Rutgers University

Department of Mechanical & Aerospace Engineering

2020-2021 Senior Design Projects

14:650:467/468 Design and Manufacturing I/II

Table of Contents

List of ME Projects

ME PROJECT 1

Mechanical Fish

Advisor: Prof. Prosenjit Bagchi

Email: pbagchi@soe.rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/pbagchi

Project Abstract: Building mechanical fish

Project Goals: Building mechanical fish-- an underwater device that can swim like a fish using body undulations.

Project Envisioned Outcomes: Design and fabrication of soft swimming devices.

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., vaccum 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	☑				

ME PROJECT 2

Gearing System for a Motorized Wheelchair

Advisor: Prof. Haim Baruh

Email: baruh@soe.rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/baruh

Project Abstract: Adding a gearing system to a motorized wheelchair. The design of previous years created a kit that can be added to a wheelchair so that the wheelchair becomes motorized. What we want to do is to add a gearing system to the motor so that it becomes easier to navigate the wheelchair.

Project Goals: Design a kit which a) can be installed or removed in less than half an hour to motorize a wheelchair and b) have some gearing capability making it easier to navigate.

Project Envisioned Outcomes: A low-cost addition to a low-priced wheelchair making it much more versatile.

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., vaccum 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	☑				

ME PROJECT 3

Multi-Mode Hybrid Unmanned Delivery System: Combining Fixed-Wing and Multi-Rotor Aircraft with Ground Vehicles

Advisor: Prof. Onur Bilgen

Email: o.bilgen@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/ob126

Project Abstract: The goal of this project is to investigate novel concepts for a multi-mode unmanned aerial system. For example, a VTOL vehicle attached (docked) to a fixed-wing (i.e. STOL) vehicle. In this case, the fixed-wing aircraft does the long-distance "cruising." 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. Navigation, planning, logistics, policy issues, docking/undocking, platforms etc. are all very interesting and relevant problems – such issues will be looked at by the design 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 packagess, 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).

Project Goals: The goal of this project is to investigate novel concepts for a multi-mode unmanned aerial system. For example, a VTOL vehicle attached (docked) to a fixed-wing (i.e. STOL) vehicle. In this case, the fixed-wing aircraft does the long-distance "cruising." 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.

Project Envisioned Outcomes: Navigation, planning, logistics, policy issues, docking/undocking, platforms etc. are all very interesting and relevant problems – such issues will be looked at by the design team.

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., vaccum 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	☑				

ME PROJECT 4

Drone Based Crop Health Detection Using Computer Vision and 5G Wireless Communication

Advisor: Prof. Onur Bilgen

Email: o.bilgen@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/ob126

Project Abstract: The goal of this project is the design, analysis, fabrication and testing of an unmanned aerial vehicle (UAV) and a ground station, both equipped with 5G transmitters/receivers to evaluate crop health for food production purposes. The team will design, fabricate and test multiple iterations of the vehicle, and the ground station, as well as develop necessary control algorithms.

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 packagess, 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).

Project Goals: The goal of this project is the design, analysis, fabrication and testing of an unmanned aerial vehicle (UAV) and a ground station, both equipped with 5G transmitters/receivers to evaluate crop health for food production purposes.

Project Envisioned Outcomes: The team will design, fabricate and test multiple iterations of the vehicle, and the ground station, as well as develop necessary control algorithms.

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., vaccum 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	☑				

ME PROJECT 5

Solar Walker

Advisor: Prof. William Bottega

Email: bottega@soe.rutgers.edu

WebEx Meeting Place: NA

Project Abstract: Solar walker

Project Goals: Design, manufacture and build a solar powered walking vehicle that can carry a small payload.

Project Envisioned Outcomes: Working vehicle that can compete with vehicle of rival group.

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., vaccum 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	☑				

ME PROJECT 6

Poly Articulated Drone

Advisor: Prof. Laurent Burlion

Email: laurent.burlion@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/lb823

Project Abstract: The team will propose an innovative design to build a drone with several movable parts.

Project Goals: The goal of the project is to design and build a drone capable of using its extra movable parts to perform more demanding maneuvers than a conventional quadcopter.

Project Envisioned Outcomes: Design and build a drone capable of using its extra movable parts to perform more demanding maneuvers than a conventional quadcopter.

