



2022 NEWSLETTER

THE
DESIGN LAB
at Rensselaer



Rensselaer

School of Engineering



designlab.rpi.edu



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A Message from the Director



Kathryn A. Dannemann, Ph.D.

*Director, O.T. Swanson Multidisciplinary Design Laboratory
Professor of Practice, Materials Engineering*

Greetings from the Design Lab at Rensselaer! I am happy to share our latest happenings with you, the Design Lab alumni/alumnae, current and past sponsors, friends, and colleagues. Several recent design projects are showcased, and demonstrate how Capstone students are changing the world, even during these unsettled times. A new robotic cell with dedicated capabilities for Design Lab projects is also highlighted, and allows student teams to tackle automation and smart manufacturing projects.

The Design Lab team is thrilled to return to “normal” operations this semester following pandemic disruptions. We welcomed several new project partners (Norsk Titanium, Western Digital, Texas Instruments, MVP Healthcare, JBT Corporation, Freudenberg-NOK and others), as well as long-time industry sponsors (e.g., Corning, Boeing). Design challenges in new application areas are providing students with learning opportunities ranging from smart manufacturing, digital dormitories and augmented reality to low cost solar thermal power and electrification of agricultural vehicles. Students, faculty, and staff are enjoying regular in-person sessions in the Design Lab – for Multidisciplinary Capstone Design (seniors), and Introduction to Engineering Design (sophomores) courses. Face-to-face interaction, and the opportunity for hands-on experience and prototype fabrication, is especially exciting to seniors whose lab experiences have been limited due to COVID constraints during their time at RPI.

A sincere thank you to the entire Design Lab team for transitioning the hands-on Capstone course to fully remote, and then hybrid mode, with alacrity. Navigation through the Capstone course during COVID was possible due to the dedication and tireless contributions of each member of the Design Lab team. Students gained new appreciation for the benefits of web-based project management for carrying out complex engineering projects, and communication tools for virtual collaboration.

We are excited by new design challenges that will provide students with project-based learning opportunities that utilize advanced and emergent technologies, as well as heightened interest from new project partners. New design challenges are always of interest! If you would like to engage a student Capstone team to address some of your organization’s technical needs and interests, please reach out to me at DesignLabDirector@rpi.edu. Project ideas can also be submitted directly on the Design Lab website designlab.rpi.edu via the appropriate link in the Sponsorship menu.



Design Lab Team (L to R): Junichi Kanai – Associate Director and Prof. of Electrical, Computer and Systems Engineering, Mark Anderson, Brad DeBoer and Aren Paster – Senior Project Engineers, Kathryn Dannemann – Director and Prof. of Practice Materials Engineering, Scott Yerbury – Electromechanical Technician, Sam Chiappone – Director of Manufacturing Innovation, Valerie Masterson – Administrative Specialist

IN CASE YOU MISSED IT...

Scott Miller Retires



Scott Miller '74, '75G, a Project Engineer and esteemed member of the Design Lab team, retired in May 2020 following 13 years of dedicated service. The team honored him in a virtual retirement gathering (via Webex).

More than 1000 Capstone students have benefited from Scott's guidance, and his diverse technical capabilities and broad engineering expertise. He advised 145 different project teams, including projects with industry, campus research centers and service-learning projects with local community organizations. Although we miss Scott's expertise, and humor, we are happy that he has supported some project teams as a mentor and reviewer since his retirement.

Robert O. Swanson '58 – In Memoriam



Honorary Trustee Robert O. Swanson '58, passed away on Aug. 18, 2021, at the age of 84. Mr. Swanson and his wife Cynthia Shevlin are loyal supporters of Rensselaer, having provided generous scholarship support to women and minority students in engineering and science.

They were also major benefactors in the establishment of the O.T. Swanson Multidisciplinary Design Laboratory, which opened in Fall 2000. The Lab was named in memory of his late father, O.T. Swanson, who was passionate about education.

Mr. Swanson was a retired executive vice president and director of Mobil Corporation and Mobil Oil Corporation. He had responsibility for Mobil's businesses in the Asia/Pacific region, Africa, and the Middle East, as well as for Mobil's chemical and technology endeavors. He was a member of the Mobil Oil and Corporation Boards and Executive Committees.

He earned his bachelor's degree in chemical engineering from Rensselaer and joined Mobil as a process engineer shortly thereafter. Mr. Swanson was an active member of the Rensselaer Board of Trustees from 1997 to 2001 and served as an adjunct trustee from 2001 to 2011.

