Rutgers University

Department of Mechanical & Aerospace Engineering

2024-2025 Senior Design Projects

14:650:487/488 Aerospace Engineering Design I/II

Aerospace Engineering Projects

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AE PROJECT 1

Mechanical Bird

Advisor: Prof. Prosenjit Bagchi

Email: pbagchi@soe.rutgers.edu

Project Goals: Conceptualize, design, fabricate and demonstrate a mechanical device that can fly like a bird using flapping and morphing wings

Project Envisioned Outcomes: robot bird

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools			☑		
Traditional Machining			☑		
CNC machining					
3D printing			☑		
Welding					
Wiring					
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)			☑		
Microcontrollers (e.g., Arduino)			☑		
Bonding					
Processing (e.g., vacuum bag, autoclave)					

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol					
Python					
Ansys			☑		
SolidWorks			☑		
Other CAD packages					
Siemens NX					
LabView					
E-Calc					
AVL					
Xfoil					
Machine vision program					

AE PROJECT 2

UAV-Based Aerosol Sampling and Analysis System

Advisor: Prof. Xiaoli Bai

Email: xiaoli.bai@rutgers.edu

Project Goals:

1. Design and develop a lightweight, efficient, and cost-effective UAV platform suitable for aerosol sampling in various atmospheric conditions.

2. Integrate aerosol sampling instruments and sensors that can accurately collect and measure aerosol properties, such as particle size, concentration, and chemical composition.

3. Implement an autonomous flight control system that optimizes flight paths based on real-time aerosol data, environmental conditions, and mission objectives, maximizing the efficiency of the sampling process.

4. Design a user-friendly ground control interface that allows operators to easily plan, monitor, and manage the UAV missions and access the collected aerosol data.

5. Validate the performance and accuracy of the UAV-based aerosol sampling system through a series of field tests and comparisons with other established measurement methods.

Project Envisioned Outcomes:

A functional, reliable, and efficient UAV system designed explicitly for aerosol sampling, capable of operating in various atmospheric conditions and covering large areas time-efficiently.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design				☑	
Analysis				☑	
Hand tools		☑			
Traditional Machining		☑			
CNC machining		☑			
3D printing			☑		
Welding		☑			
Wiring			☑		
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)		☑			
Microcontrollers (e.g., Arduino)				☑	
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab				☑	
Comsol		☑			
Python				☑	
Ansys		☑			
SolidWorks		☑			
Other CAD packages		☑			
Siemens NX		☑			
LabView		☑			
E-Calc			☑		
AVL		☑			
Xfoil		☑			
Machine vision program			☑		

AE PROJECT 3

Lunar Lava Tube Access

Advisor: Prof. Haym Benaroya

Email: benaroya@soe.rutgers.edu

Project Abstract: Design Structure to access lunar lava tube, where habitats will eventually be placed.

Project Goals: Consider environment, design options, and select optimal design based on criteria developed by the group. This will build upon the project results from the AY 23-24 project with similar goals.

Project Envisioned Outcomes: A working design is required.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools			☑		
Traditional Machining			☑		
CNC machining					
3D printing			☑		
Welding					
Wiring					
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)					
Microcontrollers (e.g., Arduino)					
Bonding					
Processing (e.g., vacuum bag, autoclave)					

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol			☑		
Python					
Ansys					
SolidWorks			☑		
Other CAD packages					
Siemens NX					
LabView					
E-Calc					
AVL					
Xfoil					
Machine vision program					

Additional Requirements and Information:

The following link provides background: https://spacesettlementprogress.com/engineering-analysis-of-pressurized-lunar-lava-tubes-for-human-habitation/

AE PROJECT 4

Design and Testing of a Liquid Rocket Propulsion System

Advisor: Prof. Steven Berg

Email: steven.berg@rutgers.edu

Project Goals: This project will involve design and construction of a liquid rocket engine (LRE) intended to be scalable for future RPL rocket applications. The liquid rocket shall use propellants storable at room temperature (i.e. no cryogenics) and hazard class 'critical' or 'marginal' as defined by AFSPCMAN 91-710. The team will be required to develop a technology roadmap which includes plans for integration into the RPL team. Considering this roadmap, the team will design and develop a subscale demonstration rocket, including all required test stand facilities and instrumentation, with extensive engineering analysis to ensure safety protocols. All testing operations will be subject to review and approval by the project direction and REHS.

