Mechanical Engineering Senior Design Projects 2019-2020

Professor	Project Title	Project Summary
Bagchi, P.	Mechanical Bird/Mechanical Fish	The goal is to build a device that can mimic flying like a bird using flapping and deforming wings. Second project deals with building a device that can swim like a fish using body flexibility.
Bai, X.	A Land-Air Hybrid Vehicle	The goal of this project is to design, fabricate, and test a vehicle that is capable of both ground travels and aerial flights. On small scale, such vehicles can be used to explore large, difficult terrains; and on large scale, such vehicles can be driven on the road and into the air.
Baruh, H.	Wheelchair Modification	The kit will motorize a wheelchair and should fit under the seat, and should be possible to install/remove it in one hour. This year's project will deal with the additional requirement that the motor inertia not impede motion in case someone wants to move the wheelchair without the aid of the motors.
Bilgen, O.	Multi-Mode Hybrid Unmanned Delivery System: Combining Fixed-Wing and Multi-Rotor Aircraft with Ground Vehicles	The goal of this project is to investigate novel concepts for a multi-mode unmanned aerial system. Once the system within the vicinity of the delivery location, the multi-rotor will detach and will take care of the vertical movement for a controlled delivery to the ground.
	A Novel Quad-Copter Drone with Solid-State Rotors	The goal of this project is the design, analysis, fabrication and testing of a small quad-copter unmanned aerial vehicle (UAV) that utilizes smart materials to achieve control and improvement of performance of its rotor blades. The team will design, fabricate and test multiple iterations of the solid-state rotors as well as power/sensing electronics and control algorithms.
	Design and Testing of a Drone to Conduct Zero-G Experiments	The goal of this project is the design, analysis, fabrication and testing of a small quad-copter unmanned aerial vehicle (UAV) to act as a platform to conduct Zero-G experiments. The team will design, fabricate and test multiple iterations of the vehicle, as well as develop necessary control algorithms.
Burlion, L.	Drone Hunter	The goal of the project is to design and build a drone capable of automatically tracking and/or neutralizing an unauthorized drone.
	Small Scale Flying Car	The goal of the project is to design and build a drone equipped with both tilt rotors (for vertical take off) and a main wing. In addition to design, special attention will be given to transition maneuvers.
ook-Chennault,	Smart Artificial Hand	Students will build and test an artificial hand using commercially available technology.
DeMauro, E.	Design of VTOL Transition Mechanism	Along with an AE group, these two groups will function together. The goal is to design the transition mechanism for a custom-built VTOL, which must transition from vertical takeoff to forward flight.
Denda, M.	Bio-Inspired Flapping Wing Energy Harvester	The goal of this project is to use recently discovered flapping flight research phenomena to efficiently harvest energy from the wind. Team members will design and construct their own wind energy harvester, then test its performance under different conditions.

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Drazer, G.	Virtual Reality Cycling for Patient Rehabilitation	The objective of this project is to integrate mechanical engineering and rehabilitation science by designing the next generation of the VRACK (virtual reality cycling kit) system. It will create an inexpensive integrated solution, containing sensorized pedals, handlebars and a heart rate monitor that are interfaced with a virtual environment, and will be tailored for persons who have had a stroke and would use it in rehabilitation.
Gu, X.	An Automated Gantry System for Individualized Production	The objective of this project is to design and construct a fully automated and flexible gantry system for individualized manufacturing/assembly. The system should be capable of picking, moving, and placing items as requested by individual users.
Guo, Y.	Selective Laser Melting of Customized Knee Implant	· Create CAD model of a knee implant using commercial CAD software package or data cloud, · Fabricate the knee implant using selective laser meting, · Measure dimensional accuracy and surface finish the fabricated knee implant
Guo, Z.	Building a Device for Harvesting Solar Energy or for Desalination	In this project, you could bring in some “wild” ideas to design and build a device for solar energy harvesting or for solar desalination.
	Solar Power	Photovoltaic (PV) or solar cells convert light energy into electricity. Solar desalination is a technique to desalinate water using solar energy, and this project, students can bring in some “wild” ideas to harvest or use solar power.
Jaluria, Y.	Wind Energy System	Design of a system to demonstrate the use of wind energy to pump water. The system consists of the wind turbine, energy storage and arrangement to pump water to a given height, and the wind may be simulated by means of an electric fan.
Knight, D.	Design of Model Aircraft Electric Engine Thrust Stand	Each group will design a tabletop test stand for measuring the thrust, input electric power, and RPM of a model aircraft electric engine according to specifications.
Lee, H.	3D Printing with Novel Materials	In this project, we aim to develop a new 3D printer and process, with which one can print non-traditional materials, such as paper, recycled material from plastic bottles, ceramic powder, or others. The project involves (1) design and machining of mechanical components (40%), (2) programming for automation and process planning (30%), and (3) characterizing material properties of printing materials (30%).
	System for Measuring the Mass of Plankton	Working with Professor Mazzeo and Professor Heidi Fuchs (Institute of Marine and Coastal Sciences), the team will design and build a system for measuring plankton.
Lin, H.	Design and Implementation of an Automated Sorter	A color-based sorting system, where color is detected optically, and sorting is driven by compressed air.
Malhotra, R.	3D Printing with Elastomers	This project will develop a 3D printer that is capable of building solid structures (on a small scale) using deposition and curing of precursors for elastomers like PDMS. An infrared heater will be integrated with the printer to allow curing of the elastomer precursors into solid structures.
Mazzeo, A.	Customized Smart Bandages for Skin Care	The project with combined mentorship of Professors Mazzeo and Tse will look at making customized bandages for skin care.