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., vaccum 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	☑				

ME PROJECT 7

Design of a Biomechanical Hand

Advisor: Prof. Kimberly Cook-Chennault

Email: cookchen@soe.rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/cookchen

Project Abstract: Design of a Biomechanical Hand

Project Goals: To design a robotic hand that incorporates both mechanical and electrical functioning.

Project Envisioned Outcomes: Incorporate of electronics for programmable execution of movement of fingers.

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., vaccum 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:

Students will need experience with CAD and using arduino. Students will have ideally had a circuits class or similar experience to excel in this project.

ME PROJECT 8

Desktop-Size Non-Destructive Material Identification Device

Advisor: Prof. Alberto Cuitiño

Email: alberto.cuitino@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/cuitino

Project Abstract: To develop a desktop-size non-destructive material identification device. This device will be based on mechanical testing of small samples. Elastic moduli (E) of the material will be obtained by recording the buckling load that for a given sample geometry and testing configuration, is only dependent on E. the By selecting the geometry of the sample and loading condition, buckling can be triggered before material material failure.

Project Goals: To miniaturize a mechanical testing machine for buckling at relatively low cost in such a way engineering students, with the proper design and documentation, can build their own testing device for testing material at home.

Project Envisioned Outcomes: A tested machine design with a full set of documentation for a DIY project for engineering students. The device should include all the components of hardware, software and integration.

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., vaccum 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				☑	

ME PROJECT 9

Bio-Inspired Flapping Wing Energy Harvester I

Advisor: Prof. Mitsunori Denda

Email: denda@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/denda

Project Abstract: Built on the latest in flapping flight research, the patent-pending technology at the core of this project has been shown to produce efficiencies higher than the best wind turbines on the market.

How? Recently, scientists discovered that birds use advanced flapping aerodynamics to move through the air up to 5 times more efficiently that man-made aircraft. The goal of this project is to use these recently discovered 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. They will have access to CAD models of working prototypes that have been previously built and tested, and they will also have access to proprietary MATLAB programs which can predict efficiency before building the device.

Project Goals: Design of Bio-Inspired Flapping Wing Energy Harvester

Project Envisioned Outcomes: Design of Bio-Inspired Flapping Wing Energy Harvester

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., vaccum 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:

Require hands on mechanical experience

ME PROJECT 10

Bio-Inspired Flapping Wing Energy Harvester II

Advisor: Prof. Mitsunori Denda

Email: denda@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/denda

Project Abstract: Built on the latest in flapping flight research, the patent-pending technology at the core of this project has been shown to produce efficiencies higher than the best wind turbines on the market.

How? Recently, scientists discovered that birds use advanced flapping aerodynamics to move through the air up to 5 times more efficiently that man-made aircraft. The goal of this project is to use these recently discovered 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. They will have access to CAD models of working prototypes that have been previously built and tested, and they will also have access to proprietary MATLAB programs which can predict efficiency before building the device.

Project Goals: Design of Bio-Inspired Flapping Wing Energy Harvester

Project Envisioned Outcomes: Design of Bio-Inspired Flapping Wing Energy Harvester

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., vaccum 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:

Require hands on mechanical experience

ME PROJECT 11

Virtual Reality Cycling for Patient Rehabilitation

Advisor: Prof. German Drazer

Email: german.drazer@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/gd247

Project Abstract: This project will integrate mechanical engineering and rehabilitation science. We want to design the next generation of the VRACK (virtual reality cycling kit) system. It will contain sensorized pedals, handlebars and a heart rate monitor that are interfaced with a virtual environment. The objective is to create an inexpensive integrated solution that is tailored for persons who have had a stroke and would use it in rehabilitation. For this project we collaborate with J. Deutsch, a professor of physical therapy in the Department of Rehabilitation & Movement Sciences at Rutgers.

Project Goals: Design and manufacture a pedal that can be integrated into any bike

Project Envisioned Outcomes: A fully functional prototype to test in rehabilitation bicycles

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., vaccum 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	☑				

ME PROJECT 12

Automated Gantry System for Individualized Production

Advisor: Prof. Xi Gu

Email: xg107@soe.rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/xg107

Project Abstract: Development of an Automated Gantry System for Individualized Production

Project Goals: 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 different items requested by individual users (by controlling the speed of movement, etc.)