Project Envisioned Outcomes:

-Don't blow yourself up

-LRE Technology Roadmap

-Subscale Demonstration Engine Design and Analysis

-Test Stand and Instrumentation Build

-Subscale Demonstration Engine Testing

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design				☑	
Analysis				☑	
Hand tools		☑			
Traditional Machining		☑			
CNC machining		☑			
3D printing		☑			
Welding		☑			
Wiring		☑			
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)		☑			
Microcontrollers (e.g., Arduino)		☑			
Bonding		☑			
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab				☑	
Comsol			☑		
Python				☑	
Ansys			☑		
SolidWorks				☑	
Other CAD packages	☑				
Siemens NX				☑	
LabView				☑	
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

AE PROJECT 5

RU Power – Rutgers Marine Energy Collegiate Competition Team (2024-2025)

Advisor: Prof. Onur Bilgen

Email: o.bilgen@rutgers.edu

Please contact Dr. Bilgen via email with the subject line starting with "Senior Design: Project Name – Your Name".

Project Goals: The goal of this project is the design, analysis, fabrication and testing of a small (model-scale) hydrokinetic turbine prototype for the purpose of competing in the Department of Energy (DOE) Marine Energy Collegiate Competition (MECC) which will take place in May 2025. The team will design, fabricate, and test multiple iterations of the hydrokinetic turbine, as well as develop necessary control algorithms. News releases from the previous teams can be found on the SOE Website: 2024 Team.

The students should be very comfortable with at least one of the following: 1) Design/analysis and programming software such as Matlab, XFOIL, AVL, E-Calc, Mission Planner, Ansys, Solid Works, Siemens NX or other CAD packages, LabVIEW, etc.; 2) Simple analog or digital electronics such as resistors, capacitors, op-amps, microcontrollers (i.e. Arduino, Raspberry Pi), wiring, soldering, etc.; 3) Fabrication techniques such as 3D printing, bonding, vacuum bagging, manual fabrication, etc.

All team members are expected to have an exceptional work ethic and dedication to the project. Students from all backgrounds who are interested in continuing to graduate school are highly encouraged to join. Please contact Dr. Bilgen via email (o.bilgen@rutgers.edu) with the subject line starting with "Senior Design: RU Power – <Your Name>" .

Project Envisioned Outcomes: See above.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design				☑	
Analysis				☑	
Hand tools				☑	
Traditional Machining			☑		
CNC machining		☑			
3D printing				☑	
Welding	☑				
Wiring				☑	
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)				☑	
Microcontrollers (e.g., Arduino)				☑	
Bonding				☑	
Processing (e.g., vacuum bag, autoclave)				☑	

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab				☑	
Comsol				☑	
Python				☑	
Ansys				☑	
SolidWorks				☑	
Other CAD packages				☑	
Siemens NX				☑	
LabView				☑	
E-Calc				☑	
AVL				☑	
Xfoil				☑	
Machine vision program				☑	

Additional Requirements and Information:

Application Process:

Please send an email to Dr. Bilgen (o.bilgen@rutgers.edu) with the subject line starting with "Senior Design: " and include the following content:

1) A brief statement indicating interest
2) Project(s) of interest (primary and secondary can be indicated)
3) Cumulative GPA (in major)
4) Theoretical (subject) strengths (i.e. dynamics, solids, fluids, control, design, etc.)
5) Software strengths
6) Hands-on, fabrication, testing strengths and experiences (outside of courses and labs)
7) Student organizations involved

