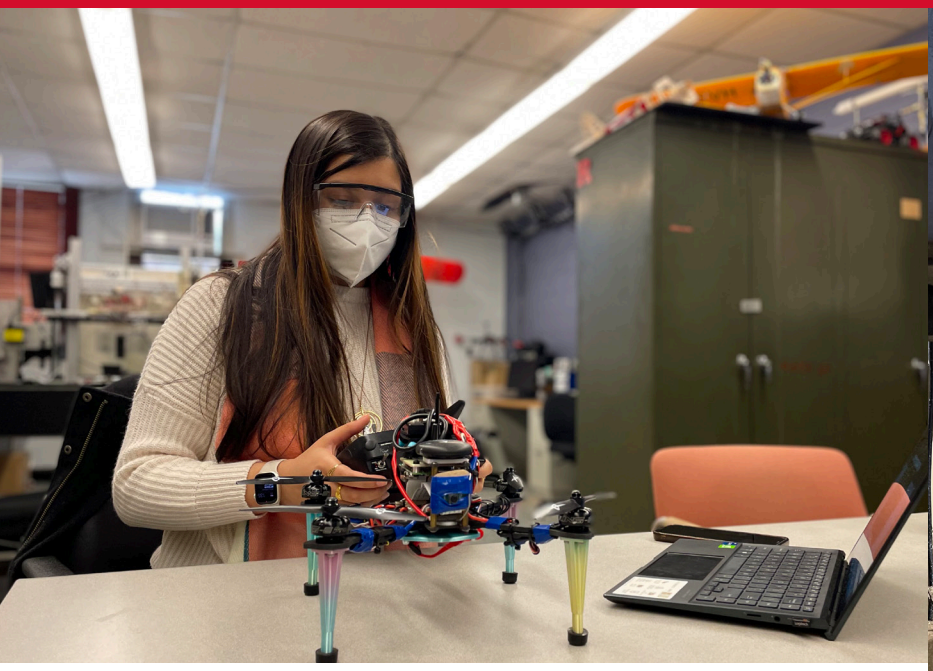
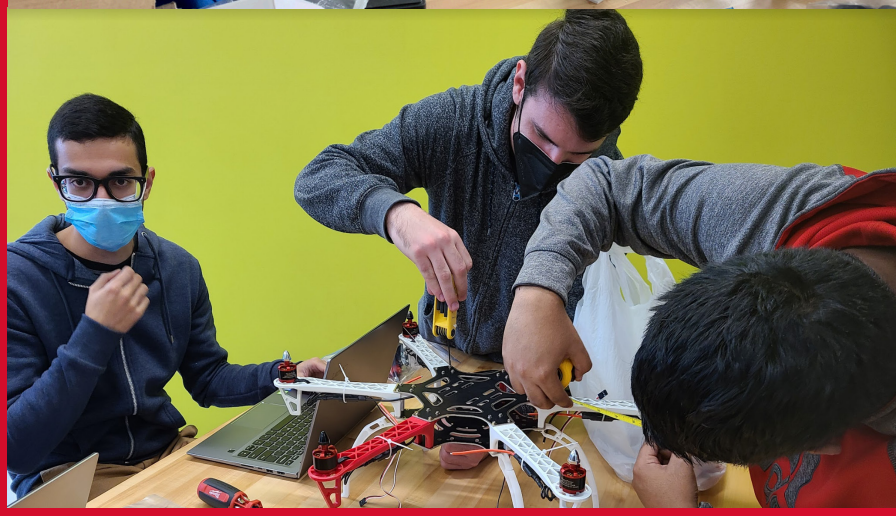


Mechanical and Aerospace Engineering
2022 Design and Manufacturing Expo
May 5, 2022

RUTGERS
School of Engineering

RUTGERS
Mechanical and Aerospace Engineering

Course Coordinators	Prof. Xi Gu Prof. Assimina A. Pelegri
Teaching Assistants	Mr. Mohit Agarwal Mr. Hang Zhang
Design Specialists	Dr. Basily Basily Mr. Milan Simonovic
Seminar Speakers	*Dr. Jerry Shan Rutgers MAE* *Mr. Milan Simonovic Rutgers MAE* *Dr. Merrill Edmonds Rutgers MAE, Siemens* *Dr. Richard Dool Rutgers School of Communication and Information* *Dr. Mukesh M. Patel Rutgers Business School*



NOTE FROM THE CHAIR

We are very excited that we are returning to campus for the 2022 Design and Manufacturing Expo after two years of virtual events! During this year's Expo, more than 40 groups will present their exciting projects, guided by our faculty. In addition, this event is a unique opportunity for our students to showcase their talent, innovation, ingenuity, teamwork, and engagement.

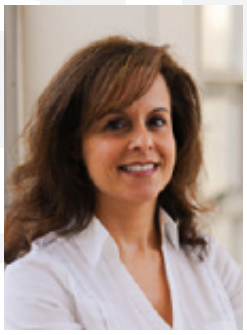
The Mechanical and Aerospace Engineering Department is a vibrant academic community offering three undergraduate degrees in Mechanical Engineering, Aerospace Engineering, and Applied Science (Packaging Engineering concentration). In addition, the Department offers graduate/advanced programs leading to M.S., M.Eng., and Ph.D. degrees.

