Matthew E. Nelson

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Education

Academic Qualifications

- **Iowa State University** **Ames, IA**
  Ph.D. in Human-Computer Interaction, Professors: Benjamin Ahn, Ph.D., & Mani Mina, Ph.D. *Spring 2023*
  Research in Engineering Education with Virtual and Augmented Reality
- **Iowa State University** **Ames, IA**
  Master of Science in Computer Engineering, Professor: Phillip Jones, Ph.D. *Spring 2016*
  Research in embedded systems and software-defined radios
- **Iowa State University** **Ames, IA**
  Bachelor of Science in Electrical Engineering, *Fall 2002*
  Emphasis in RF and digital signal processing

Research Projects

- **Ph.D. Dissertation Topic:** *'Teaching engineering students professional development skills through augmented and virtual reality gaming environments'*

  Application of virtual reality (VR) as a teaching tool for engineering students to gain valuable professional development skills. Using Game-Based Learning (GBL) as the framework and virtual reality to expose students to an immersive environment designed to introduce and teach students professional development skills such as leadership, teamwork, communication, and ethics. The effectiveness of VR and GBL will be examined, and the benefits these skills have on students.

- **Thesis Topic** *'Implementation and evaluation of a software defined radio based radiometer'*

  Application of remote sensing radiometer with Software Defined Radios (SDR). My thesis area focused on using SDRs, along with GNURadio to create a flexible tool that can be used for remote sensing using an L-band radiometer. My focus was on rebuilding the digital side of an existing L-band radiometer with more modern equipment and designing a flexible and better user-friendly interface for this equipment. This design is now being integrated into the CySat-1 Cubesat satellite for verification.

Employment

- **Iowa State University** **Ames, IA**
  Assistant Teaching Professor *2019–Present*

  This position is a term faculty position within the Aerospace Engineering department in which I serve as the Director for the Make to Innovate (M2I) program and oversee the M2I courses and additional teaching responsibilities. The M2I program is a multidisciplinary program that engages students in problem and project-based learning in a flipped classroom environment. The program has approximately 160 students from all majors in the College of Engineering and includes majors across campus. The program has operated for over 11 years and has impacted thousands of students. As the director for M2I, I oversee the curriculum for the courses associated with the program and oversee and serve as the PI for any funding used to support the program. Funding for this program comes from several sources, such as grants, departmental support, and industry support. We have an annual operating budget of approximately $120,000. As the director, I coordinate with our primary industry supporters, Boeing and Collins Aerospace, to meet our program objectives. I also work closely with the ISU Foundation to maintain and bring new sponsors to the program. Regarding the curriculum, I am the instructor on record for both the AerE 294 and AerE 494 courses used in the program. I am also the program coordinator's supervisor, who assists me in running the program. Additional teaching responsibilities include mostly our courses with programming components and the following courses: Introduction to Aerospace Engineering (AerE 160) and Computational Techniques for Aerospace Design (AerE 361). I have also assisted with both of our capstone courses, and I have assisted with our Aerospace Systems Integration (AerE 362) course. Additional appointment as the Assistant Director for the Iowa Space Grant Consortium.

- **Iowa State University** **Ames, IA**
  Assistant Director, Iowa Space Grant Consortium *2018–Present*

  As Assistant Director, I work with the Iowa Space Grant Consortium (ISGC) management team in carrying out the ISGC mission to improve and inspire Iowa's future in Science, Technology, Engineering and Math (STEM). The ISGC receives funding from NASA as part of the space grant program to provide funding for research, student activities, scholarships, and education initiatives that match NASA's Space Mission Directorates (SMD). ISGC works with the core institutions (Iowa State University, University of Iowa, University of Northern Iowa, Drake) and our industrial, non-profit and governmental affiliates to promote STEM and NASA initiatives. Duties include assisting with reviewing proposals, supporting the ISGC Director, building our industrial partners with the ISGC, and working with other space grant consortiums for regional projects. I serve as a Co-PI on the NASA Grant that funds the ISGC. This position is in conjunction with my other duties at Iowa State University, and 20% of my time is dedicated to this position

- **Iowa State University** **Ames, IA**
  Make to Innovate Director *2011–2018*

  Oversee operations and engineering projects within the Make to Innovate (M:2:I) program in the Aerospace Engineering department. Instructor on record for the AerE 294 and 494 courses. Developed both courses, including course materials, assessment, and materials. Manage the Make to Innovate budget, including all fundraising and grants towards Make to Innovate. Directly advised some projects within Make to Innovate. Managing several undergraduate and graduate students employed by the Aerospace Engineering Department related to M:2:I. Projects done within the M:2:I program included Cubesat (CySat) project, High Altitude Balloon operations (HABET), Rocket projects (CySLI), Unmanned Aerial Vehicles (Cardinal Flight, AirOne, CyNest), ground-based vehicle (MAVRIC) that competed in the University Rover Competition (MAVRIC), on water (Sailbot) and underwater vehicles.