AE PROJECT 6

Wind – Rutgers Collegiate Wind Competition Team (2024-2025)

Advisor: Prof. Onur Bilgen

Email: o.bilgen@rutgers.edu

Project Goals:

The goal of this project is the design, analysis, fabrication and testing of a small (model-scale) offshore wind turbine prototype for the purpose of competing in the Department of Energy (DOE) Collegiate Wind Competition (CWC) which will take place in May 2025. The team will design, fabricate, and test multiple iterations of the turbine, as well as develop necessary control algorithms. News releases from the previous teams can be found on the SOE Website: 2023 Team and 2024 Team.

The students should be very comfortable with at least one of the following: 1) Design/analysis and programming software such as Matlab, XFOIL, AVL, E-Calc, Mission Planner, Ansys, Solid Works, Siemens NX or other CAD packages, LabVIEW, etc.; 2) Simple analog or digital electronics such as resistors, capacitors, op-amps, microcontrollers (i.e. Arduino, Raspberry Pi), wiring, soldering, etc.; 3) Fabrication techniques such as 3D printing, bonding, vacuum bagging, manual fabrication, etc.

All team members are expected to have an exceptional work ethic and dedication to the project. Students from all backgrounds who are interested in continuing to graduate school are highly encouraged to join. Please contact Dr. Bilgen via email (o.bilgen@rutgers.edu) with the subject line starting with "Senior Design: RU Wind – <Your Name>" .

Project Envisioned Outcomes: See above.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design				☑	
Analysis				☑	
Hand tools				☑	
Traditional Machining			☑		
CNC machining		☑			
3D printing				☑	
Welding	☑				
Wiring				☑	
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)				☑	
Microcontrollers (e.g., Arduino)				☑	
Bonding				☑	
Processing (e.g., vacuum bag, autoclave)				☑	

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab				☑	
Comsol				☑	
Python				☑	
Ansys				☑	
SolidWorks				☑	
Other CAD packages				☑	
Siemens NX				☑	
LabView				☑	
E-Calc				☑	
AVL				☑	
Xfoil				☑	
Machine vision program				☑	

Additional Requirements and Information:

Please send an email to Dr. Bilgen (o.bilgen@rutgers.edu) with the subject line starting with "Senior Design: " and include the following content:

1) A brief statement indicating interest
2) Project(s) of interest (primary and secondary can be indicated)
3) Cumulative GPA (in major)
4) Theoretical (subject) strengths (i.e. dynamics, solids, fluids, control, design, etc.)
5) Software strengths
6) Hands-on, fabrication, testing strengths and experiences (outside of courses and labs)
7) Student organizations involved

AE PROJECT 7

Stop-Rotor Rotary Wing Aircraft

Advisors: Prof. Laurent Burlion and Gaylord Olson (external)

Email: laurent.burlion@rutgers.edu

Project Goals: Develop a non-conventional drone that seamlessly transitions between two flight modes:

Helicopter Mode: At low speeds, the drone will utilize rotors for vertical takeoff, landing, and hovering, similar to a helicopter.

Fixed-Wing Mode: Once airborne, the rotors will come to a complete stop, transforming the drone into a fixed-wing aircraft for efficient forward flight.

Project Envisioned Outcomes: The project will culminate in testing this transformative flight within a controlled environment using a large windwall to analyze the transition between the two modes

If the design proves successful, the ultimate goal is to achieve outdoor flight with the stop-rotor drone.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design				☑	
Analysis				☑	
Hand tools			☑		
Traditional Machining			☑		
CNC machining			☑		
3D printing				☑	
Welding		☑			
Wiring			☑		
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)					
Microcontrollers (e.g., Arduino)				☑	
Bonding		☑			
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab				☑	
Comsol		☑			
Python				☑	
Ansys			☑		
SolidWorks			☑		
Other CAD packages		☑			
Siemens NX	☑				
LabView	☑				
E-Calc				☑	
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

AE PROJECT 8

Streamlined Heavy Lift Small UAS

Advisor: Prof. Laurent Burlion

Email: laurent.burlion@rutgers.edu

Sponsor: This project is sponsored by US-ARMY DEVCOM

Project Goals: Provide optimum design for maximum takeoff mass vs. loiter time/range/top speed (across environmental conditions). Reimagine mass distribution in a way that might allow you to have a heftier frame, better aerodynamics, and greater performance. Get a small but optimized UAS that can be carried on your back.