Project Envisioned Outcomes: A built gantry system with control.

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., vaccum 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	☑				

ME PROJECT 13

Solar Energy Harvesting or Water Desalination Device

Advisor: Prof. Zhixiong Guo

Email: zguo@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/zguo

Project Abstract: The amount of solar irradiation on earth's surface is gigantic, but most of which remains unutilized while we keep depleting traditional fossil fuels. Photovoltaic (PV) or solar cells convert light energy into electricity. The yearly installation capacity of solar photovoltaic facilities has seen a continuous significant increase worldwide in recent years. Solar energy is also used for natural illumination and water and space heating. 97% of the water on the Earth is salt water. Water scarcity is among the major problems to be faced by human beings. Solar desalination is a technique to desalinate water using solar energy.

In this project, you could bring in some "wild" ideas to harvest or use solar power. For example, you may consider harvest solar energy for illumination and water heating via a smart window, build a small solar cell power generator, or design a solar desalination device. The objective of this project is to design, build, and analyze a device for solar energy harvesting or water desalination for engineering practice of natural renewable resources.

Project Goals: The objective of this project is to design, build, and analyze a device for solar energy harvesting or water desalination for engineering practice of natural renewable resources.

Project Envisioned Outcomes: Device built.

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., vaccum 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	☑				

ME PROJECT 14

Hybrid Manufacturing of Customized Knee Implant

Advisor: Prof. Yuebin Guo

Email: yuebin.guo@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/yg387

Project Abstract: Hybrid Manufacturing of Customized Knee Implant.

Project Goals: Leveraging coursework knowledge to design, manufacturing, and testing of a product for customer needs.

Project Envisioned Outcomes: Functional Prototype.

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., vaccum 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				☑	

ME PROJECT 15

Low Cost Ventilators for COVID-19 Patients

Advisor: Prof. Yuebin Guo

Email: yuebin.guo@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/yg387

Project Abstract: Design and Manufacturing of Low Cost Ventilators for COVID-19 Patients.

Project Goals: Leveraging coursework knowledge to design, manufacturing, and testing of a product for customer needs

Project Envisioned Outcomes: Functional Prototype.

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., vaccum 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			☑		

ME PROJECT 16

Wind Energy System to Store and Employ Energy

Advisor: Prof. Yogesh Jaluria

Email: jaluria@soe.rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/jaluria

Project Abstract: Use of wind energy to raise water to a height of 1 m and store remaking energy

Project Goals: Develop wind energy system to store and employ energy for a practical use

Project Envisioned Outcomes: Direct use like irrigation, plus storage as electricity or water available at given height.

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., vaccum 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	☑				

ME PROJECT 17

Hybrid Solar And Wind Energy for a Practical Use Plus Storage

Advisor: Prof. Yogesh Jaluria

Email: jaluria@soe.rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/jaluria

Project Abstract: Use of hybrid solar and wind energy for a practical use plus storage

Project Goals: Develop and test the designed system

Project Envisioned Outcomes: Fabricate and test the system and the design

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., vaccum 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	☑				

ME PROJECT 18

Table Top Subsonic Wind Tunnel I

Advisor: Prof. Doyle Knight

Email: doyleknight@gmail.com

WebEx Meeting Place: https://rutgers.webex.com/meet/ddknight

Project Abstract: The project is the design, fabrication and demonstration of a table top subsonic wind tunnel measuring the lift and drag on an airfoil, air velocity, temperature and pressure.

Project Goals: Completion and demonstration of the table top subsonic wind tunnel.

Project Envisioned Outcomes: Demonstration of ability to design, manufacture and validate table top subsonic wind tunnel.

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., vaccum 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	☑				

ME PROJECT 19

Ceramic 3D Printing

Advisor: Prof. Howon Lee

Email: howon.lee@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/hl586

Project Abstract: Ceramic 3D printing

Project Goals: Development of a ceramic 3D printer

Project Envisioned Outcomes: students are expected to build a 3D printer that can handle viscous slurry materials using a mechanical spreader.