- **Iowa State University** **Ames, IA**
  Chief Design and Operations Engineer *2006–2011*

  Oversaw the Space Systems and Controls Lab for the Iowa Space Grant Consortium. Worked directly with the high-altitude balloon project, CubeSat project, and the Mars rover project within the lab. Worked on several electrical projects related to those projects. Worked on several projects as contracted through the lab. Taught the AerE 265 class that covered high-altitude ballooning.

Organizations

- **Stratospheric Ballooning Association (SBA)** **Ames, IA**
  President and Chairman of the Board *2012–Present*

  The Stratospheric Ballooning Association is a non-profit organization whose mission is to promote and encourage of the use of high altitude ballooning in STEM education. The SBA promotes best practices and provides information for those wishing to use high-altitude ballooning through online content and an annual conference. We publish peer-reviewed papers from the annual conference. Starting in Fall 2018, we will begin our peer-reviewed journal. I co-founded this organization in 2012. My duties include overseeing the organization, helping to organize our annual conference, and serving as the chief editor for our journal, the Journal of High Altitude Ballooning. Additional information on the organization can be found at http://www.stratoballooning.org

Committees

- **Aerospace Engineering Curriculum Committee**
  Committee Member *2019–Present*

  Committee that oversees the curriculum in the Aerospace Engineering department. Assesses courses, learning outcomes, and compliance with ABET requirements. Approves potential new courses to the program for evaluation by the college.
- **Stratospheric Ballooning Association**
  Editor-in-Chief *2016–Present*

  Editor-in-Chief for both the Academic High Altitude Balloon Conference (`https://www.iastatedigitalpress.com/ahac/`) and the Journal for High Altitude Ballooning (`https://www.iastatedigitalpress.com/jhab/`). The conference proceedings and the Journal are hosted through Iowa State University's Digital Press site. Duties include overseeing and assigning reviewers, contacting and working with authors, and performing the final copy-editing publication stages.
- **Cyber Physical Security Minor - Iowa State University**
  Committee Member *2018–2021*

  Served on the committee to propose a Cyber-Physical Security minor at Iowa State University. This multi-departmental effort involved Electrical and Computer Engineering, Mechanical Engineering, and the Aerospace Engineering department. The committee was successful, and the minor was approved in Spring 2021 and started as a minor in Fall 2021.
- **Aerospace Engineering Labs and Equipment Committee**
  Committee Member *2013–2019*

  This committee meets to determine how funding from the College of Engineering (EFTF) is spent on improving the labs, equipment, and computers used in the Aerospace Engineering Department.
- **Resource Hub**
  Treasurer *2011–2018*

  The Undergraduate Resource Hub (URH) is an organization on the campus of Iowa State University that works to bring various shops and labs together for students to use in their hands-on projects. The URH collects information on the capabilities of various shops and labs on campus so students know where to go for certain tasks such as 3D printers, CNC work, or soldering stations.

Publications

Ahn, Benjamin and Matthew Nelson (2018). "Assessment of the effects of using the cooperative learning pedagogy in a hybrid mechanics of materials course Introduction and literature review". In: *International Journal of Mechanical Engineering Education* 47.3, pp. 210–226. DOI: 10.1177/0306419018759734.

Nelson, Matthew Erik (2016). "Implementation and evaluation of a software defined radio based radiometer". MA thesis. Iowa State University.

Conference Proceedings

Nelson, Matthew E, Dae Young Lee, et al. (n.d.). "Preparing CySat-1: A look at Iowa State University's rst CubeSat". en. In: Ogden, UT, p. 17.

