Swarm Micro UAVs for Area Mapping in GPS-denied Areas

Daniel Golan, Engineering Physics Propulsion Lab, Embry Riddle Aeronautical University

Abstract

Using micro–Unmanned Aerial Vehicles (UAVs) or Micro Aerial Vehicles (MAVs) for mapping and cartography applications has the potential to change the way UAVs and MAVs are used, especially in treacherous and GPS-denied locations. Mapping in the past would take place with a person using various tools to map or survey any given area, but there has been a fundamental switch to autonomous vehicles that can accomplish the task in less time and with less effort. Autonomous mapping practices are typically completed using an individual UAV that maps using Simultaneous Localization and Mapping (SLAM) or photogrammetry. This project aims to use swarm robotics to map complex environments and harsh terrain using MAVs with a quicker, more accurate, and more precise method. The scope of the mapping procedure will cover difficult-to-reach locations such as cliffs, abandoned buildings, and forests. It also covers areas that would take too long for a surveyor to do by hand, such as construction sites and large indoor spaces like warehouses, factories, or historical buildings that cannot be modified for surveying. The swarm will utilize an emergent-like behavior to map in any given location without collisions of MAVs or ground objects. This project aims to fit under Thrust 6, Assured Autonomy of Aviation Transformation, of NASA's Strategic Implementation Plan. This project will be an intelligent machine system capable of operating in complex environments and offer effective evaluations of autonomous systems in both a laboratory and operational setting to implement autonomy in aviation applications.

Introduction/Background

The usage of aerial vehicles for mapping is no new concept and has been around for decades. It has been used for surveying land, creating a 3D interactive model of buildings, and mapping dense forestry [1]. UAV mapping solves many problems surveyors had when they mapped land by hand, namely the time taken to complete large projects. They also were limited to areas that don't require intrinsically safe equipment/HAZMAT training or are low in complexity. Locations such as chemical plants or construction sites needed to be mapped extensively however, they present large human-based challenges.

After UAV mapping was introduced, much quicker, more efficient, and more detailed large-scale surveys are possible with ease. In the past, one person would go through a large property only to return with elementary information such as building location and geographic boundaries. However, a UAV could give areas and locations of everything, from forestry and rock structures to hills, buildings, equipment, and people; nonetheless, it has drawbacks. The most prevalent is the issue of the photogrammetry approach to mapping, which was widely used at the beginning of the practice. Photogrammetry works well under certain conditions; however, it takes longer to get an accurate model because the camera is small and not very powerful, causing a need to retake photos of areas it has already been. Another issue is the introduction of vegetation or slight differences in the region's topography. This variation in the typical flat ground can cause a propagation error to take place in the map when the onboard computer attempts to process the images being taken. Those issues stem from a fundamental issue that photogrammetry uses 2D images to try to create a 3D model [2]. Although, there have been

breakthroughs recently in the field of drone cameras. Drone racing has led to the development of First Person View (FPV) cameras that have higher resolution images and higher frames per second. This type of camera is favorable because of how small it is in size, and the small amount of power draw it takes while providing up to 4k resolution [3].

The best solution to these problems is to use a light detection and ranging (LiDAR) sensor. LiDAR can tell the difference in a 3D environment based on the onboard time of flight calculator, eliminating the problem computers have with 2D vision. To map effectively, the onboard computer for this project will collect raw data from the LiDAR and camera to create a full map. For localization purposes, a variation of SLAM will be used. SLAM is a way to both map locations and locate where the robot is concerning the map it creates.

Methodology

For our approach, the swarm will utilize emergent-like behavior with guidelines or rules to control how all MAVs work together. Emergence is seen in nature with ant colonies, insect groups, and bird flocks. Emergent behavior works based on the biological behavior of individuals working together to achieve a common goal, like multiple ants moving a leaf, without one individual knowing what the other is doing at any given time [4]. In our case, this will be applied where each MAV will create a map of its environment with a fusion of LiDAR and FPV drone racing cameras. After it is done, each of the MAVs will upload its mapping data to an external computer, where information fusion will occur. Information fusion combines factors like data collection, the control theory, the technology for the sensors, and the code to provide a much more accurate and put-together deliverable [5]. This fusion after the fact allows for each MAV to move quicker, creating a less accurate map that will get fixed later during the fusion with all the other maps.