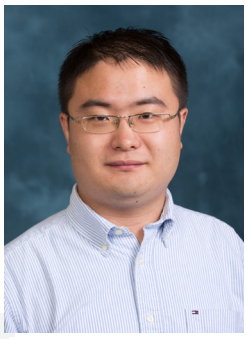
Our 35+ full-time faculty members educate more than 750 undergraduate and 160 graduate students. Our community of students, faculty, alumni, and industry partners is devoted to collaborative work at the highest standards of research and innovation. Our faculty member is dedicated to helping our students achieve success and become problem solvers and innovators. Students have access to a wide range of classes that train them in the core principles of mechanical and aerospace engineering. In addition, they can participate in research projects as undergraduates, allowing them to gain experience in real-world applications comparable to research conducted by industry. Our faculty has achieved distinction among their peers and as fellows of professional engineering societies, including the American Society of Mechanical Engineers (ASME), American Physical Society (APS), Acoustical Society of America (ASA), and the American Academy of Mechanics (AAM). Our Department has an exciting and multidisciplinary research portfolio, which includes advancing scientific knowledge and technology in various areas, including nanostructures, autonomous robotics, electro-hydrodynamics, fluid interactions, energy science, and advanced materials, among many others.

We are grateful to all judges for their sustained commitment and participation in this event and our external Advisory Board for its dedicated support through the planning and execution. Thanks to all the faculty advisors, including Prof. Assimina Pelegri and Prof. Xi Gu, for leading and coordinating the entire Senior Project Experience. To our staff, particularly Dr. Basily Basily and Mr. Milan Simonovic, for their technical advice in reviewing designs and manufacturing project components.

To our students, we are very proud of your efforts and accomplishments! We wish you a successful and rewarding career. Stay in touch!

Alberto Cuitiño, Ph.D.
Professor and Chair
Department of Mechanical and Aerospace Engineering





NOTE FROM THE COORDINATORS

Dear students, parents, and friends,

We would like to take this opportunity to welcome you to the Mechanical and Aerospace Engineering Department at Rutgers! In the following pages, you will find the Senior Design projects for AY 2021-22. During these projects, students have the opportunity to work with industry and faculty advisors, gaining experience in real-world engineering. Many of these projects can lead to new technologies or other innovations outside of academia, and they help our students transition to life after graduation.

To our seniors, we celebrate your accomplishments and appreciate your efforts. Despite the challenges of Covid 19, your class achieved record numbers in engaging in professional and educational development activities, including internships and co-Ops, JJ Slade fellowships, and undergraduate research opportunities. You are now at the finishing line, ready to explore the many "tomorrows" to come. Many of you will continue your education in the BS/MS program at Rutgers or pursue higher degrees at other institutions, and many of you, at the time of this letter, have secured jobs. We are very proud of you and what you have accomplished under these difficult circumstances. We know that this was not easy for many of you, but again you raised to the occasion, and you showed how innovative, entrepreneur, and resourceful our young MAE engineers are. Use the inspiration and ingenuity you exhibited in your classes to propel you in the next chapters of your lives!

We would also like to express our gratitude to the course teaching assistants, Mr. Hang Zhang and Mr. Mohit Agarwal, whose hard work and dedication made senior design experience possible.

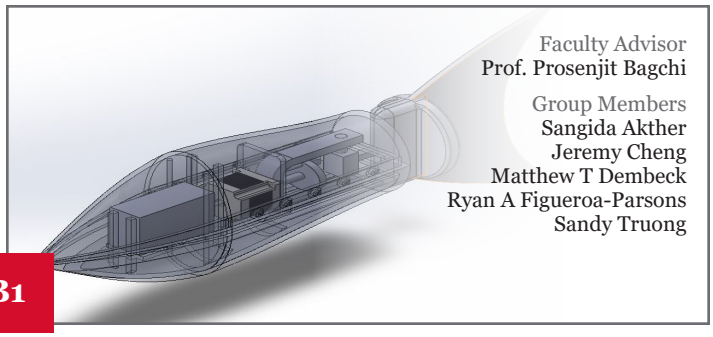
This brochure is a record of your achievements! Congratulations, Class of 2022!

Assimina A. Pelegri, Ph.D.
Professor and Associate Chair
Dept. of Mechanical & Aerospace Engineering

Xi Gu, Ph.D.
Assistant Teaching Professor
Dept. of Mechanical & Aerospace Engineering

DESIGN AND MANUFACTURING PROJECTS

MECHANICAL FISH



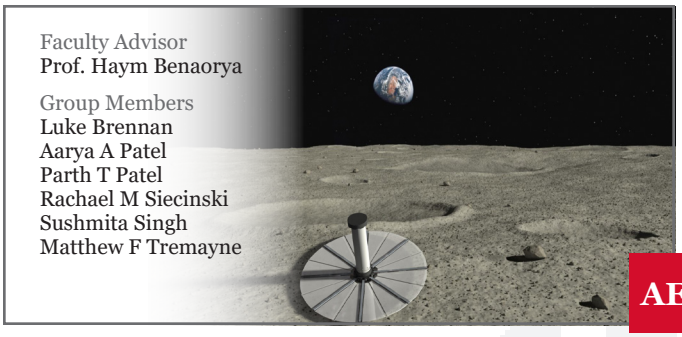
Faculty Advisor
Prof. Prosenjit Bagchi

Group Members
Sangida Akther
Jeremy Cheng
Matthew T Dembeck
Ryan A Figueroa-Parsons
Sandy Truong

B1

A submersible robot, capable of moving itself forward and turning through water via fish-like tail undulations, allowing for covert movement deep underwater to advance exploration and promote a greater understanding of the marine world.