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., vaccum 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	☑				

ME PROJECT 20

3D Printing with a Recycled Material

Advisor: Prof. Howon Lee

Email: howon.lee@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/hl586

Project Abstract: 3D printing with a recycled material

Project Goals: Development of a filament extruder

Project Envisioned Outcomes: students are expected to build an extruder that produces 3D printing filament using plastic bottles

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., vaccum 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	☑				

ME PROJECT 21

Color-Based Sorter

Advisor: Prof. Hao Lin

Email: hlin@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/hlin

Project Abstract: Students will design, manufacture, and implement a color-based sorter. Examples include sorting colorful subjects such as lego pieces and M&M chocolate beans. The objects will be serialized and then each color detected when the pass through a tube or conveyor belt. Based on the color detection they will be sorted into single color groups using a downstream sorting mechanism.

Project Goals: To build a color-vision-based mechanical sorter

Project Envisioned Outcomes: A color-vision-based mechanical sorter

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., vaccum 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:

Require control of motors and other components through arduino

ME PROJECT 22

3D Printer Capable of Printing Elastomeric Composites

Advisor: Prof. Jennifer Lynch-Branzoi

Email: jklynch@soe.rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/jklynch

Project Abstract: 3D printing is used to quickly fabricate prototypes. With the development of new materials, including polymeric nanocomposites, 3D printing is a good choice to easily fabricate parts from these novel feedstocks and perform materials characterization. However, high concentration of nanoparticles in a polymer matrix nanocomposite can cause difficulties when using a 3D printer. The aims of this project are to develop and build a 3D printer capable of printing elastomeric composites with a high concentration of nanoparticles and characterize printed novel elastomeric composites, as well as the elastomer alone as a control.

Project Goals: The project goals are to (1) develop and build a 3D printer capable of printing elastomeric composites with a high concentration of nanoparticles, (2) enable accessories to be used with the printer including a spot heater to aid curing and a thermal imager to monitor curing, and (3) characterize these printed novel elastomeric composites, as well as the elastomer alone as a control.

Project Envisioned Outcomes: The primary outcome of this project will be a functioning 3D printer enabling printing of novel polymeric nanocomposites with in situ monitoring of the curing process, which will aid in materials optimization for a specific application and prototyping.

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., vaccum 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:

Use Excel or Origin for data analysis

A similar project can be found at http://3dprintingfromscratch.com/common/how-to-build-a-3d-printer-from-scratch/

ME PROJECT 23

3D Printer for Thermoplastics, Thermosets, Conductive and Metallic Materials

Advisor: Prof. Rajiv Malhotra

Email: rajiv.malhotra@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/rm1306

Project Abstract: The project involves the integration of lasers and other light sources with an in-development 3D printer for printing thermoplastics, thermosets, conductive and metallic materials within the same process. A setup has been developed in past projects for this process. This particular project will involve integration of a fiber-laser with this setup to enable laser processing of these materials as well.

Project Goals: The project involves the integration of lasers and other light sources with an in-development 3D printer for printing thermoplastics, thermosets, conductive and metallic materials within the same process.

Project Envisioned Outcomes: Integration of lasers and other light sources with an in-development 3D printer for printing thermoplastics, thermosets, conductive and metallic materials within the same process.

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., vaccum 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					

ME PROJECT 24

Detachable Propulsion Unit for Surfboards of Varying Size I

Advisor: Prof. Aaron Mazzeo

Email: aaron.mazzeo@rutgers.edu

WebEx Meeting Place: by schedule

Project Abstract: Surfing requires a high level of fitness to paddle with sufficient speed and power to catch green waves as they break. For beginning and intermediate surfers, paddling with sufficient speed can be challenging and lead to difficulty in popping up to catch waves and develop skills. This project will focus on the design and manufacture of a detachable propulsion unit that can fit on the underside of surfboards of varying size. The goal is not to create a fast-traveling vehicle but provide enough power in a portable, lightweight attachment to allow surfers to catch waves automatically based on the measured paddling rate of the surfer's arms. Future applications may include systems that assist lifeguards in rescue of drowning surfers.

Project Goals: Create a safe and lightweight system for hydraulic propulsion. Create a control system that uses wireless accelerometers mounted on the upper arm to determine when to power the propulsion system. Collect information from the surfer to then aid in customized instruction.

