autonomy
  - Algorithms for Kalman filtering, path planning, Bayesian networks
- Aerospace electromagnetic sensing
  - Signal analysis, image processing
- Advanced C++ and OOP

## ORGANIZATIONS

- American Institute of Aeronautics and Astronautics (AIAA)
- American Astronautical Society (AAS)
- Texas A&M Land Air and Space Robotics (LASR) Lab
- Penn State Schreyer Honors College

## CERTIFICATIONS

- PSU Space Systems Engineering Certificate
- Systems Tool Kit (STK) Level II (Advanced)
- SAIC Digital Engineering Lab SysML Certification

## EDUCATION

### Ph.D., Aerospace Engineering

Texas A&M University: 2023-2027

- 3.8/4.0 GPA

### B.S. with Honors in Aerospace Engineering

The Pennsylvania State University, Schreyer Honors College: 2019-2023

- 3.95/4.0 GPA

## ACADEMIC EXPERIENCE

### Model Fidelity Quantification Measures for Optimal Control of Complex Systems

Land, Air, and Space Robotics (LASR) Lab: Fall 2023 – Present

- Deriving novel model fidelity quantification measures to measure the accuracy of a model
- Applying the novel tools to analyze the effects of model order reduction and design control systems with optimal model complexity

### Sentient Engineering Autonomy: Learning, Intelligent, and Optimal Naval Systems (SEALIONS)

Land, Air, and Space Robotics (LASR) Lab: Fall 2023 – Present

- Developed autonomous multi-agent systems for littoral proximity operations

### 3D Circular-Restricted 3-Body Problem Honors Project – Corrector Design and Optimization

Astrodynamics and Design Optimization: 2022-2024

- Programmed MATLAB scripts to simulate spacecraft trajectory about Earth-Moon Lagrange Points for given time periods
- Designed a shooting algorithm to attain and graph multiple families of periodic orbits in nonlinear dynamics, including Lyapunov and halo orbits
- Implemented numerical optimization algorithms, such as trust region and Levenberg-Marquardt, to minimize error in corrector results

### Honors Thesis: Investigation of the Astrodynamics and GNC Challenges for Space-Based Solar Power Satellite Spacecraft-To-Spacecraft Power Beaming

PSU Space Propulsion Lab: 2021-2023

- Determined technical requirements for implementing space-based solar power satellites for use of powering smallsats and chipsats in orbit

### ADCS Subsystem Lead: Cislunar Servicing Station Mission Design

Aerospace Capstone: 2022-2023

- Led a team to design a mission to place a station in a cislunar halo orbit that can provide refueling and communications relay services
- Performed trade studies and research on trajectories and ADCS systems

### Various Simulation, Algorithm Development Autonomy Projects

Aerospace Autonomy: 2022

- Designed sensor suits used for autonomous navigation planning
- Wrote algorithms for Kalman Filtering, path finding with various heuristics, and real-time decision-making using Bayesian networks

### NASA L'SPACE Academy

Proposal Writing Academy: 2021

- Developed proposal review techniques taught by NASA personnel

Project Manager, Mission Concept Academy: 2021

- Orchestrated the design of a small exploration mission concept that will focus on mapping the water-ice deposits in the lunar South Pole Region

### **Student Space Programs Laboratory (SSPL)**

2021 NASA Break the Ice Lunar Challenge: 2021

- Challenged to design a system architecture that would excavate icy regolith and deliver it to a lunar human habitat in hopes of creating a sustainable water resource on the Moon

2021 NASA BIG Idea Challenge: 2020

- Spearheaded the concept of a spacesuit with a carbon nanotube electrode system that can mitigate lunar dust while traversing the Moon's surface

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## **PROFESSIONAL EXPERIENCE**

### **Spacecraft Autonomy Intern – Decision Making in the Space Domain**

Air Force Research Lab (AFRL): 2024

- Applied estimation techniques to determine the constraints and capabilities of a deputy satellite in close proximity to a chief satellite
- Reparametrized teardrop (pogo) relative orbit equations for easier design and analysis

### **Spacecraft Autonomy Intern – Decision Making in the Space Domain**

Air Force Research Lab (AFRL): 2023

- Derived novel formation control algorithms for space-based agents
- Applied Model Predictive Control (MPC) to improve control optimality

### **Space Engineering Intern – Model-Based Systems Engineering (MBSE)**

Science Applications International Corp. (SAIC): 2022

- Developed unclassified SysML satellite and ground station model templates for classified use, saving modelers 80 work hours each

### **NASA/DoD Supply Chain Intern**

KUOG Inc: 2021

- Supported supply chain efforts, research, analysis, and procurement in federal contacts

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## **HONORS AND AWARDS**

- DoD SMART Scholar at Air Force Research Laboratory Space Vehicles Directorate
- NSF Graduate Research Fellowships Program (GRFP) Honorable Mention
- College of Engineering Graduate Merit Fellowship, Texas A&M University
- Honors Scholar of the Schreyer Honors College, Pennsylvania State University
- Member of Sigma Gamma Tau National Aerospace Engineering Honors Society, Pennsylvania State University
- Leonhard Scholars Aerospace Engineering Scholarship, Pennsylvania State University
- R. Walker Society Trustee Scholarship, Pennsylvania State University
- Ceridian's \$10k Dave MacKay Memorial Scholarship, Pennsylvania State University

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## **TECHNICAL PUBLICATIONS AND PRESENTATIONS**

*"Dynamical Model Fidelity Measures for Cislunar Astrodynamics", 2024 American Astronautical Society (AAS) Astrodynamics Specialist Conference*

August 2024

- Oral presentation and to be published in conference proceedings through AAS

*"Bridging the Gap: Dynamical Model Fidelity Measures to Enable Cislunar SSA", 2024 Air Force Research Laboratory Scholars Internship*

July 2024

- Oral presentation at end of internship

*"Bridging the Gap: Dynamical Model Fidelity Measures to Enable Cislunar SSA", 2024 Air Force Research Laboratory Cislunar SSA Summit*

March 2024

- Oral presentation

*"Resilient Formation Control for Optimal Space-Based Inspection Under Visual Information Sparsity", 2024 American Astronautical Society (AAS) Guidance, Navigation and Control Conference*

February 2024

- Poster presentation at end of AFRL internship
- Oral presentation and to be published in conference proceedings through AAS

*"Sentient Engineering Autonomy: Learning, Intelligent, and Optimal Naval Systems (SEALIONS)," Naval Surface Warfare Center Dahlgren Division Student Day*

October 2023

- Oral presentation

*"Investigation of the Astrodynamics and GNC Challenges for Space-Based Solar Power Satellite Spacecraft-To-Spacecraft Power Beaming," American Institute of Aeronautics and Astronautics (AIAA) 2023 Regional Student Conferences*

April 2023

- Published in Schreyer Honors College thesis catalogue
- Oral presentation and published conference proceedings through AIAA