INFLATABLE LUNAR HABITAT



Faculty Advisor
Prof. Haym Benaorya

Group Members
Luke Brennan
Aarya A Patel
Parth T Patel
Rachael M Siecinski
Sushmita Singh
Matthew F Tremayne

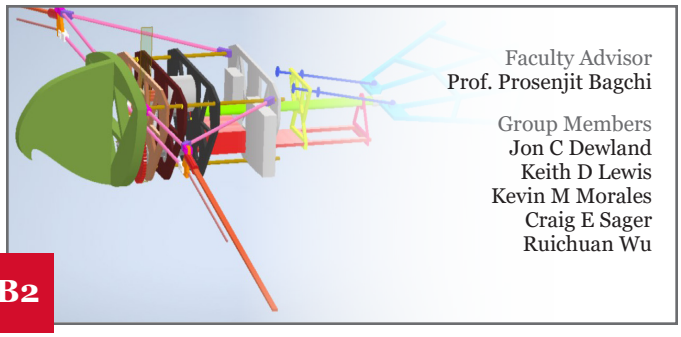
AEROSPACE DESIGN PROJECT

AE B4

Our project focuses on demonstrating an inflatable lunar habitat proof-of-concept originating from the hybrid lunar inflatable structure approach by creating a scaled down prototype of said structure from scratch.

MECHANICAL BIRD

AEROSPACE DESIGN PROJECT



Faculty Advisor
Prof. Prosenjit Bagchi

Group Members
Jon C Dewland
Keith D Lewis
Kevin M Morales
Craig E Sager
Ruichuan Wu

AE B2

The design and manufacturing of a mechanical bird capable of producing lift to fly, mimicking real life designs of birds.

DESIGN AND TESTING OF A DRONE TO CONDUCT ZERO-G EXPERIMENTS

Faculty Advisor
Prof. Onur Bilgen

Group Members
Aditya A Anikode
Ali Z Hamza
Tiffany K Kensah
Brenda R Noriega
Prutha N Patel
Allison J Scarinci

AEROSPACE DESIGN PROJECT

AE B5

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

UAV SYSTEM WITH CO_2 DETECTION

AEROSPACE DESIGN PROJECT

Faculty Advisor
Prof. Xiaoli Bai

Group Members
Rahul M Bhatt
Anthony J Mazzilli
Kai Nissimov
Donny Putra
Gurjinder Singh
Jameson A Woodell

AE B3

An autonomous drone equipped with CO_2 sensor, Pixhawk controller, Raspberry Pi and LiDAR sensor that can collect and transmit CO_2 levels from a desired route to parent computer.

MULTI-MODE HYBRID DRONE DELIVERY SYSTEM

Faculty Advisor
Prof. Onur Bilgen

Group Members
Jessica G Carvalho
Aditya Dabas
Dov Z Frommer
Renée Ghosh
Pooja A Gupta
Brijesh G Mangrolia
Anusha Nagar

AEROSPACE DESIGN PROJECT

AE B6

An autonomous multi-UAV delivery system using a fixed-wing airplane carrying a quadcopter over long distances. On arrival the quadcopter undocks, drops off the payload, and re-docks, allowing the system to continue its journey without landing.

DESIGN AND MANUFACTURING PROJECTS

AIRCRAFT STABILITY AND CONTROL DERIVATIVES

AEROSPACE DESIGN PROJECT

Faculty Advisor
Prof. Haim Baruh

Group Members
Anthony J Autera
Jeffrey C Bandara
Matthew A Mariner
Michael G Philip

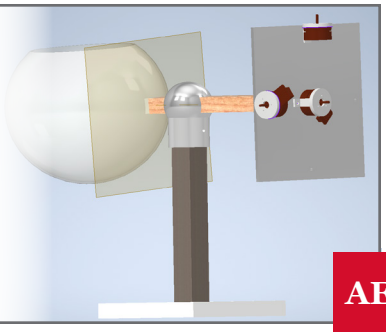
AE B7

This project determines the stability and control characteristics of an aircraft using on-board motion sensors to create mathematical models. Thus, the resulting motion will be related to the corresponding deflection of control surfaces.

SATELLITE TESTBED FOR ZERO-G FLIGHT

Faculty Advisor
Prof. Laurent Burlion

Group Members
Samantha L Carey
Ryan Chen
Connie Liou
Lisa T Vu

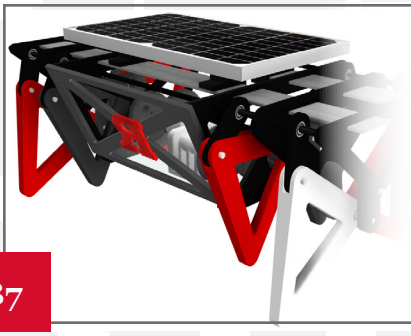


AEROSPACE DESIGN PROJECT

AE BB

Many modern spacecraft rely on large propellant tanks whose fluid dynamics greatly affect the spacecraft dynamics. Our team is developing an active slosh controls test bench using to characterize and stabilize a sloshing fluid motion.