The difference in the behavior this project takes compared to the normal emergence or a global model is the utilization of emergence behavior with a leader. This leader will be determined by which MAV is closest to the center of the MAV swarm, and its primary purpose is to dictate where the swarm will be moving. It will also continue to map so the onboard computer can make decisions based on the data it has collected. However, this differs from global behavior because if the leader were to be downed, another MAV would take its place and continue as if there was no change. This means there is no set leader, and that position is varying between MAVs depending on which one is closest to the center of the swarm, or if the leader has been damaged. This behavior approach is not typically taken as it is a middle ground between the two established methods. This project aims to be an effective adaptation of these currently used methods in order to yield greater results when mapping.

The two primary sensors used for the mapping are the LiDAR and the FPV drone racing camera. The LiDAR is the central mapping source used for most of the actual surveying, but it has its faults. LiDAR is based on time-of-flight measurements using lasers. The main issue that arises from this form of measurement occurs when the laser hits a body of water, causing the beam to get wholly absorbed in bodies of water. This effect is negligible for water droplets on buildings or surfaces but is very apparent when looking at bodies like lakes or puddles. Another issue is the shadows behind objects that the LiDAR cannot pick up. To solve this issue, a camera will be fastened to each MAV. The onboard computer will filter the data and create a visible map

that the computer will then use to localize. The camera will also serve as the primary way to differentiate the MAVs from other objects. The main proposed collision avoidance method will be the utilization of the predictive analysis aspect of a digital twin. This will allow the MAV to create a form of object permanence to avoid colliding with fixed objects that are blocked by other bodies [6]. The filtering of data from both the digital twin and the localization method occurs so that one MAV can keep track of another, while also knowing not to include it in its final map. Including the digital twin as an obstacle avoidance system will include a decision-making algorithm that will greatly increase safety and add to the swarm's success during mapping. The system will be set up with four motors, each with a motor controller that connects back to the main flight controller.

The process explained is a modified version of SLAM with more emphasis on mapping. In practice, using swarm SLAM is not optimized, and the localization aspect of the research needs more documentation [7]. However, due to the nature of emergent behavior and the environment to which these will be applied, having an approximation of each MAV's location concerning one another should be enough to complete its task if bounds are used in the individual's code [7]. This is further enhanced with the addition of a digital twin. For making the map, we will take the general graph optimization approach (G2o) because the raw data recorded is very light and works well with swarm robotics [8]. The main drawback of this technique is the precision that each graph produces, and this leads to propagation error. These issues will be nullified after the operation and when the data is filtered and fused. Combining all the maps will compensate for the lack of precision during the original mapping and create a more robust and versatile map. This however will not affect the localization as that is taking place primarily from the FPV camera.

The first drone being developed will start as a kit bought from get FPV [3]. Beginning with a kit will allow us to take some liberties that will shrink the scope of work that has to be completed, most importantly, developing an actual drone. By ruling out a few factors at the start, we can focus on the actual sensor payload and the mapping software that must be built. However, soon after everything is verified, multiple drones will be 3D printed from a composite so they can be adjusted and tailored to the project's needs. This process will happen rather early on so that the modular design can suit the needs at the beginning. Testing will take place indoors in a closed-off test chamber to comply with ERAU and FAA safety rules and guidelines. There will be enough equipment to purchase an extra 10 drones to have insurance on damaged or faulty components. The beginning of this project will start in April and end one year after that. It will consist of two phases, the first of which is initial testing with just 3 MAVs. Then once this is confirmed a larger test will be conducted with 10 MAVs. After that Phase 2 will commence and this is a full test of all MAVs as well as the beginning of the final deliverable. Embry-Riddle Aeronautical University will help to develop proper crowdfunding in association with the students on the team. At the time of this proposal, there is not a business student on the team, however, funds are allocated to pay them when he or she is added to the project. This will be before the funds are dispersed. He or she will conduct the market analysis and crowdfunding campaign, working alongside the other team members. The crowdfunding website that will be used is GiveCampus [9]. They have ties with the university and are used for many other active projects. After the crowdfunding and funds are dispersed, the final deliverable for the project is for the swarm to have mapped an indoor GPS-denied environment and an acre of a state or national park.