Nelson, Matthew and Benjamin Ahn (2021). "Use of games to teach teamwork and communication skills to engineering students". In: *2021 IEEE Frontiers in Education Conference (FIE)*. Lincoln, NE, USA: IEEE, pp. 1–9. ISBN: 978-1-66543-851-3. DOI: 10.1109/FIE49875.2021.9637377. URL: https://ieeexplore.ieee.org/document/9637377/ (visited on 09/29/2022).

Kim, A. Ram, Benjamin Ahn, and Matthew Nelson (2020). "Implementation of an Inductive Learning and Teaching Framework for an Aircraft Flight Dynamics and Control Class". In: *2020 ASEE Virtual Annual Conference Content Access Proceedings*. Virtual On line: ASEE Conferences, p. 34772. DOI: 10.18260/1-2--34772. URL: http://peer.asee.org/34772 (visited on 09/29/2022).

Nelson, Christine and Matthew Nelson (2020). "A collaborative project using high altitude balloons to design, build and test space hardware in a classroom setting". In: *2019 Academic High Altitude Conference*. Iowa State University Digital Press. DOI: 10.31274/ahac.201. URL: https://www.iastatedigitalpress.com/ahac/article/id/201/ (visited on 09/29/2022).

Nelson, Mr Matthew, Benjamin Ahn, and Christine Nelson (2019). "Make to Innovate: Blending of Project-based Learning and Flipped Class-room Pedagogies to Provide Real-world Engineering Experiences to Engi-neering Students". In: *2019 ASEE Annual Conference & Exposition*. Tampa, FL. URL: https://peer.asee.org/33074.

Nelson, Matthew E and Benjamin Ahn (2018). "Virtual reality activities for teaching engineering students professional development skills". In: *2018 IEEE Frontiers in Education Conference (FIE)*. San Jose.

Nelson, Mr Matthew and Benjamin Ahn (2018). "Work-In-Progress: Developing engineering students' professional development skills through augmented and virtual reality gaming environments". In: *2018 ASEE Annual Conference & Exposition*. Salt Lake City, Utah.

Calfee, Dakota and Matthew Nelson (2017). "The Thunderstorm Project—Iowa State University". eng. In: *Academic High Altitude Conference*. Vol. 2016. Number: 1 Publisher: Iowa State University Digital Press. DOI: 10.31274/ahac.5562. URL: https://www.iastatedigitalpress.com/ahac/article/id/5562/ (visited on 03/30/2022).

Nelson, Matthew E and Benjamin Ahn (2017). "Improving engineering students professional development skills in the Make to Innovate program". In: *2017 IEEE Frontiers in Education Conference (FIE)*. Indianapolis, IN, pp. 1–5. ISBN: 978-1-5090-5920-1. DOI: 0.1109/FIE.2017.8190504.

Nelson, Matthew (2015). "Stratospheric Ballooning Association". eng. In: *Academic High Altitude Conference*. Vol. 2015. Number: 1 Publisher: Iowa State University Digital Press. URL: https://www.iastatedigitalpress.com/ahac/article/id/9797/ (visited on 03/30/2022).

Nelson, Matthew E. (2014). "Teaching students science and engineering with high altitude balloons and ChipKits". In: *2014 ASEE Annual Conference & Exposition*. Indianapolis, Indiana. URL: https://peer.asee.org/23104.

– (2013). "A new organization: Making high altitude ballooning accessible to everyone". In: *AIAA Balloon Systems (BAL) Conference 2013*. Daytona Beach. ISBN: 978-1-62410-226-4. DOI: 10.2514/6.2013-1336.

Nelson, Matthew E (2012). "Formation of the National Near Space Alliance". In: *Academic High Altitude Conference*.

Nelson, Matthew E, Christine N Jensen, and Michael Lazere (2011). "Bridging college students and K-12 students together through High Altitude Ballooning". In: *Academic High Altitude Conference*. Ames.

Nelson, Matthew E. (2009). "Modular Electronics System for High Altitude Balloon Flights". In: *AIAA Balloon Systems Conference*. Seattle, pp. 1–7. ISBN: 978-1-62410-136-6. DOI: 10.2514/6.2009-2820. URL: http://arc.aiaa.org/doi/abs/10.2514/6.2009-2820.

Teaching Experiences

Primary Instructor

AerE 294X

Make to Innovate I *Fall 2016–present*

Introduction to the Make to Innovate program. Students experience hands-on learning through interactive projects to engage students in the fundamentals of engineering, project management, and system engineering. Students will work in a multi-disciplinary team environment and must accomplish their team objectives and milestones by utilizing existing skills and learning new skills.