SOLAR POWERED TERRAIN WALKER



Faculty Advisor
Prof. William Bottega

Group Members
Ase W Awari
Isaac S Berroa
Adam T Columbia
Matthew G Nugent
Trevor Shin
David J Stein

B7

Custom-built, remote-controlled, table-top sized terrain walker fully powered by solar panels, designed to quickly navigate various terrain without wheels while carrying a small payload.

DESIGN OF A BIOMECHANICAL HAND

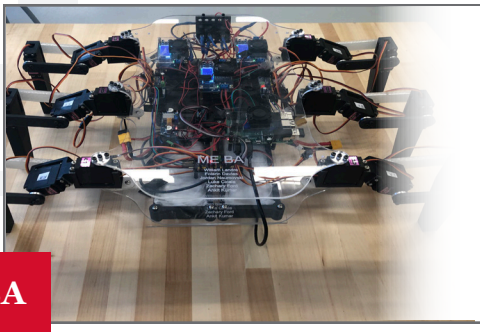
Faculty Advisor
Prof. Kimberly Cook Chennault

Group Members
Jack P Goodall
Yaxin Mo
Emma E Nichols
James W Randolph

C3

The design and manufacturing of an electro-mechanical, silicon prosthetic hand using soft robotic techniques. The focus will be on the mechanical functions of a human hand by incorporating movement through Arduino board programming.

SOLAR POWERED TERRAIN WALKER



Faculty Advisor
Prof. William Bottega

Group Members
Luke P Cicala
Folarin A Davies
Zachary J Ford
Ankit Kumar
William C Landre
Jordan F Naumovski

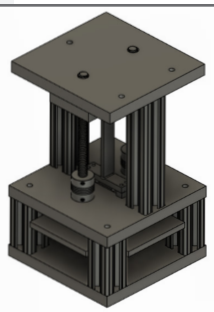
BA

A 6-legged solar-powered robotic crawler that can traverse rugged terrain and carry an 8 oz. payload using an ABS structure, a solar panel, servos, servo drivers, buck converters, LiPo batteries, and a Raspberry Pi.

NON-DESTRUCTIVE MATERIALS TESTING DEVICE

Faculty Advisor
Prof. Alberto Cuitiño

Group Members
Ethan J Hurilla
Mohammad A Khan
Kyle Y Kuhl
Michael A Peck
Boyan Lazarov
Jonathan H Williams



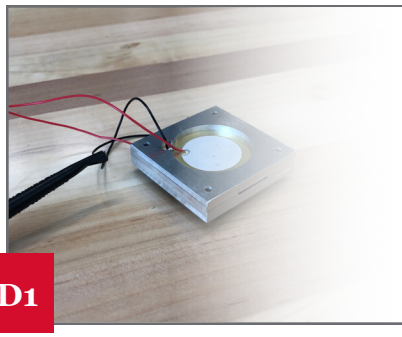
C4

The non-destructive material identification device will be able to electronically determine the type of material using the displacement under a given load.

DESIGN AND MANUFACTURING PROJECTS

SYNTHETIC JET ACTUATOR

AEROSPACE DESIGN PROJECT



Faculty Advisor
Prof. Edward DeMauro

Group Members
Jose A Jimenez
Said Koubane
Artur P Kurdusiewicz
Deep Patel
Michael L Wallin

AE D1

A synthetic jet actuator is a device that can be used to enhance the performance of an airfoil at high angles of attack when flow separation is a concern.

BIO INSPIRED FLAPPING WING ENERGY HARVESTER

Faculty Advisor
Prof. Mitsunori Denda

Group Members
Vevikanand S Deonarine
Donald W Grabinksy
David M Tran
Cole Woloszyn

D3

This energy harvester simulates a flapping motion via a symmetrical airfoil that is guided by a linear rail and coupled to a flywheel via a crank-shaft. This spins a generator that charges a battery.

STRATO

AEROSPACE DESIGN PROJECT

Faculty Advisor
Prof. Edward DeMauro

Group Members
Jean P Alvarez
Frederick A Diaz
Michael E Ferrell
Daulton J James
Connor J Magee
Roy Mauricio Monge Hidalgo
Bertrand T Smith

AE D2

In partnership with NASA, our project endeavors to bridge the gap between lab research and the commercialization of synthetic jets by creating a modular model and driving circuit for testing system-level integration, robustness, and reliability.

HEXACOPTER DRONE WITH MECHANICAL CLAW

Faculty Advisor
Prof. Francisco Diez Garias

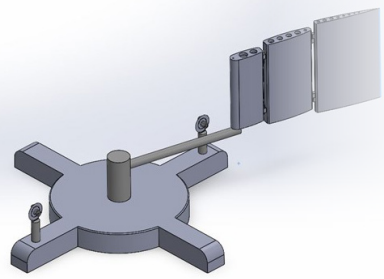
Group Members
Thomas J D'Auria
Mangesh V Nadkarni
Nelson M Ngai
Rohit G Rajeev
Nicolo V Spinelli
Sebastian Toledo
Andy W Yang

AEROSPACE DESIGN PROJECT

AE D4

A hexacopter has a mechanical claw system with the purpose of picking up and delivering medical supplies. The drone features a servo motor-driven 3D printed mechanical claw to clamp down on supply packages.

