

# Paul Andrew Burke

## Curriculum Vitae

Aerospace Human Systems Laboratory, Department of Aerospace Engineering  
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### **EDUCATION**

#### **Doctor of Philosophy:**

**Ph.D. in Aerospace Engineering, Texas A&M University, May 2021**

Dissertation: “*Computational Fluid Dynamic (CFD) Modeling and Experimental Study of the Formation and Buoyancy-Driven Detachment of Bubbles in Variable Gravity Environments*”

Advisor: Dr. Bonnie J. Dunbar

Committee Members: Drs. Helen Reed, Edward White, Cable Kurwitz, Katherine Hurlbert

#### **Bachelor of Science:**

**B.S. from the University of Virginia, May 2017 (Graduated with highest distinction)**

Double Major:

Aerospace Engineering

Engineering Science (Concentration in Materials Science and Applied Mathematics)

Double Minor:

Materials Science and Engineering

Applied Mathematics

### **RELEVANT APPOINTMENTS**

**July 2017 – Present: Graduate Research Assistant in the Aerospace Human Systems Laboratory, Texas A&M University.** Engaged in experimentation and Computational Fluid Dynamic (CFD) modeling (OpenFOAM) of multiphase fluid flows (bubble formation and detachment) in variable gravity environments, including 1 g, microgravity, and partial gravity. Perform research on human systems and digital human modeling with the goal of designing next generation space suits and environmental controls and life support systems for space habitats. Work also includes reach volume analysis, CAD modeling, and 3D printing. As senior graduate student, manage lab purchase orders, equipment maintenance, and personnel, including a team of 6 undergraduates and 4 graduate students.

**March 2020 – Present: Graduate Student Project Lead on the FLUIDS Lunar Payload, part of the Texas A&M Lunar Surface Experiments Program (LSEP).** Manage the design, schedule, sourcing, testing, and integration of a partial gravity fluid physics payload on board the

Intuitive Machines NOVA-C Lunar Lander (a NASA CLPS mission). Work with a team of graduate students, professors, and undergraduates to ensure the successful integration of a total of 3 Lunar surface experiments.

**January 2017 – May 2017: Teaching Assistant and Flight Simulator Instructor for MAE 3730 (Flight Vehicle Dynamics) at the University of Virginia**, Mechanical and Aerospace Engineering Department. Mentored and instructed groups of 5 undergraduates by successfully planning and teaching weekly lesson plans and flight simulations for an entire semester. Duties included the evaluation of students' skills and modification of lesson plans as needed.

**March 2016 – May 2017: Undergraduate Research Assistant, Wadley Materials Group at the University of Virginia Materials Science and Engineering Department**. Independent Senior research project investigating the use of tri-layer EBCs (composed of ytterbium monosilicate, mullite, and silicon layers) on silicon containing ceramic matrix composite (CMC) turbine blades. Tested coatings for resistance to creep and erosion due to steam, pressure, thermal, and mechanical cycling. Designed and conducted creep experiments after assembling and calibrating the creep-testing apparatus. Other duties included the careful documentation of calibration and writing of procedures for the creep-testing apparatus. After conducting experiments, I presented the experimental findings in reports and presentations. Duties also included the writing of data collection and instrument calibration software in LabVIEW. Research project was sponsored by the Office of Naval Research.

**August 2016 – May 2017: CubeSat Attitude Determination and Control Team on the Virginia CubeSat Constellation (NASA USIP-15 Mission)**. University of Virginia Mechanical and Aerospace Engineering Department. Under the umbrella of the Virginia Space Grant Consortium (VSGC), my team of six managed the attitude determination and control systems (ADCS) of the UVA 1U CubeSat. Managed the ADCS, including passive and active attitude controls, orbit modeling, and attitude determination; all while considering power, mass, environmental, and monetary restrictions. Worked as part of a team to develop a Kalman filter for attitude control.

**August 2016 – May 2017: Undergraduate Researcher, Mars Mission Planning project**. University of Virginia Mechanical and Aerospace Engineering Department. Special topics research project investigating the orbital mechanics needed for a manned mission to Mars. With aid from NASA headquarters, the Glenn Research Center, and Jet Propulsion Laboratory, we calculated a mission mass gearing ratio and the feasibility of logistics nodes, solar electric propulsion, in-situ resource utilization, and 3D printed components, all to support the planning and design of cargo missions to Mars.