AerE 494X

Make to Innovate II *Fall 2016–present*

Students experience hands-on learning through interactive projects to engage students in the fundamentals of engineering, project management, and system engineering. Students will work in a multi-disciplinary team environment and must accomplish their team objectives and milestones by utilizing existing skills and learning new skills.

AerE 361

Computational Techniques for Aerospace Design *Fall 2019 - present*

Advanced programming, workstation environment, and development of computational tools for aerospace analysis and design. Technical report writing. Application of programming in aerospace engineering design.

AerE 161

Numerical, Graphical and Laboratory Techniques for Aerospace Engineering *Fall 2019*

Computer-based problem solving using Matlab, with emphasis on numerical methods. Introduction to solid modeling and aerospace design using SolidWorks.

AerE 290A/B

Private Pilot and Instrument Ground School *Fall 2019–current*

In the Fall of 2019, we started a ground school for students that were interested in obtaining their private pilots' license (PPL). AerE 290A covered material for taking the written exam for a PPL from the FAA and included topics that covered Part 107 rules. AerE 290B then covered material for taking the written exam for a student instrument rating.

AerE 290

Independent Study *Fall 2009–Spring 2016*

The AerE 290 course was used to allow students to get course credit for Make to Innovate. This was then formalized into an experimental course called 294X. Both 290 and 294 had similar learning outcomes as it was a continuation of the M:2:I program.

AerE 490

Independent Study *Fall 2009–Spring 2016*

The AerE 490 course was used to allow students to get course credit for Make to Innovate. This was then formalized into an experimental course called 494X. Both 490 and 494 had similar learning outcomes as it was a continuation within the M:2:I program.

AerE 160

Introduction to Aerospace Engineering *Fall 2014*

Solving aerospace engineering problems and presenting solutions through technical reports. Significant figures and estimation. SI units. Graphing and curve fitting. Introduction to aerospace engineering and engineering design. Spreadsheet programs. History of aerospace. Systems thinking. Team projects. For the Fall 2014 semester, I was the sole instructor for one section of 160.

AerE 265

Scientific Ballooning Engineering and Operations *Fall 2006–Spring 2014*

The focus of this class will be on the High Altitude Balloon Experiments in Technology (aka HABET program) operations in the Aerospace Engineering department. The class will study the general engineering practices related to high-altitude ballooning and the operations involved in launching, flying, and recovering a high-altitude balloon payload. In addition, a Systems Engineering approach to spacecraft systems design will also be discussed and how it's implemented into the HABET program.

Co-Instructor

AerE 161

Numerical, Graphical and Laboratory Techniques for Aerospace Engineering *Spring 2020*

Computer-based problem solving using Matlab(R), with emphasis on numerical methods. Introduction to solid modeling and aerospace design using SolidWorks.

AerE 160

Introduction to Aerospace Engineering *Fall 2011–Spring 2016, F 2018-S 2019, Spring 2020*

Introduction to aerospace engineering and engineering design. Spreadsheet programs. History of aerospace. Systems thinking. Team projects. For these semesters, I taught all Matlab lecturers and two lectures on electronics. I developed the lecture materials and the labs used in the lab. I also developed the quizzes, homework assignments, and questions used in the final exam.

AerE 461

Modern Design Methodology with Aerospace Applications *Spring 2019 – Fall 2021*

Introduction to modern engineering design methodology. Computational constrained optimal design approach includes selecting objective function, characterization of constraint system, materials and strength considerations, and sensitivity analyses.

AerE 462
Design of Aerospace Systems *Spring 2019 – Fall 2021*

Fundamental principles used in engineering design of aircraft, missile, and space systems. Preliminary design of aerospace vehicles. Engineering Ethics.

Guest Lecturer

EE/Mtreo/Agron 518
Microwave Remote Sensing *Spring 2012,2014,2016*

Guest lecturer discussing how a radiometer works and later how a software-defined radio radiometer works. Also assisted Dr. Brian Hornbuckle, instructor for the class, with labs that used a radiometer to collect data.

AerE 464
Spacecraft Systems *Spring 2011*

Guest lecturer that covered spacecraft power systems and communication systems. Dr. Bong Wie was the primary instructor.