Project Envisioned Outcomes: Detachable propulsion system. Control system with wireless accelerometers; Data science to aid beginning surfers and help them learn to surf more quickly; Low-cost prototype that we can think about marketing.

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., vaccum 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:

Two teams -- one focusing on propulsion; one focusing on the accelerometers.

ME PROJECT 25

Detachable Propulsion Unit for Surfboards of Varying Size II

Advisor: Prof. Aaron Mazzeo

Email: aaron.mazzeo@rutgers.edu

WebEx Meeting Place: by schedule

Project Abstract: Surfing requires a high level of fitness to paddle with sufficient speed and power to catch green waves as they break. For beginning and intermediate surfers, paddling with sufficient speed can be challenging and lead to difficulty in popping up to catch waves and develop skills. This project will focus on the design and manufacture of a detachable propulsion unit that can fit on the underside of surfboards of varying size. The goal is not to create a fast-traveling vehicle but provide enough power in a portable, lightweight attachment to allow surfers to catch waves automatically based on the measured paddling rate of the surfer's arms. Future applications may include systems that assist lifeguards in rescue of drowning surfers.

Project Goals: Create a safe and lightweight system for hydraulic propulsion. Create a control system that uses wireless accelerometers mounted on the upper arm to determine when to power the propulsion system. Collect information from the surfer to then aid in customized instruction.

Project Envisioned Outcomes: Detachable propulsion system. Control system with wireless accelerometers; Data science to aid beginning surfers and help them learn to surf more quickly; Low-cost prototype that we can think about marketing.

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., vaccum 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:

Two teams -- one focusing on propulsion; one focusing on the accelerometers.

ME PROJECT 26

Optical Torque Measurement System

Advisor: Prof. Michael Muller

Email: muller555@gmail.com

WebEx Meeting Place: https://rutgers.webex.com/meet/mullerm

Project Abstract: develop an optical torque measurement system for motor efficiency determination

Project Goals: develop an optical torque measurement system for motor efficiency determination

Project Envisioned Outcomes: develop an optical torque measurement system for motor efficiency determination

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., vaccum 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	☑				

ME PROJECT 27

Dynamic Vibration Absorber

Advisor: Prof. Andrew Norris

Email: norris@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/norris

Project Abstract: Dynamic Vibration Absorber: Elimination of unwanted vibration is a major challenge in many mechanical and aerospace systems, such as large electric turbines in power plants, or for accurate motion control in robots. The project will develop a simple but powerful dynamic vibration absorber (DVA) that significantly reduces machine vibration. The DVA design will focus on is a spring mass system which operates at frequencies close to the primary system (or machine) resonance. The project will combine analysis, design, fabrication and testing of an important mechanical engineering application.

Project Goals: The goal of the project is the analysis, design, and fabrication of a bench-top system that demonstrates the principle of a single degree of freedom dynamic absorber. The project team will learn how to analyze a two degree of freedom machine plus DVA, design the mechanical components and electronic controls, and fabricate and test a robust working system.

Project Envisioned Outcomes: The end product is a robust device that can serve as an educational tool for future MAE students. It can be used by undergraduates to apply and understand vibration control theory to minimize machine vibration. In the process the project team members will learn about the important mechanical engineering field of vibration absorption.

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., vaccum 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:

Require class experience for some team members at least: 650:401, 650:443

Links to similar projects:

https://www.youtube.com/watch?v=2_TjQoyV5RE
https://www.youtube.com/watch?v=x5BMlPe_mQY
https://www.youtube.com/watch?v=KxEJ0xkLO7g

ME PROJECT 28

Drill Press Conversion Kit to CNC Mill

Advisor: Prof. Assimina Pelegri

Email: pelegri@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/pelegri

Project Abstract: This purpose of this project is converting a drill press to a 2.5 axis CNC mill.

Project Goals: Students will research and design a cross slide vise fitted with computer numerically controlled stepper motors utilizing open-source G—code driving software (i.e. GERBL, LINUX CNC, etc), as well as an easy replacement of the Morse taper/Jacob Chuck with a collet holder to allow for torsional motion. The cross-slide vise and replacement collet holder would then be attached to the already existing drill press to create a totally new more accurate machine capable of doing more complex machining.