Project Envisioned Outcomes: Run design optimizations using modeling and simulations. Build and test various small UAS using a large windwall.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design				☑	
Analysis				☑	
Hand tools			☑		
Traditional Machining			☑		
CNC machining			☑		
3D printing				☑	
Welding		☑			
Wiring				☑	
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)			☑		
Microcontrollers (e.g., Arduino)				☑	
Bonding		☑			
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab				☑	
Comsol			☑		
Python				☑	
Ansys				☑	
SolidWorks				☑	
Other CAD packages			☑		
Siemens NX		☑			
LabView		☑			
E-Calc				☑	
AVL				☑	
Xfoil				☑	
Machine vision program			☑		

AE PROJECT 9

Design of a Hand-Operated Shock Tunnel

Advisor: Prof. Edward DeMauro

Email: ed451@soe.rutgers.edu

Project Goals: We are investigating the feasibility of creating a hand-operated shock tunnel based on designs produced within existing literature. This will be a multi-year project whereby we will start with the design of the driver and driven portions of the shock tunnel, i.e., constructing a hand-operated shock tube. The first year will focus on these sections, demonstrating that a shock is achievable using schlieren imaging.

Project Envisioned Outcomes:

- Design of a pressure vessel

- System sizing based on constraints including cost, pressure, and fluid dynamics

- Preparation of the system for future modifications

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools		☑			
Traditional Machining		☑			
CNC machining	☑				
3D printing	☑				
Welding	☑				
Wiring		☑			
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)		☑			
Microcontrollers (e.g., Arduino)		☑			
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol	☑				
Python	☑				
Ansys		☑			
SolidWorks			☑		
Other CAD packages			☑		
Siemens NX		☑			
LabView		☑			
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

Additional Requirements and Information:

https://link.springer.com/article/10.1007/s00193-015-0608-x

AE PROJECT 10

AIAA Low-Cost Anti-Missile Missile Competition

Advisor: Prof. Edward DeMauro

Email: ed451@soe.rutgers.edu

Project Abstract: The military services of the United States and its allies have a need for a short- to medium-range missile defense system capable of protecting against large salvos of threat missiles. The key to defeating these salvos of hundreds of thousands of incoming threat missiles includes a low-cost interceptor. According to various news reports, as an example, the Tamir missile used by the Iron Dome air defense system is about $50k per missile. However, as threat salvo size increases it is necessary for interceptor cost to decrease to preserve economically feasible defenses.

Project Goals: The objective of this project is to design a low-cost interceptor for a short- to medium-range missile defense system. Participants shall provide engineering analysis and total system design associated with this system. The teams shall determine a system concept that best satisfies mission requirements and goals. The teams shall describe their design process, the physical and performance characteristics of the final system design and its components, an operational concept, cost estimate, development plan, and necessary support equipment and other resources necessary to comply with the Technical Requirements.

Project Envisioned Outcomes: The overall requirement of this Design Competition is to develop a low-cost anti-missile missile. Emphasis should be on minimizing system cost while meeting system performance and effectiveness requirements.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design			☑		
Analysis			☑		
Hand tools		☑			
Traditional Machining		☑			
CNC machining	☑				
3D printing	☑				
Welding	☑				
Wiring		☑			
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)		☑			
Microcontrollers (e.g., Arduino)	☑				
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol	☑				
Python	☑				
Ansys		☑			
SolidWorks			☑		
Other CAD packages			☑		
Siemens NX	☑				
LabView		☑			
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