FLAPPING WING ENERGY HARVESTER



Faculty Advisor
Prof. Mitsunori Denda

Group Members
Ashwin Baskaran
Vaibhav Gupta
Justin D Holgado
Kaif Z Mahajan
James W Mehrtens
Neil D Patel

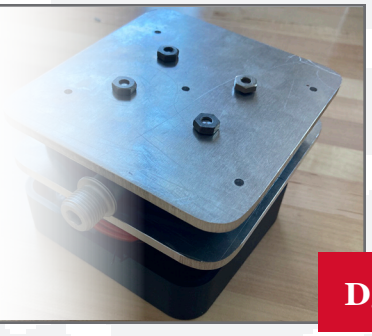
D2

Our objective is to design and construct a wind energy harvester considering the newly discovered advanced flapping wing aerodynamics that birds use to move the air five times more efficiently than man-made applications.

VRACK

Faculty Advisor
Prof. German Drazer

Group Members
Melanie J Alpert
Connor M Devosa
Michael Guzman
Kelsey J McLennan
Charm O Nicholas
Timothy H Tchou



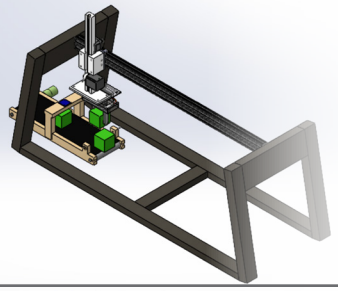
D5

A bike pedal designed to aid in rehabilitating stroke patients that measures applied force. Victims of stroke suffer lack of mobility in one side of their body and stationary bikes are frequently used in rehabilitation.

DESIGN AND MANUFACTURING PROJECTS

AUTOMATED GANTRY FOR FRAGILE OBJECTS

G1



Faculty Advisor
Prof. Xi Gu

Group Members
Dhruv Chawla
Juan G Jaramillo Barnuevo
Sahith Nagireddy
Rutvik S Parikh
Manav Vaghasiya

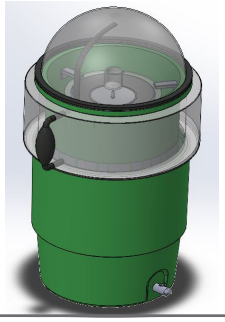
Tabletop automated gantry system using Arduino sensors and motors to move fragile objects within an assembly line in a XZ coordinate system.

DESALINATION DEVICE

G4

Faculty Advisor
Prof. Zhixiong Guo

Group Members
Chelsea V Cheng
Ryan S Halloran
Alice N Krauze
Christine Vu
Stepan Zybin



This device is designed to evaporate the salt water using the sunlight that will be concentrated on an aluminum heat chamber in order to yield clean, drinkable water.

HYBRID MANUFACTURING OF CUSTOMIZED KNEE IMPLANT

G2

Faculty Advisor
Prof. Yuebin Guo

Group Members
Ryan J Andrews
Cristian J Contreras
Riley W Meskill
Jonathan C Perino
Parker T Scott

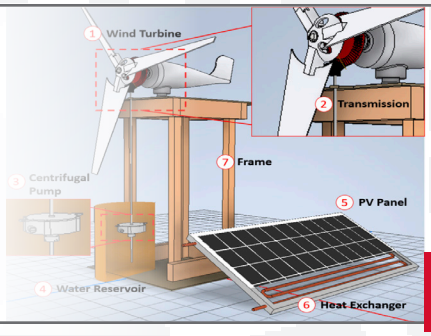
The original design, manufacturing, and analysis of a customizable knee implant. This project uses 3-dimensional design software, 3-dimensional printing in metal and polymer materials, machining of parts, and analysis software for product stress testing.

HYBRID WIND AND SOLAR ENERGY HARVESTER

J1

Faculty Advisor
Prof. Yogesh Jaluria

Group Members
Wai-Jian Chia
Gabriel J DeMarco
Saifeldeen S Khalil
Panayiotis Kousoulas
Srinath R Menon
Evan A Williams



This hybrid system utilizes a wind turbine and a photovoltaic panel to generate electricity. A wind-powered pump cycles water through a heat exchanger which cools the PV panel and generates hot water for use.

SOLAR PLANE

G3

Faculty Advisor
Prof. Zhixiong Guo

Group Members
Oluwaloba D Jacob
Austin M Lampitt
Aamir Mansuri
Waleed B Syed Faizi

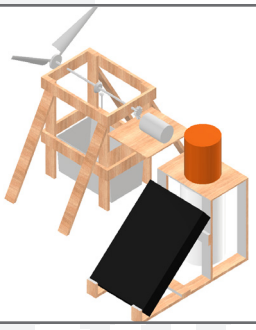
Solar powered aircraft intended for long range or indefinite flight depending on flight conditions. Allows for long mission time flights ideal for surveillance and cinematography.

WIND AND SOLAR POWERED WATER HEATER AND FILTRATION SYSTEM

J2

Faculty Advisor
Prof. Yogesh Jaluria

Group Members
Christopher D Gorka
Ahmad Nadeem
Mariam Y Refai
John J Wiech
Nicole Zelaya



Water filtration and heating system is powered by solar and wind energy. The wind energy pumps the water and generates electricity for the control system. The solar energy is used to heat up the water.