**May 2016 – August 2016: Aerospace Engineering Intern, Rolls-Royce, Critical Parts Lifting, Turbines, and Rotatives Group**. Assessed the life of critical rotative parts in all classes of engines using physics based and statistical models. Used metallurgical analysis to approve manufacturing process changes and to analyze material failure. This metallurgical analysis included optical microscopy and etching techniques. Administrative duties included the automation of processes, such as bulk document downloads, using Windows PowerShell.

**June 2015 – August 2015: Pathways Engineering Intern, United States Army Research Laboratory, CEO P3T, Aberdeen Proving Ground, Maryland.** Developed, tested, and debugged software and electrical components to be used in Mobile User Objective System (MUOS) compatible radios, with the Tactical Radios division of CEO P3T. Administrative duties included the establishment of a Linux-based local file server for the lab.

**August 2014 – May 2017: Undergraduate Researcher, Nanotechnology and Graphene Production Project.** University of Virginia Materials Science and Engineering Department. Created a student-led, for-credit research class in order to investigate the viability and scalability of the ‘blender method’ for the production of graphene by using this method and variants of it to produce graphene. With a group of 7, investigated quality of the graphene using Raman spectroscopy, SEM, and AFM microscopy. From these tests, we explored uses for the graphene, including graphene reinforced polymers.

**August 2014 – May 2017: Secretary** of the University of Virginia Nano and Emerging Technologies Club (NExT).

**August 2014 – December 2015: Structural Engineer and Team Member** of the University of Virginia Hoos Flying (Aero design and RC airplane team).

**August 2015 – May 2017: Team member** of the Virginia Rocketry and Propulsion Club (VRPC) at the University of Virginia.

## **OTHER APPOINTMENTS**

Photographer, August 2017 – Present  
The Battalion, Texas A&M University

Freelance Photographer, December 2017 – Present  
Various publications such as Maroon Life and Aggieland Yearbook

KANM Student Radio DJ, January 2018 – Present  
KANM Student Radio Station, Texas A&M University

WXTJ Student Radio DJ, August 2015 – May 2017  
WXTJ 100.1 FM, University of Virginia

Senior Photographer, December 2014 – May 2017  
The Cavalier Daily, Charlottesville, VA

## **RELEVANT SKILLS AND CLEARANCES**

- **Secret Security Clearance:** Secret security clearance was obtained in June 2015, while working for the US Army at Aberdeen Proving Grounds.
- **Modeling, Computational Fluid Dynamics (CFD), Simulation, and High-Performance Computing:** Advanced skills in OpenFOAM CFD and MATLAB-based

PIVlab (Particle Imaging Velocimetry) suite. Advanced skills in high-performance computing, mesh creation and optimization, the parallelization of models, and optimization of computational efficiency. Basic to intermediate skill level in Thermal Desktop thermal modeling. Proficient skill level in SolidWorks CAD design. Basic skill level in Abaqus FEA modeling. Experience with Systems Tool Kit (STK) Orbit Modeling tools.

- **Fluid Imaging, Computer Vision, and High-Speed Videography:** Advanced skill level in computer vision techniques, using Python's OpenCV library. Advanced skills in high-speed videography hardware/software integration and operation, for use in fluid imaging experiments. Advanced skills in Schlieren imagery and high-speed shadowgraphy.
- **Programming Languages:** Advanced skill level in MATLAB, Python, and Java languages; experience with LabVIEW, C, C++, and HTML.
- **Microscopy and Spectroscopy:** Proficient skills in sample preparation, optical microscopy, scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS), atomic force microscopy (AFM), and Raman spectroscopy; experience with TEM
- **Additive Manufacturing:** Proficient skills in the calibration, testing, optimization, and operation of small to mid-sized 3D printers. Experience with multi-material and dual extruding 3D printers.
- **Digital Human Modeling:** Proficient skill level in digital human modeling and anthropometric measurement techniques using the 3dMD photogrammetric scanning system, Vitus Laser Scanner, and Artec 3D scanning system. Digital human modeling skills also include reach volume analysis using custom-written MATLAB code.
- **Administrative and Computer Software Skills:** Advanced skill level in Microsoft Office Suite, including Word, Excel, PowerPoint, Project, and Publisher. Advanced skills in WordPress website design and maintenance. Experience with Windows PowerShell.