AE PROJECT 11

Persistent Drone Weather Monitoring

Advisor: Prof. F. Javier Diez

Email: diez@soe.rutgers.edu

Project Abstract: Persistent drone weather monitoring

Project Goals: Develop a drone that can flight tethered continuously for 24hrs for weather monitoring

Project Envisioned Outcomes: Demo a drone that can achieve the project goals.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design				☑	
Analysis		☑			
Hand tools			☑		
Traditional Machining		☑			
CNC machining		☑			
3D printing		☑			
Welding		☑			
Wiring			☑		
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)				☑	
Microcontrollers (e.g., Arduino)				☑	
Bonding		☑			
Processing (e.g., vacuum bag, autoclave)		☑			

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab				☑	
Comsol		☑			
Python				☑	
Ansys		☑			
SolidWorks			☑		
Other CAD packages			☑		
Siemens NX		☑			
LabView			☑		
E-Calc			☑		
AVL		☑			
Xfoil			☑		
Machine vision program			☑		

AE PROJECT 12

Design, Fabrication and Testing of Test Stand to Measure Torque and Power of RC Electric Motors

Advisor: Prof. Doyle Knight

Email: ddknight@rutgers.edu

Project Goals: Develop test stand to measure torque and power of RC electric motor

Project Envisioned Outcomes: Successful design, fabrication and testing of test stand

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design		☑			
Analysis			☑		
Hand tools			☑		
Traditional Machining		☑			
CNC machining		☑			
3D printing			☑		
Welding		☑			
Wiring			☑		
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)			☑		
Microcontrollers (e.g., Arduino)			☑		
Bonding			☑		
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol			☑		
Python	☑				
Ansys			☑		
SolidWorks			☑		
Other CAD packages	☑				
Siemens NX	☑				
LabView			☑		
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

AE PROJECT 13

Continuously Variable Transmission for Propulsion and Wind Turbines

Advisor: Prof. Amin Reihani

Email: amin.reihani@rutgers.edu

Project Goals: The goal of this project is to design and fabricate an electronically-actuated continuously variable transmission (eCVT) with the potential for delivering high power at low weight for aerial propulsion as well as wind turbine applications. To maximize the energy efficiency of aerial propulsion systems (e.g. turbofan and turboprop engines), it is beneficial for the speed of the propeller or the fan of a gas turbine to be controlled independent of the turbine shaft speed. A CVT placed between the gas turbine and the propeller or the fan would achieve this goal. Similarly, in horizontal axis wind turbines, the ability of continuously varying the rotor speed as a function of wind speed would maximize the energy extraction from wind. However, electrical generators typically operate at a constant speed and do not allow continuous wide range variation of the rotor speed. A CVT placed in between the wind turbine rotor and the generator enables continuous wide range variation of the rotor speed independent of the generator speed.

Project Envisioned Outcomes: The students will design the components of an eCVT gearbox using 3D CAD software, fabricate or purchase the necessary components and assemble parts including the gears, shafts, bearings and the casing. Next, two electrical motors will be connected to the gearbox, one of which would be a high power prime mover, and the other would be a smaller motor used as an actuator. The output of the gearbox will be connected to a large propeller. The goal of the project would be to continuously vary the rotational speed of the propeller while the rotational speed of the prime mover remains constant.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design				☑	
Analysis		☑			
Hand tools				☑	
Traditional Machining			☑		
CNC machining	☑				
3D printing			☑		
Welding	☑				
Wiring			☑		
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)				☑	
Microcontrollers (e.g., Arduino)			☑		
Bonding	☑				
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol	☑				
Python	☑				
Ansys	☑				
SolidWorks					☑
Other CAD packages			☑		
Siemens NX	☑				
LabView			☑		
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

AE PROJECT 14

Drone for Automated Mapping of Flow Generated by Windwall

Advisor: Prof. Jerry Shan

Email: jshan@soe.rutgers.edu

Project Goals: Students will design and build a drone that can autonomously map the velocity distribution generated by the Windwall (a new digital wind tunnel that is being installed in Weeks Hall), for different conditions.