DESIGN AND MANUFACTURING PROJECTS

AEROSPACE DESIGN PROJECT

TABLETOP SUBSONIC WIND TUNNEL

Faculty Advisor
Prof. Doyle D. Knight

Group Members
Cody D Conroy
Owen D Kunzle
Daniel P Pursell
Leonard C Rowley
Asjad I Shaikh

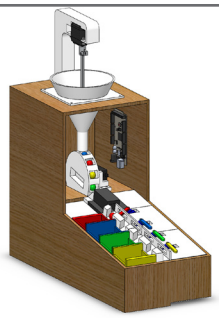
AE K1

The project objective is to design and manufacture a subsonic wind tunnel small enough to fit on a tabletop. It must provide various measurements, including air velocity, aerodynamic lift, and aerodynamic drag.

TABLETOP COLOR BASED SORTER

Faculty Advisor
Prof. Hao Lin

Group Members
Joseph D Breslin
Daniel A Conforti
Siddarth Kanoongo
Niyati T Patel
Soham N Shah



L2

The tabletop color based sorter uses a color sensor to detect a small sphere that passes through a funnel and wheel. Servo motors are used to push objects into their respective receptacles.

TABLETOP SUBSONIC WIND TUNNEL

Faculty Advisor
Prof. Doyle D. Knight

Group Members
Catherine C Biava
Ronan A Laaouina
Kevin Lin
Justin M Liu
Vraj Mantora
Christian T Martin

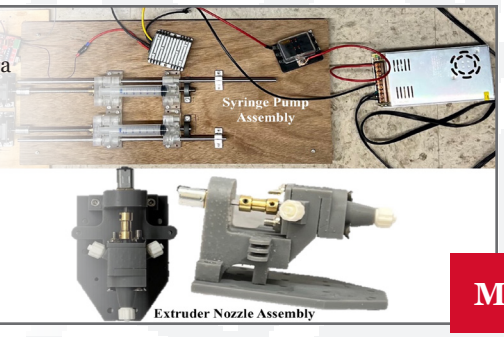
K1

Our project is a wind tunnel that will be affordable and accessible for students to use in future aerospace engineering labs.

3D PRINTER FOR THERMOPLASTIC MATERIALS

Faculty Advisor
Prof. Rajiv Malhotra

Group Members
Badder Hussein
Dhairy K Patel
Yash B Patel
Ishan P Shah



M1

Creating a 3D Printer that can efficiently print thermosets using a DIW (Direct In Writing) approach on a heated platform using a free flow nozzle and curing through frontal polymerization.

PHYSICAL INFORMATION PROCESSOR [PIP]

Faculty Advisor
Prof. Hao Lin

Group Members
Joseph Erreich
Evan D Krause
Gleb Orlov
Seth A Seely

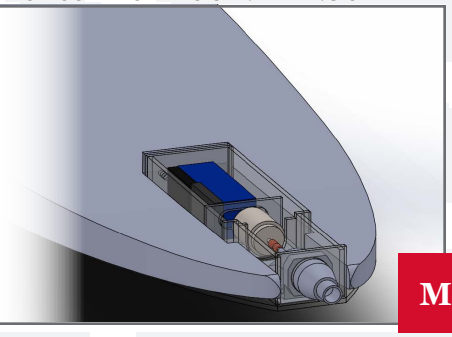
L1

The physical information processor modularly sorts a random mass of objects by color. Objects are linearized into a single stream using a vibratory bowl feeder and then color-sorted using a sensor to activate motorized gates.

PROPULSION UNIT FOR SURFBOARDS OF VARYING SIZE

Faculty Advisor
Prof. Aaron Mazzeo

Group Members
Samieh A Abdul-Raziq
Thomas P Bruckman
Jiapeng Ding
Gennaro A Gencarelli
Max W Kuhlman
Allen Nathaniel T Lim

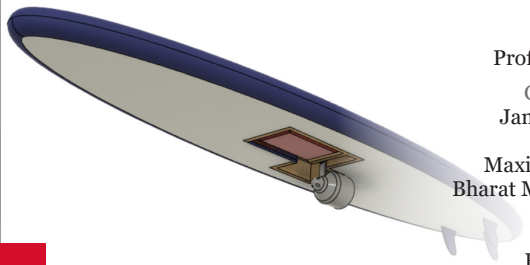


M2

Customized surfboard equipped with a water jet thruster that is controlled by the user. This would assist those who struggle with catching waves by providing them with an initial boost of thrust.

DESIGN AND MANUFACTURING PROJECTS

RETRACTABLE SURFBOARD PROPULSION UNIT



Faculty Advisor
Prof. Aaron Mazzeo

Group Members
James H Branagan
Roy B Brown
Maxim Z Chmigelski
Bharat M Gianchandani
Salman Haider
Eric C Knauss
Elijah E Somrah
Michael D Zacieracha

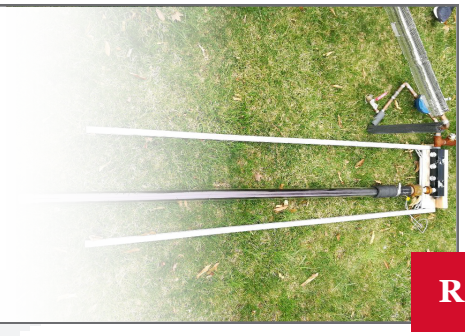
M3

A retractable motor integrated into the underside of a surfboard, meant to propel surfers through the water to any waves they want to catch, saving them the time and energy of paddling.