## **COURSE INSTRUCTION**

### *University of Virginia*

- MAE 3730: Flight Vehicle Dynamics (Spring 2017)
  - Teaching Assistant and Flight Simulator Instructor. Mentored and instructed undergraduates by successfully planning weekly lesson plans and flight simulations.

## **PUBLICATIONS**

1. **Burke, Paul A.,** Dunbar, Bonnie J. *Development of Computational Fluid Dynamic (CFD) Models of the Formation and Buoyancy-Driven Detachment of Bubbles in Variable Gravity Environments.* 2021 AIAA SciTech Forum, American Institute of Aeronautics and Astronautics. Nashville, TN, January 11-15, 2021. [arc.aiaa.org/doi/10.2514/6.2021-1838](https://arc.aiaa.org/doi/10.2514/6.2021-1838)

2. **Burke, Paul Andrew.** *The Democratization and Future Ubiquity of STEM Education.* Symposium on Imagining the Future of Undergraduate STEM Education. National Academies of Sciences, Engineering, and Medicine. Washington, DC, November 12-19, 2020. [cdn.filestackcontent.com/y5UTY8jRQkCdZK28VmFl?burke.pdf](https://cdn.filestackcontent.com/y5UTY8jRQkCdZK28VmFl?burke.pdf)
3. **Burke, Paul Andrew;** Varnum-Lowry, Daniel; Dunbar, Bonnie J. *Microgravity and Partial Gravity Fluid Physics: An Experimental and Computational Study of Bubble Formation and Detachment.* The 2020 International Space Station Research and Development Conference. September 23, 2020.
4. Hall, Dillon C.; Dunbar, Bonnie J.; **Burke, Paul A.;** Hajda, Callen J. *Range of Motion (ROM) Analysis for Pressure Garments (EVA and LES) using 3D Photogrammetric Motion Capture.* 50th International Conference on Environmental Systems (ICES). Lisbon, Portugal, July 12-16, 2020. [hdl.handle.net/2346/86475](https://hdl.handle.net/2346/86475)
5. **Burke, Paul Andrew;** Varnum-Lowry, Daniel; Dunbar, Bonnie J. *Microgravity and Partial Gravity Fluid Physics: Bubble Formation and Movement in Variable Gravity Environments.* The 2019 International Space Station Research and Development Conference. Atlanta, GA, July 31, 2019.
6. **Burke, Paul Andrew;** et al. *Use of Logistics Nodes in Cargo Missions to Mars.* Presented and published at the 2017 AIAA Region I Student Conference. Charlottesville, VA, 2017.
7. **Burke, Paul Andrew.** *Virginia CubeSat Constellation (VCC) Mission: An Examination of Atmospheric Drag and Orbital Decay of a Constellation of CubeSats.* Senior Technical Thesis. University of Virginia, 2017.
8. **Burke, Paul Andrew.** *Public and Private: Explaining NASA's Support.* Senior Research Thesis. University of Virginia, 2017.

## **HONORS**

- Paper selected as 1 of 25 “Winners of the Idea Competition for Symposium on Imagining the Future of Undergraduate STEM Education” organized by The National Academies of Science, Engineering, and Medicine. As featured in Texas A&M Press: <https://engineering.tamu.edu/news/2021/01/the-future-of-stem-education-student-wins-national-academies-idea-competition.html>
- 1<sup>st</sup> place in the graduate and undergraduate division of the 2019 International Space Station Research and Development (ISS R&D) Conference Poster Competition. As featured in Texas A&M Press: <https://engineering.tamu.edu/news/2019/08/aerospace-engineering-students-win-international-space-station-research-and-development-poster-contest.html>
- Lawn Resident at the University of Virginia
- Raven Society (Academic Honor Society at the University of Virginia)