References

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[2] E. P. Baltsavias, "A comparison between photogrammetry and laser scanning," *ISPRS Journal of Photogrammetry and Remote Sensing*, vol. 54, no. 2-3, pp. 83–94, Jul. 1999.

[3] "Qav-Piko 2' micro quadcopter kit," *www.getfpv.com*. [Online]. Available: https://www.getfpv.com/qav-piko-2-micro-quadcopter-kit.html?gclid=Cj0KCQiAofieBhDXARIsAHTTldr8J6DrfCziZ9Lco_VnuFNDL29zvnS122X_npdX7dxHGUQjgGstI2UaAkG7EALw_wcB. [Accessed: 04-Feb-2023].

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[5] "What is Multisource Information Fusion?," *Center for Multisource Information Fusion - University at Buffalo*, 21-Sep-2017. [Online]. Available: https://www.buffalo.edu/cmif/center/what-is-MIF.html#:~:text=Data%20fusion%20refers%20to%20the,broad%20range%20of%20contextual%20data. [Accessed: 17-Feb-2023].

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[7] M. Kegeleirs, G. Grisetti, and M. Birattari, "Swarm slam: Challenges and perspectives," *Frontiers in Robotics and AI*, vol. 8, Mar. 2021.

[8] R. Kummerle, G. Grisetti, H. Strasdat, K. Konolige, and W. Burgard, "G2O: A general framework for graph optimization," *2011 IEEE International Conference on Robotics and Automation*, Aug. 2011.

[9] "Embry-Riddle Aeronautical University · givecampus." [Online]. Available: https://www.givecampus.com/schools/EmbryRiddleAeronauticalUniversity [Accessed: 23-Feb-2023].

Project Timeline

Task	Start Date	End Date
Proposal Due	February 2023	-
Business Student Added	February 2023	April 2023
Award Granted	April 2023	-
Crowdfunding starts	April 2023	August 2023
Market Analysis	April 2023	April 2024
Phase 1	April 2023	-
3 MAVs Check	April 2023	August 2023
10 MAVs Check	August 2023	October 2023
Phase 2	October 2023	April 2024
All units of MAVs Check	October 2023	December 2023
In field testing	January 2024	April 2024
Customer Testing	February 2024	April 2024
Customer Feedback and Improvements	February 2024	April 2024
Final Report	March 2024	April 2024

College of Arts and Sciences and Department of Physical Sciences
1 Aerospace Boulevard
Daytona Beach, FL 32114-3900
Telephone: (386) 226-6709

February 22, 2023

TO WHOM IT MAY CONCERN:

This is the letter of support of the Proposal "**Swarm Micro UAVs for Area Mapping in GPS-denied Areas.**" by Daniel Golan who is applying to the National Aeronautics and Space Administration Program NNNH21ZEA001N-USRC2.

The proposal goal is to create a system of robotic swarm to map complex environments and harsh terrain using MAVs with a quicker, more accurate, and more precise method. The scope of the mapping procedure will cover difficult-to-reach locations such as cliffs, abandoned buildings, and forest. By my opinion this is interesting and potentially high impact research that is worth to pursue.

The suggested project if funded will be performed in the Engineering Physics Propulsion Laboratory (EPPL) at the Department of Physical Sciences, College of Arts and Sciences, ERAU. The lab has all necessary equipment and tools that will be required for this project.

Daniel Golan is involved in such research activity at EPPL for several years and he demonstrated capabilities and skills to perform research in aerospace area. He is one of the leaders among student researchers at my laboratory. By my opinion Daniel is very consistent in achieving his goals and I have not doubt that he will successfully implement this project if it is funded. On my side as the EPPL Laboratory Director I will provide all support and my scientific expertise in control systems for the suggested project.

The project is in-line with the EPPL research direction, and I fully support its potential funding by this NASA Program.

Sincerely,
Sergey V. Drakunov, Ph.D.

Professor of Engineering Physics
EPPL Director
drakunov@erau.edu

Daniel Golan

Daniel_golan@icloud.com · 14 Park Lane, Galveston, Tx 77551· 409-692-4404

OBJECTIVE To obtain a Mechanical Engineering internship in summer of 2023.