VACUUM TUBE SOLAR STEAM GENERATOR

Faculty Advisor
Prof. Todd Rossi

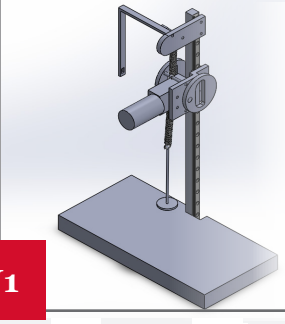
Group Members
Sushrut Awasarmol
Samuel V Breslau
Peter N Bui
Xingqi Che
Thomas Chen
Kevin Szymborski



R1

We are designing a machine that can generate steam from water and solar energy, have it at a constant pressure and then condense it back to water.

DYNAMIC VIBRATION ABSORBER



Faculty Advisor
Prof. Andrew Norris

Group Members
Javier E Ramirez
Azhar Safa
Russell T Soto
Gafar O Tajudeen

N1

Dynamic vibration absorber is a theoretical project on how a secondary mass dampener can absorb unwanted vibrational energy from an inital mass to create an efficient system.

MECHANICAL DEVICE FOR TRANSDERMAL DRUG & GENE DELIVERY

Faculty Advisor
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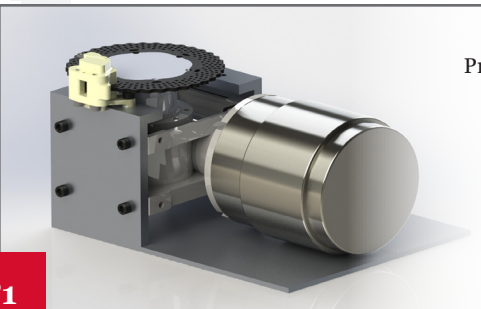
Brian T Nodine
Sean P O'Reardon
Mitchell J Ortega

S1

This device stretches skin and measures its displacement and the force applied to aid in the rearch of transdermal drug delivery.

RFR BRAKE DYNAMOMETER



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Gregory Scatko
Asaad I Shaikh

P1

The brake dynamometer is designed to measure the coefficient of friction of different brake pad materials. This permits the independent validation of manufacturer's specifications and the ability to compare braking performance for various applications.

GECKO-INSPIRED WALL CLIMBING ROBOT

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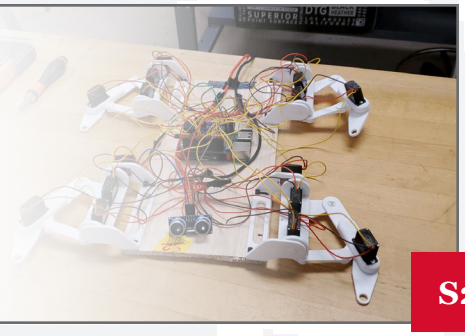
Luke W Eidle
Aadil Mahmood
Agam J Modasiya
William S Rice

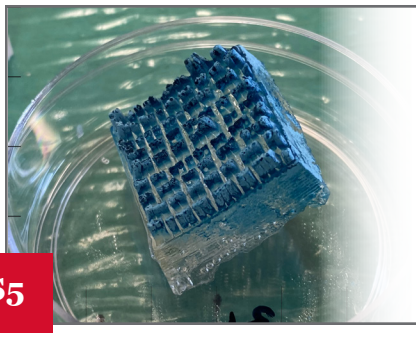


S2

This gecko-inspired robot is capable of climbing walls using an adhesive footpad. It's main purpose is using attachable sensors to replace human workers in the inspection industry.

DESIGN AND MANUFACTURING PROJECTS

GECKO-LIKE FOOT PAD



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Catherine J Nachtigal

S5

Inspired by the hierarchical structure of a gecko's foot, this project uses molding and electrospray deposition techniques to develop micro- and nanostructures, respectively, on a gelatin pad to enhance its adhesive properties for robotic applications.

HIGH STRENGTH, LIGHT WEIGHT SPHERICAL PRESSURE VESSEL WITH FIBER- REINFORCED COMPOSITES

AEROSPACE DESIGN PROJECT

Faculty Advisor
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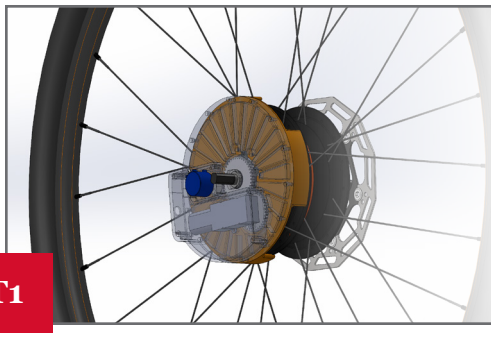
Lihao Feng
Zhuocheng Han
Kinza Iqbal
Hao Wu
Keming Yan

AE W1

A spherical pressure vessel was constructed using carbon fiber filaments and epoxy resin. The epoxy resin is applied to a spherical mold and carbon fiber filaments are wound around the sphere and cured with air.