Project Envisioned Outcomes:

1. Significantly reduced cost barrier to entry of CNC milled prototypes for small businesses
2. No need for outsourcing small prototyping projects
3. Accessible/Affordable novice machining equipment

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., vaccum 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	☑				

ME PROJECT 29

Go-Baby-Go Adaptable Harness/Switch Systems/Steering/Transmission Systems for International Use

Advisor: Prof. Assimina Pelegri

Email: pelegri@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/pelegri

Project Abstract: Go Baby Go's genius is that it merges "off the shelf" technology with some simple adaptations which can allow a child who is not able to walk the opportunity to independently move around their environment. There are no commercially available devices for children with mobility issues to get around on their own; and power wheelchairs cost thousands of dollars (average price is 20,000) and usually aren't an option until a child is over 3-years of age (a typical child walks at 1- meaning that kids might lose 2 years of skills). The modified cars provide them independence at a much younger age and at a relatively low cost. One of the most beautiful things about the Go Baby Go initiative is that there are no restrictions on duplication or inventing better ways for us to pair technology with affordability and adaptability.

Project Goals: The intention of using cars in the US is for one child (and although the cars are oftentimes recycled between families). In an orphanage more than one child will need to use the car and therapists can use these cars in therapy but not unless they can easily adapt them for different needs.

1. We need greater flexibility harness with a harness systems that can be easily fabricated in different countries around the world with 'off the shelf' components.
2. The switch everyone uses is a challenge to find internationally (and if you can find it, it is much more expensive-in the US 65.00 is not exorbitant but it is in other countries). We need to figure out a way to make this switch with all of the required features for less money.
3. Modified steering? The steering is unmodified, meaning there is almost no steering for those with upper body impairments; they can only lean on the wheel and "go" switch. Need a more versatile motion "joystick".
4. There is no progressive speed control. It's on-off only, leading to jerky behavior that is frightening to many kids. Reverse gear is also not accessible to many mobility-limited kids. Need alternate smoother forward and reverse transmission.

Project Envisioned Outcomes: Develop an adaptable harness and switch for expanding the Go-Baby-Go products internationally with designs that follow the below principles:

1. Off the shelf (meaning anyone can access materials to modify these cars)
2. Affordability (no child is asked to pay for a car)
3. Anyone can be taught to build & put together a car (build guides)
4. Share all information! Build guides, techniques, etc.

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., vaccum 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:

Links to similar projects:
https://health.oregonstate.edu/gobabygo
https://www.ablenetinc.com/big-red
https://www.adaptivedesign.org/

ME PROJECT 30

Steam-Generating Solar Collector System

Advisor: Prof. Todd Rossi

Email: todd.m.rossi@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/tr406

Project Abstract: The goal of this project is to improve the design steam-generating solar collector system.

More information at: https://drive.google.com/open?id=1iINCCkA_6jezU-hnI5K0s6dVrjA34xdC

Project Goals: Project goals are to lower manufacturing cost for high performance non-concentrating solar thermal collectors, simplify installation for large arrays, reduce parasitic power requirements, and provide passive protection against stagnation

Project Envisioned Outcomes: Improved design steam-generating solar collector system

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., vaccum 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	☑				

ME PROJECT 31

Blue Energy from the Sea

Advisor: Prof. Jerry Shan

Email: jshan@soe.rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/jshan

Project Abstract: Blue Energy from the Sea: We have recently developed novel ion-selective membranes that generate electricity from simply mixing water with different salt concentrations, such as those available at river estuaries, from desalination brine and grey waste water, or even within the human body. In this project, students will design, fabricate, and test a small-scale osmotic-power generator that can power small electronics using the new membranes, together with salt and fresh water.

Project Goals: Design, fabricate, and demonstrate a small-scale osmotic-power generator that can power small electronics using the new membranes, together with salt and fresh water. Test system performance to find how much power can be produced, and for how long given a certain amount of fresh and salt water.

Project Envisioned Outcomes: Working device powering small electronics, test data on system performance, conceptual design for scaled-up osmotic-power generator.