EDUCATION

Embry-Riddle Aeronautical University (ERAU) — Daytona Beach, FL
Bachelor of Science in Mechanical Engineering — May 2025

Galveston College — Galveston, TX
Associate of Applied Science in Welding Technology — August 2021
Associate of Arts in General Studies — August 2021

Certifications: Autodesk Inventor, OSHA Construction Safety and Health, NCCER Welding 1
Air Force Reserve Officer Training Corps: Learning leadership and followership mentalities in a military manner

INTERNSHIP EXPERIENCE

Intern Mechanical Engineer I, *Elliot Group,* Houston, TX, 05/2022-08/2022
- Put in charge of redesigning the weld shop and implementing laser welding into everyday operations
- Read work scopes and provided engineers with a detailed rundown on problems with each rotor or turbine
- Designed a new fixture for holding an impeller onto a positioner for improved safety using Creo Parametric
- Modeled a full layout of the 125,000+ sq. ft. compound on AutoCAD with machines and permanent structures
- Created a new filing system for rotor storage that allowed for spatial visualization in Excel

Intern Welder*, Gulf Copper Dry Dock & Rig Repair***,** Galveston, TX, 11/2019-4/2020
- Applied welding knowledge to real-world situations that required adaptability
- Supported welders by fitting and prepping materials and work areas
- Provided repairs on barges and other tanker boats based on the blueprints provided by the construction manager

PROJECT EXPERIENCE

NASA FLOATing DRAGON Competition, Principal Investigator, EPPL
HiDRA is a payload recovery glider that falls from 120,000 feet above ground level and carries terabytes of telemetry data from NASA's newest weather balloons. Fully autonomous UAS that was tested using XFLR5, OpenVSP, ANSYS, and wind tunnel testing. Coded using python initially and C++ for controls. Used expandable wings to save space and emphasized payload safety.

CubeSat Controls, Team member, EPPL
This CubeSat was made to help college students test their controls with actual hardware. It uses flywheels that can rotate in 3 axes so students can test all aspects. I modeled and printed the body for the 3U version using Autodesk Fusion, as well as worked with my team to create the test bed for the 3U version.

Carbon Fiber Electric Skateboard, Principal Investigator
Designed and built a foam-cored, carbon fiber, belt-driven skateboard. Pitched idea to gain classmate interest and create a team. Delegated tasks and determined timelines using a Gantt chart. Conducted research to determine materials for fabrication, ordered parts and materials. Writing progress reports on a biweekly basis. The goal is to create a board with a maximum weight of 10 lbs, a maximum speed of 13.5 m/s, and an acceleration of 2 m/s^2.

WORK EXPERIENCE

Entrepreneur, Galveston, TX, 2/2021-8/2021
- Created multiple custom orders and artistic CAD models on Vcarve for local retailers
- Cut out each model from sheet metal, on a plasma arc cutter, applied a custom finish

SKILLS

Engineering Software: Autodesk Inventor 2019, Vcarve, Java, Gantt, Catia V5, MATLAB 2022b, Creo Parametric, AutoCAD, Autodesk Fusion, Windchill, C++
Office Software: Microsoft Word, Excel, PowerPoint, Sharepoint
Technical: Fabrication, CNC Plasma Cutting, Welding (TIG, MIG, FCAW, SMAW steel and aluminum)

AWARDS & HONORS

Presidential Scholarship, ERAU
Achievement Scholarship, ERAU
Dean's List, ERAU
Summa Cum Laude, Galveston College

Bryan Gonzalez

Phone: (980) 425-4678
GPA: 3.272 **Email:** Gonzab18@my.erau.edu

SUMMARY

Mechanical Engineer with hands-on experience designing, developing, and programming robotic systems and experimental soft robotics. Mechanical Engineer focused on leveraging the latest controls algorithms to build and implement innovative technology solutions in production of new hardware.

SKILLS

- **Engineering:** Computer Aided Design (AutoCAD, Solidworks, Catia, Inventor), Pneumatic circuit design (Scheme Editor), Simulink, Programming (Python, MATLAB, C++) and Simulink, Multisim, KiCad. Experience with CNC Lathes, Mills and additive manufacturing in 3d printing
- **Leadership:** Strategic Planning & Execution, Project Management, Prioritization, Process Improvement, Cross-functional.