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Muller, M. R.	Optical Torque Measurement for Motor Efficiency Determination	This topic could change by fall - we often have more urgent needs at the Center for Advanced Energy systems. The current project involves designing an optical torque device to allow the efficiencies of small motors to be determined.
Norris, A.	Designing and Testing a Dynamic Vibration Absorber	The objective is bench-top system that demonstrates the principle of a single degree of freedom dynamic absorber. The end product is a robust device that can serve as an educational tool for future MAE students.
Pelegri, A.	High Speed Data Acquisition System for Impact Tester	The focus of this project will be on designing, building, and testing a data acquisition system capable recording impact events at over 1 MHz. This system will expand the capabilities of the impact tester to include analyzing properties of composite and other high stiffness materials used for ballistic, aerospace, and recreational equipment applications. Students interested in this project should be comfortable and/or highly interested in sensor design, stress-strain analysis, materials science as applied in mechanics, and programming. The team will design, build and perform testing with this system, analyzing several high strength materials to validate system performance. (5-6 students max) [1]
Pelegri, A.	Fatigue Testing System for RFR	A cyclic load tester for small specimens according to RFR regulation specs.
Shan, J.	Blue Energy from the Sea	In this project, we will seek to build a demonstration reverse-electrodialysis stack that will utilize ion-selective membranes to generate electrical power directly from salt and freshwater. The prototype device will be used to power small electronics, like a digital watch.
Singer, J.	Roll-to-Roll Electrospray Deposition	Team will be tasked with building a roll-to-roll apparatus to continuously deposit thin films onto a non-conductive substrate. Early stages of the project will focus on the design of a system that incorporates these features, while later stages will involve construction and testing the resulting deposition system.
Tse, S	Equine Simulator for Hippotherapy	Hippotherapy is a form of physical therapy that uses the characteristic movements of a horse to provide graded motor and sensory input as a treatment strategy. Hippotherapy can help patients with neurological or other disabilities, such as cerebral palsy, arthritis, multiple sclerosis, head injury, stroke, and spinal cord injury. The students will design and construct an equine simulator that can provide the four basic gaits of a horse, namely walk, trot, canter, and gallop, for an average adult.

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Weng, G.	High Strength, Light Weight Cylindrical Pressure Vessel with Fiber-Reinforced Composites	For engineering applications where both light weight and high strength are essential factors, fiber-reinforced polymer composites often provide one of the best choices as compared to traditional materials such as steel or aluminum. In this project, we will first learn the basic principles of fiber reinforced composites, and then apply them to construct a cylindrical pressure vessel subjected to a prescribed internal pressure without failure.
Yi, J.	Wheelchair Modification	The kit that motorizes a wheelchair should fit under the seat of the wheelchair and it should be possible to install or remove in one hour. This year's project will deal with the additional requirement that the motor inertia not impede motion in case someone wants to move the wheelchair without the aid of the motors.
Zou, Q.	A Multi-dimensional Fleet of Intelligent Mobile Plants for Unknown Territory Exploration	In this project, we are 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. 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 success of IndaPlant senior design projects and plant-centered mobile robot network in the last a few years. The task of your team is to further enhance the function and capability of three mobile robots, develop autonomously-flying drones, and make the robots and drones working together in real-time for territory exploration.
Zou, Q.	A Smart Fertilizer Machine for Urban Organic Waste Recycling	In this project, we are creating one-of-its-kind smart machine that turns urban organic waste (e.g., vegetable and fruit left-out) into fertilizer. Urban agriculture has becoming an indispensable component of the food supply in big cities around the world, whereas in the contrast, organic waste has also becoming an increasingly critical environmental concern in these big cities as well. Thus, turning organic waste into fertilizer that can be directly applied in urban agriculture is not only very environmentally but also economically beneficial. In this project, you are asked to design, build, and test a prototype machine that can automatically sort the organic waste, break them into small pieces, and convert them into fertilizer through processes such as fermentation. The system you will make is a truly mechatronics system, and you will utilize the state-of-the-art sensing, actuation, computer vision, and onboard computation technologies to make the whole system completely autonomous, robust, and highly efficient that can be easily deported and installed in communities and/or urban farm factory in the future.

[1] Responder updated this value.