- Award for highest GPA in University of Virginia's Aerospace Engineering 2017 graduating class
- Dean's List at the University of Virginia all 8 semesters
- Intermediate Honors (Awarded at the University of Virginia to the top twenty percent of the class after 60 credit hours)
- 2<sup>nd</sup> place in the 2019 Texas Intercollegiate Press Association awards for Journalism Excellence (News Multimedia category)

## **FUNDING AND FELLOWSHIPS**

- \$12,500 – 2021 Texas A&M Ph.D. Graduate Excellence Full-Tuition Fellowship
- \$1,000 – Spring 2021 Texas A&M Aerospace Engineering Graduate Excellence Fellowship
- \$500 – Fall 2020 Texas A&M Aerospace Engineering Conference Travel Grant
- \$1,000 – Fall 2020 Texas A&M Aerospace Engineering Graduate Excellence Fellowship
- \$2,500 – Summer 2020 Texas A&M Aerospace Engineering Graduate Excellence Fellowship
- \$1,000 – Spring 2020 Texas A&M Aerospace Engineering Graduate Excellence Fellowship
- \$1,000 – Fall 2019 Texas A&M Aerospace Engineering Graduate Excellence Fellowship
- \$1,000 – 2019 Texas A&M Aerospace Engineering Conference Travel Grant
- \$800 – 2019 Texas A&M Aerospace Engineering Workshop Travel Grant
- \$8,000 – 2017 Texas A&M College of Engineering Enhancement Top-Off Fellowship
- \$2,000 – Graduating with Excellence Fellowship, Aerospace Engineering Department at the University of Virginia (2017)
- \$3,000 – 2016 George B. Matthews Aerospace Engineering Scholarship

## **SERVICE**

- Letters to a Pre-Scientist (July 2020 – Present)
  - Write pen-pal letters to 5<sup>th</sup> – 10<sup>th</sup> grade students in low-income American communities encouraging STEM education and answering questions about the fields of Science, Technology, Engineering, and Mathematics.

- Science Fair Team Advisor (Spring 2019)
  - Served as an advisor to a local middle school science fair team as they prepared for a national science fair competition.
- Engineering Open House (March 2015 – May 2017)
  - Gave lab tours of UVA’s School of Engineering and Applied Science and held science demonstrations for K-12 and prospective high school students.
- Nano Day Organizer (January 2015 – May 2017)
  - Working with the Nano and Emerging Technologies Club (NExT), organized an open house including science demonstrations and lab tours in the University of Virginia’s School of Engineering and Applied Science. Purpose was to educate and excite elementary school students about nanotechnology.
- Wahoo Wizards (September 2013 – May 2016)
  - Science tutoring program which held weekly events at local elementary schools to teach science lessons to K-5 students.

## **PROFESSIONAL DEVELOPMENT**

- March 2020: Completion of the **Academy for Future Faculty Associate Certificate Program**
- June 2019 – August 2019: Completed the eight-week CIRTL certificate program in *An Introduction to Evidence-Based Undergraduate STEM Teaching, with distinction*. Course taught by The Center for the Integration of Research Teaching and Learning (CIRTL), a National Science Foundation (NSF) Center for Learning and Teaching in higher education.
- August 2014 – Present: Member of the **American Institute of Aeronautics and Astronautics (AIAA)**

## **CONFERENCES AND SUMMITS ATTENDED**

AIAA SciTech Forum	Nashville, TN	2021
NASA Human Research Program Investigator Workshop	Virtual	2021
National Academies of Science, Engineering, and Medicine Symposium on Imagining the Future of Undergraduate STEM Education	Washington, DC	2020
NASA Glenn SLPSRA Fluid Physics Workshop	Cleveland, OH	2019
International Space Station Research and Development Conference (ISS R&D)	Atlanta, GA	2019, 2020
International Space Medicine Summit (ISMS)	Houston, TX	2018, 2019, 2020

Small Satellite Conference	Logan, UT	2017, 2018
International Conference on Environmental Systems	Albuquerque, NM	2018
EVA Technology Workshop	Johnson Space Center (TX)	2017
AIAA Region I Student Conference	Charlottesville, VA	2017