Project Envisioned Outcomes: Please see https://windshape.com/home/for more information about the windwall.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design				☑	
Analysis				☑	
Hand tools			☑		
Traditional Machining				☑	
CNC machining			☑		
3D printing				☑	
Welding	☑				
Wiring				☑	
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)				☑	
Microcontrollers (e.g., Arduino)				☑	
Bonding			☑		
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab				☑	
Comsol			☑		
Python				☑	
Ansys			☑		
SolidWorks			☑		
Other CAD packages			☑		
Siemens NX	☑				
LabView				☑	
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program				☑	

AE PROJECT 15

Design of Strong and Lightweight Spherical Pressure Vessel Using Carbon Fibers and Epoxy Resin

Advisor: Prof. George Weng

Email: gjweng@rutgers.edu

Project Goals: To build a light-weight composite spherical pressure vessel that can sustain high pressure without failure.

Project Envisioned Outcomes: A hardware composite spherical pressure vessel.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design		☑			
Analysis		☑			
Hand tools		☑			
Traditional Machining		☑			
CNC machining		☑			
3D printing		☑			
Welding		☑			
Wiring		☑			
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)		☑			
Microcontrollers (e.g., Arduino)		☑			
Bonding		☑			
Processing (e.g., vacuum bag, autoclave)		☑			

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol	☑				
Python	☑				
Ansys	☑				
SolidWorks	☑				
Other CAD packages	☑				
Siemens NX	☑				
LabView	☑				
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program	☑				

AE PROJECT 16

Cooperation of A Fleet of Intelligent Mobile Plants for Unknown Territory Exploration

Advisor: Prof. Qingze Zou

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Project Abstract: In this project, we seek to create and optimize a suite of strategies (algorithms) to allow a fleet of mobile plants combining both ground robots and drones to cooperate with each other efficiently and robustly, to seek resources and maximize the plants survivability in an unknown and potentially hazardous territory. The idea is to equip the plants with mobility, environment sensing (e.g., light, temperature, and vision) and communication capability (wireless communication), and allow and help the plants to communicate and share information with each other about the environment, to seek resources (e.g., water, light) and/or avoid dangers (e.g., harsh temperature and/or harmful insects), thereby, turning the group of plants into a group of social "animal-like" subjects. This project is built upon the successful outcomes of senior projects in the last a few years. The task of your team is to develop and test optimal path planning and guidance algorithms along with necessary hardware enhancement (e.g., real-time image-based navigation, guidance and control) drawing from machine learning, computer vision, and multi-agent network systems, aiming to optimally maximize the survivability of the plants in harsh environment.

Project Goals: Creating a fleet of mobile plants combining both ground robots and drones working cooperatively together to seek resources and maximize the plants survivability in an unknown and potentially hazardous territory.

Project Envisioned Outcomes: Enhance the function and capability of the robot network, develop autonomously-flying drones, and make the robots and drones working together in real-time for territory exploration.

Students Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Design		☑			
Analysis	☑				
Hand tools		☑			
Traditional Machining	☑				
CNC machining	☑				
3D printing	☑				
Welding	☑				
Wiring			☑		
Simple analog or digital electronics (e.g., resistors, capacitors, op-amps)			☑		
Microcontrollers (e.g., Arduino)			☑		
Bonding		☑			
Processing (e.g., vacuum bag, autoclave)	☑				

Software Expertise:

	None	Beginner	Intermediate	Serious Hobbyist	Professional
Matlab			☑		
Comsol	☑				
Python	☑				
Ansys	☑				
SolidWorks	☑				
Other CAD packages	☑				
Siemens NX	☑				
LabView	☑				
E-Calc	☑				
AVL	☑				
Xfoil	☑				
Machine vision program			☑		

Additional Requirements and Information:

Programming experience with Arduino and Raspberry Pi