CprE 584
Modeling and Techniques for Embedded Systems *Spring 2010*

Conducted lecturers that discussed the Microchip PIC under the 8-bit, 16-bit, and 32-bit architectures. Discussed optimization techniques in these micro-controllers to optimize code execution and memory usage. Dr. Phillip Jones was the primary instructor.

Advisor

EE 491 & 492
ECpE Senior Design Capstone Course *Fall 2006–Spring 2010*

Advised ECpE Senior Capstone projects that were related to the High Altitude Balloon project and Co-Advised a project related to the Fick Observatory and the radiometer and optical telescope established there.

Grants, Honors, and Awards

Grants

- **Iowa Space Grant Consortium (Co-PI)** - *$3,925,000, Base award for ISGC for years 2020-2024*
- **Iowa Space Grant Consortium (Co-PI)** - *$1,428,800, Base award for ISGC for years 2018-2020*
- **Iowa Space Grant Consortium Base Program (PI)** - *$80,000, Awarded from July 2020 to June 2024*
- **Proctor and Gamble Grant (PI)** - *$20,000, Spring 2020* P&G grant for purchasing and updating equipment in the Make to Innovate lab.
- **ISGC SHO Award (PI)** - *$5,000 RAFF, Fall 2019*
- **ISGC SHO Award (Co-PI)** - *$5,000 Micro-G, Fall 2019*
- **ISGC SHO Award (PI)** - *$5,000 MAVRIC, Fall 2017, 2018,2019,2020,2021*
- **ISGC SHO Award (PI)** - *$5,000 HABET, Fall 2018,2019,2020,2021*
- **ISGC SHO (PI)** - *$5,000 CySat, Fall 2017,2018,2019,2020,2021*
- **ISGC SHO Award (PI)** - *$5,000 CySLI, Fall 2017, 2018,2020, 2021*
- **Miller Grant (Co-PI)** - *$8,500, Spring 2019* Innovative learning framework for classes involving physical systems: Combining the inductive teaching and learning method and the Make To Innovate program
- **ISGC Collaborative Grant (Co-PI)** - *$20,000, Spring 2019* - Development of an Innovative Joint Space Instrumentation / Aerospace Engineering Course with Iowa State University and the University of Iowa
- **ISGC Collaborative Program Award (PI)** - *$8,500, Spring 2018* - Teaching professional development skills to engineering students in Iowa using virtual and augmented reality

- **NASA X-Hab Grant (Co-PI)** - *$30,000, Spring 2018*
- **CIRTL-ISU Teaching as Research Grant Award (PI)** - *$800, Fall 2016*

Fellowships

- **College of Engineering Entrepreneurship Fellow** - *$5,000, 2021 - 2023*
- **Student Innovation Center Fellow** - *$10,000, 2022 - 2023*

Gifts

- **Boeing** - *$47,000 Annual contribution for Make to Innovate*
- **Collins Aerospace** - *$20,000, Annual contribution to Make to Innovate*

Awards

- **American Society of Engineering Education Poster Award** - *$500, Spring 2019*
- **Induction into IEEE Etta Kappa Nu Honors Society** - *Spring 2016*
- **Iowa State University Professional and Scientific Excellence Award** - *$1,500 Fall 2014*
- **Iowa State University Professional and Scientific Teamwork Award** - *Spring 2014*
- **NASA Exploration Systems Mission Directorate (ESMD) Award for Capstone** - *$4,000, Fall 2011*
- **NASA Exploration Systems Mission Directorate (ESMD) Award** - *$6,000 Summer 2010*

Affiliations

Professional

- **IEEE:** Institute of Electrical and Electronics Engineers
- **AIAA:** American Institute of Aeronautics and Astronautics
- **ASEE:** American Society for Engineering Education
- **SBA:** Stratospheric Ballooning Association

Hobby

- **ARRL:** American Radio Relay League
- **EAA:** Experimental Aircraft Association
- **WIA:** Women in Aviation

Interests and Extra-curricular Activity

- FAA Private Pilot License. High performance and Complex endorsements. Currently working on an instrument rating.
- FAA Unmanned Aerial Systems Pilot's license (Part 107)
- Extra Class Amateur Radio Operator. Volunteer Examiner and ARRL liaison for the local VE testing group at Iowa State University.

References

- Dr. James Flaten
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