EDUCATION & CERTIFICATION

- Bachelor of Science in Mechanical Engineer with minor in Applied Math, Embry Riddle Aeronautical University **12/2023**

RELEVANT EXPERIENCE

Mechanical Engineer Undergraduate **2019 – Present**

- **IHMC Human Performance Exoskeleton:** I was the main mechanical intern for the human performance exoskeleton team which focused on designing a neural network for gate estimation with the intent of application to exoskeletons. My job was to perform finite element analysis for the exoskeleton pieces and design joints to mimic human motion for the lower body exoskeleton
- **IHMC Sandia exoskeleton:** Designed sensor mounts for various electrical components. Aided in the design of an adaptive strapping system. The purpose behind the Sandia exoskeleton is meant to help the ageing population at the Hagerty nuclear disposal plant with lifting there safety equipment
- **CubeSat Controls Project:** Analyzed and created the equations of motion for a 3 Degree of Freedom CubeSat test bed platform and have been designing a full state feedback controller. The main intent behind this project is to create a testbed platform for the controls of various students in the Engineering Physics and Propulsion Lab.
- **Soft Robotic Arm for Construction Drone (SRACD):** Designed and tested a soft robotic arm for construction drones. The soft robotic arm had the intention of verifying the practicality behind the usage of Fluid Driven Origami Soft Muscles a newer soft muscle type.
- **Integrated Spacecraft Autonomous Attitude Control (ISAAC):** Aided in the Pneumatic design for the project's propulsion system. As well aided in the design of mounts for propulsion of the craft in gimble.
- **Omni-usability Soft Robotic Exoskeleton (OSRE):** I lead research that consists of the design of a full body exoskeleton that uses pneumatic soft robotics as its actuators. The purpose of this exoskeleton is to be a full body system for rehabilitation as well as test bed for soft robotic control systems.

WORK EXPERIENCE

Surf Grant Researcher Internship – Engineering Physic Propulsion Lab under Dr. Sergey Drakunov **Summer 2021**

- Developed a small testbed platform for the testing of Fluid Driven Origami Soft Muscles in the form of a Delta Arm.
- Designed pneumatic and sensor system for testbed
- Implemented a PID for control of arm

IHMC Internship – Institute for Human Machine Cognition Mechanical engineering intern under Dr. Anil Raj **Summer 2022**

- Developed a lower body exoskeleton that mimicked anatomical motion.
- Design hardware for pneumatic soft muscle and motor actuated hybrid system
- Implement IMU and EMG sensors across the lower body exoskeleton

Peer Mentor – Embry Riddle Aeronautical University **2021 - 2022**

- Aided in teaching classes for UNIV 101
- Taught students how to set up academic path plans
- Showed students how to use the online resources and software offered by Embry Riddle

Student Resource - Embry Riddle Aeronautical University **2021 - present**

- Mentored students in scholarships, financial aid, and academic plans.
- Facilitate communication with professors through emails bringing students to the help they need
- Helped students find research labs and related project clubs on campus; allowing students to follow their research passions on campus.

Kyle Fox

foxk8@my.erau.edu
www.linkedin.com/in/kylefox123
+1 (704) 960-3123
U.S. Citizen, Security Clearance - Inactive - TS with Poly (2019)

Education

- **Embry-Riddle Aeronautical University** — Daytona Beach, Florida
  Bachelor of Science - Electrical Engineering; — *July 2018 - Present*
  CumGPA: *2.847;* ***EngGPA:*** *3.478*
  Expected Graduation Date: *May 2024*
  Courses: *Digital Signal Processing, Digital Systems Design(FPGA), Microprocessor Systems, Incompressible & Compressible Aerodynamics, Optimization in Systems Engineering, Trade Studies Risk and Decision Analysis*

Skills

- **Software**: Vivado, Keil, LTSpice, Microsoft Office, Confluence, Automation Builder, SDR#, WireShark
- **CAD**: KiCAD, EagleCAD, Altium, Autodesk Inventor, EPLAN, CATIA
- **Languages**: C, ARM Assembly, Verilog, Java, MATLAB/Simulink, Lua, Git, Python