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., vaccum 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	☑				

ME PROJECT 32

Electrostatic Spray Automotive Scratch Eliminator

Advisor: Prof. Jonathan Singer

Email: jonathan.singer@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/js2176

Project Abstract: Repair to automotive paints can be a pricey process that is not always necessary. If a scratch goes all the way to the metal of the car, however, it can lead to damaging and costly corrosion. This project aims to develop a method of repair and sprayer based on high voltage electrostatic sprays that only targets the regions of a scratch that are metal-deep and protects those regions from corrosion. Students will also investigate means to prepare the scratched area for the maximum effect and durability. Analysis will involve mechanical, optical, and aging testing.

Project Goals: Repair scratches in automotive paints.

Project Envisioned Outcomes: A sprayer and method for repairing scratches in automotive paints.

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., vaccum 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		☑			

ME PROJECT 33

Equine Simulator

Advisor: Prof. Stephen Tse

Email: sdytse@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/sdytse

Project Abstract: Equine simulator for learning to ride and transition between different gaits.

Project Goals: Based on an equine simulator prototype constructed last year, the students will modify the apparatus to support a person up to 150 lbs, along with adding controls for the rider to switch gaits (walk, trot, canter, and gallop). Moreover, active sensors will be incorporated to change movements to stabilize the rider and prevent falling, as needed.

Project Envisioned Outcomes: If possible, jumping motion will be added to the controlled movement.

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., vaccum 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	☑				

ME PROJECT 34

Single-Step-Climber Add-On Device for Wheel Chairs and Scooters

Advisor: Prof. Stephen Tse

Email: sdytse@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/sdytse

Project Abstract: ADA compliance has made accessibility to facilities greatly enhanced, more so than ever before, for those in need. However, although a building may have a ramp, a single step (un-noticed by those who can walk freely) somewhere in the route can be the bottle-neck for a person in a wheelchair to enter or exit the building. Even a single curb on a sidewalk path may prevent a person on a scooter from reaching their destination.

Project Goals: For this project, the students will design and build a compact device that can be retrofitted to an existing wheelchair or scooter than can allow it to climb up or down a single step. There are massive and expensive devices to climb stairs, but this device does not need to address that scale of hindrance.

Project Envisioned Outcomes: This invention will address a common unmet (and often overlooked) need, i.e., overcoming a single-step obstacle, which can be as insurmountable as a flight of stairs, for those who are independent but wheelchair/scooter-bound, significantly improving quality of life.

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., vaccum 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	☑				

ME PROJECT 35

Autonomously Navigating Robotic Service Delivery System

Advisor: Prof. Jingang Yi

Email: jgyi@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/jgyi

Project Abstract: Autonomously Navigating Robotic Service Delivery System

Project Goals: The goal of this project is to design and develop a fully functional robot that self-navigates through restaurants or hospitals. The robot will be equipped with necessary sensors and navigational components to ensure that the food or medicine reaches its destination safely. This fast and organized delivery system would minimize the hassle for the customer and the employee.

Project Envisioned Outcomes: Design, prototyping and extensive functionality testing and demonstration

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., vaccum 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:

Require Programming in C/C++

ME PROJECT 36

Smart Machine for the Production of Biogas and Fertilizer

Advisor: Prof. Qingze Zou

Email: qzzou@rutgers.edu

WebEx Meeting Place: https://rutgers.webex.com/meet/qzzou

Project Abstract: 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 biogas and 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 biogas and fertilizer that can be directly used as energy resource and applied in urban agriculture, respectively, is not only very environmentally, but also economically beneficial. In this project, you are asked to build upon the outcome of the previous year's group, to improve their design and construction, and then build, and test a prototype machine that can automatically sort the organic waste, break them into small pieces, and convert them into biogas and fertilizer through fermentation process. 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.

Project Goals: Create a one-of-its-kind smart machine that produces both biogas and fertilizer from urban organic waste (e.g., vegetable, fruit left-out, and food leftover from cafeteria and restaurants).

Project Envisioned Outcomes: The students will improve the design and construction from the previous year's group work, build, and test the prototype machine to achieve the following functions: (1). Automatically sort the organic waste, break them into small pieces for fermentation; (2). Collect the biogas into a container, and automatically collect and move the residual materials as fertilizer; (3). Provide necessary safety and monitor functions using electrical sensors, micro-controller (e.g., arduino) and wireless communication.

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., vaccum 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	☑				