AUTONOMOUS BIKE SHIFTING



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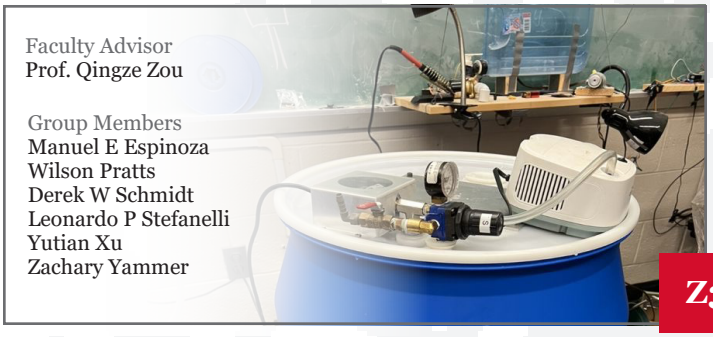
Dylan T Fallows
Ralph D Ricciardi
Yash Sanghvi
Xiaohan Xu

T1

A bicycle equipped with mechanics, electronics, and a control system programmed to allow a rear CVT hub to shift to an optimal value without any user input similar to an automatic transmission.

A SMART FERTILIZER MACHINE FOR URBAN ORGANIC WASTE RECYCLING



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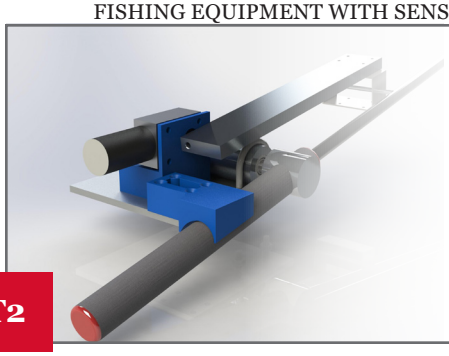
Wilson Pratts
Derek W Schmidt
Leonardo P Stefanelli
Yutian Xu
Zachary Yammer

Z3

Smart machine to convert organic waste into usable energy in the form of biogas and fertilizer. The project also aims to automate this process lessening user interaction and shortening expected time to compost food waste.

FISHING EQUIPMENT WITH SENSORY FEEDBACK



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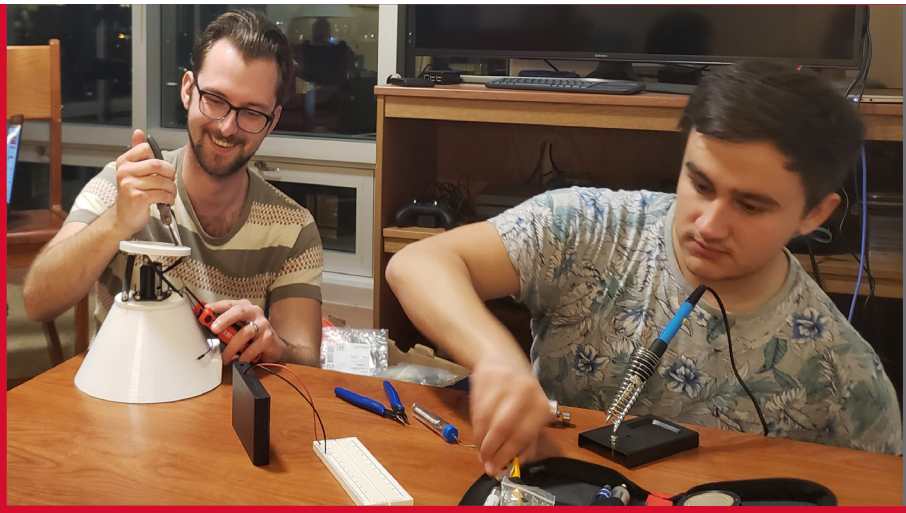
Gerard S Wietecha

T2

A haptic fishing system allowing people with physical disabilities to have a fulfilling and satisfying endeavor by developing a mechanism to lower the physical requirements while also providing sensory feedback to the user.



Cover Photos:
(All group members listed left to right, top to bottom)

Front top left: Anusha Nagar
Front bottom left: Tiffany Kensah, Brenda Noriega, Prutha Patel
Front right: Asaad Shaikh
Front inside top: Trevor Shin, Matthew Nugent
Front inside bottom: Mangesh Nadkarni, Thomas D'Auria, Sebastian Toledo
Back inside top left: Connor Devosa
Back inside top right: Alice Krauze
Back inside middle left: Wai-Jian Chia, Saifeldeen Khalil
Back inside middle right: Roy Mauricio Monge Hidalgo, Daulton James
Back inside bottom: Seth Seely, Gleb Orlov
Back: Darien Sajewski, Gerard Wietecha, Sean Doran

Mechanical & Aerospace Engineering at Rutgers

The Department of Mechanical Engineering at Rutgers was founded in 1908 with a focus on driving the country's industrial growth. Aerospace Engineering was added in 1965 as a certificate program with a full degree program established in 2015. It is now the only Aerospace Engineering degree offered among New Jersey's public universities. The Department is a vibrant academic community offering three undergraduate degrees in Mechanical Engineering, Aerospace Engineering, and Applied Science (Packaging Engineering concentration). The Department has state of the art laboratories used for research leading to M.S., M.Eng., and Ph.D. degrees. Undergraduate and graduate students participate in cutting edge research funded by federal and state agencies, and industrial partners. With more than 35 full-time faculty members, the Mechanical and Aerospace Engineering Department educates more than 750 undergraduate students and more than 160 graduate students. Excellence in both research and teaching is the top priority for our faculty.

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