Experience

- **Steam Solutions** — New Orleans, LA
  Electrical Engineering Intern (Full-time) — *June 2022 - August 2022*
  - Working with industrial equipment, such as steam tracing equipment and product transfer pipes, in a research facility.
  - Designing a Programmable Logic Controller (PLC) electrical diagram and hardware circuitry.
  - Designing custom PCBs for use as a standalone PLC, a demonstration PCB for use in an example steam tracing system, and rewiring/installation of sensors and thermocouples for an experimental steam tracing system.
  - Collaborated between Multinational, local, and interdepartmental teams to ensure project cohesion.
- **Engineering Physics Propulsion Lab - EPPL** — Daytona Beach, FL
  Student Lab Lead (Part-Time) — *May 2021 - Present*
  - Project management and structuring of all teams and PIs.
  - Supporting other PIs and students with their projects by reviewing grant applications, guiding their work, and finalizing papers for publishing.
  - Allocating monetary and physical resources for each project and student needs.
  - Liaison between the Lab, the Faculty Mentor, and other school bodies.
  - Creating and assisting with electrical circuits and PCB designs for projects.
- **Office of Undergraduate Research - OUR** — Daytona Beach, FL
  Student Research Peer Mentor (Part-time) — *August 2021 - Present*
  - Performing both classroom and community based outreach events to involve fellow students with research.
  - Supporting OUR office tasks and coordinating with other mentors to ensure completion of office projects.
  - Assisting with inquires from students who are looking to work on research at ERAU, through the office.

Projects

- **ISAAC - Integrated Spacecraft for Autonomous Attitude Control**: **Principle Investigator.** The purpose of this project is to give undergraduate students an opportunity to design, manufacture and maintain a testbed for an autonomous control system. I created the electrical system for the spacecraft and worked on the control system using MATLAB Simulink.
- **Project Solstice**: This project was the design of a 6U Cubesat for space debris mitigation in Low Earth Orbit (LEO). I designed a prototype electrical system for the CubeSat to extend the robotic arm and sail.
- **OSRE - Omni-usability Soft Robotic Exoskeleton**: Was an Electrical Engineering Advisor to the OSRE team and assisted in their development of a external logic board for monitoring and execution of control algorithms.
- **Robotics Project**: Creating a autonomous robot for industrial survey applications. Using a quadruped robot to carry sensors into human based environments for steam trap monitoring, data collection, and non-invasive equipment testing.

Publications

- **AIAA Conference Paper: Comparative Methodology and Validation of Steam as a Monopropellant Through a Converging-Diverging Nozzle**: This paper presents an extensive understanding of the behavior of steam as a compressible gas through a thrust optimized parabolic nozzle designed for small spacecraft In-Situ Resource Utilization missions. The designed nozzle had an efficiency of 94% and was tested in a vacuum environment. (2021)
- **Research Gate: Design and Assembly of a Prototype 6U Solar Sail CubeSat for Debris Capture Operations in LEO**: This paper overviews the design and assembly process for a test-bench prototype model of a solar sail-based debris capture LEO satellite. The core systems being designed and tested for the prototype are the boom deployment mechanism, debris capture mechanism, and the vision and electronics systems. (2021)
- **ERAU Commons: EasyControls.org - A real life platform to learn spacecraft controls from your browser**: Retrofitting the existing NASA Asteroid Free Flyer prototype with an updated electronics suite, software, and gimbal system to allow those interested in control theory, to go online and connect with a real working controls testbed.

Ethan Thomas

Current:
Melbourne 32940
Phone: (424) 206-3545 **Email:** Thomae21@my.erau.edu

Objective: To obtain an internship utilizing my work ethic and leadership skills, enabling me to grow in knowledge and skills from the gained experience.

Education

Embry-Riddle Aeronautical University, Daytona Beach, FL
- Major in **Mechanical Engineering**
  Expected Graduation Date: 2025
  GPA:3.33

Osaka Metropolitan University, Osaka, Japan
- Study abroad, Calculus III, May 15, 2022 – June 18, 2022

Melbourne Central Catholic High School, Melbourne, FL
- *Graduation Class of 2021*
  Cum GPA: 3.90/4.00

Work Experience

Golf Cart Center: Golf Cart Technician Apprentice
July 2022- August 2022
- Performed visual inspections and reviewed findings with Lead Mechanic and Service Advisor before recommendations for repairs were relayed on to the customer for approval
- Investigated problems with different types of motors
- Performed various tasks including checking and filling vital fluids, removal and installation of filters, properly inflating tires, replacing batteries and other preventative maintenance services

Daytona International Speedway: Ambassador
August 2021- April 2022
- An ambassadors' position is to supervise the customer on the trams and ensure their safety, answer any questions they have, and to be a friendly face that represents the speedway.

Tennis Instructor
April 2021 - June 2021
- Provided tennis instruction to middle school students.

City of Melbourne: Lifeguard
June 2017 – August 2019
- Rescue distress persons, using rescue techniques and equipment.
- Examine injured persons and administer first-aid or cardiopulmonary resuscitation, if necessary, using training and medical supplies and equipment. Contact emergency medical personnel in case of serious injury. Warn recreational participants of inclement weather, unsafe areas, or illegal conduct.
- Inspect recreational facilities for cleanliness.

Urban Air Trampoline Park: Floor Monitor
June 2018- December 2019
- Provide proper instruction on the use of all the different play stations (including: zipline, virtual reality center, laser tag, and bounce floor)
- Monitor the safety of guests
- Enforce floor rules and regulations

Ethan Thomas

Current:
Melbourne 32940
Phone: (424) 206-3545 **Email:** Thomae21@my.erau.edu

Clubs & Project Experience

Floating Dragon

August 2022-Febuary 2023

- Lead CAD designer for Hidra
  - Program used was Inventor
- Hidra is a recovery glider
- It consists of an airfoil body based off NACA airfoil dimensions
- The wings are based off NACA airfoil dimensions
- Implements a custom deployable and retractable wing mechanisms

EPPL

August 2022 - Current

- EPPL is a research club that is fully funded and supported by Embry- Riddle and its faculties.
- EPPL allows students to work together towards a collections of research projects
  - Project Hidra is EPPL's entry design into NASA's Floating Dragon Competition.

Det 157 Color Guard

September 2022- January 2023

- Guards:
  - Brazilian graduation 2nd ceremony – 4 November 2022

ERAU Motorsports FSAE (Built and Raced Formula 1 Style Race Cars): Mechanical Team

September 2021- Current

- Provided supply chain support to the various teams in procuring parts and material for the fabrication of the car's frame, drive shaft, suspension, and body.
- Provided support to the ERO6 model, checking the calculation and the regulations of the car frame.

Skills, Certification and Achievements

- **Coding Software**: JavaScript, HTML
- **Modeling Programs**: Inventor, Catia
- **Office Software***:* Word, Excel, PowerPoint
- **Technical***:* Soldering, Welding (Fundamentals), 3D Printing, Specialized Hand Tools
- **Certified Lifeguard:** American Red cross CPR Certified, AED Certified
- **Educational Awards:** Magna Cum Laude (through grade 9,10,11), Summa Cum Laude (through grade 12), honor Roll and Recipient of the Brevard County Mathematician of the Year (2016), Brevard Federation of Teachers RALPH AITKEN, Presidential Award
- **National Junior Honor Society and Beta Club** (Member)
- **National Honor Society**

Stanlie Cerda-Cruz

15121 Woodrich Bend Court Apt 455, Fort Myers FL 33908
239-645-5018 Stanliecerda3@gmail.com

EDUCATION

Embry-Riddle Aeronautical University (ERAU): Class of 2026
- GPA 4.0
- Bachelor of Science in Aerospace Engineering
- Area of Concentration: Propulsion

Florida Southwestern State College
- Dual Enrollment

Fort Myers High School: Class of 2022
- GPA 4.18
- ACT 28
- ASVAB: AFQT 82 / Mechanical Comprehension 97

AWARDS AND HONORS

Embry-Riddle:
- Presidential Scholarship
- Dean's List (Fall 2022)

EXPERIENCE

Electronics:
- AC Motors, 3D printing

Computer Experience:
- Coding: Python, MATLAB, Terminal, Arduino
- CAD: Fusion, Inventor, Catia V5
- Productivity: Microsoft Office (Word, Excel, PowerPoint), Premier Pro, Adobe Acrobat

ATHLETICS

Wrestling	$9^{th}/10^{th}$	(nothing further due to COVID)
Weightlifting	Varsity -10^{th} Grade	(nothing further due to COVID)

WORK EXPERIENCE

Planet Fitness	38 hrs. per week	(April 2021 - December 2021)
Publix	40 hrs. per week	(January 2022 - August 2022)
Honey Baked Ham	Seasonal employee	(April 2021)

COMMUNITY SERVICE

Road Cleanup — Keep Volusia County Clean