**DESIGN LAB CELEBRATES 22 YEARS
COLLABORATING WITH INDUSTRY**

ALUMNI SPOTLIGHT



Daniel Nathan, ME '21
*Development Engineer,
Honda Performance Development*

Daniel participated in the Capstone course during Spring'21 and joined Honda Performance Development (HPD) in Santa Clarita, CA following graduation. HPD is the technical operations center for Honda's American motorsports programs. At HPD, Daniel plans and executes tests for engine durability and performance and analyzes and reports on the results to feed back into the design process. He is directly responsible for the execution, as well as the safety of the engine. Daniel took a risk and gambled on applying the experience and skills he gained and developed at RPI through classes, clubs, and Capstone to live out his personal dream to be involved in motorsport. He shared his excitement: "Being surrounded by technology that is truly cutting edge and being a part of the tight knit family developing it is what keeps me coming back for more. It is incredibly rewarding to go to the track and see the cars winning and hear positive feedback from the teams and drivers and know that I was involved in that success. I couldn't be happier!"

Daniel uses the skills he learned in Capstone every day. He summarized that "Capstone emphasizes a rigorous design process predicated on loops of needs analysis, concept generation, estimation, simulation, validation, documentation, and a continuing cycle of small improvements. Although it exists in a relatively short timeline, it exposes you to every step in this process while allowing you to learn the reason for each step." Originally from Seattle, Daniel enjoys exploring LA and farmer's markets with his girlfriend, hiking with friends, riding his dirt bike, playing with a 1969 MGB GT in his garage and pots and pans in his kitchen, as well as learning new things.



Elise Druehl, EE '22
Commission Engineer, First Energy

Elise completed her Capstone project experience in Spring'22. She is on a rotational engineering program with First Energy. Her first assignment is as a commission engineer in Greensburg, PA, driving distance from her hometown of Bethesda, MD. In this role, she helps to commission new equipment and test if the equipment is functioning properly. Elise has always been interested in renewable energy and chose this opportunity, which includes four rotations within the company, to understand our current grid setup, how the industry works and how new policies will impact the grid system. The most exciting part of her work is being in the field getting to understand the design and solving problems as they arise.

She shared that her Capstone experience "allowed me to feel more comfortable jumping into a new project I may not fully understand". Other useful Capstone skills that Elise is applying in the technical workplace include working with a diverse team on different aspects of a project, project and time management skills, as well as being proactive and asking questions. Her advice to Capstone students is: "Use your professors. They are there to help you and want you to succeed." In her newfound spare time, Elise enjoys reading and hiking.

RECENT PROJECTS

Service-Learning Project Aids Children with Disabilities

Double H Ranch is a camp in Lake Luzerne that provides specialized programs and support for children and families dealing with life-threatening illnesses and physical disabilities. Co-founded in 1993 by philanthropist Charles R. Wood and actor Paul Newman, its purpose is to enrich the lives of the children they serve and provide camp experiences that are memorable, exciting, fun, physically safe and medically sound. Their Adaptive Ropes course utilizes a specialized chair to support campers and to contain any needed medical equipment. A belay system is the primary safety feature and allows these children to experience a zip line and giant swing ropes courses at the camp.

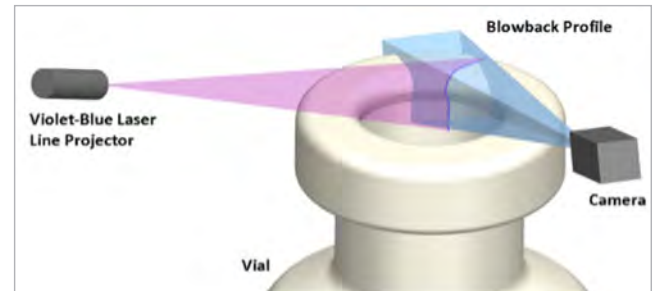
Chris Pezzulo, Assistant Camp Director at Double H, contacted the Design Lab with a technical challenge for Capstone students: develop a new or modified Adaptive Ropes chair to accommodate campers of various sizes and their associated medical equipment. This will allow them to participate safely in this empowering activity. The current chair has size limitations, lacks head and leg support and is uncomfortable. Several Capstone student teams worked to improve the functionality of the Adaptive Ropes chair. The chair developed during this multi-semester design project is more comfortable, supportive, adjustable for different sized children, and supports attachments for each camper's medical equipment (e.g., oxygen tanks, ventilators). The new chair will be paired with a carriage, also designed by a Capstone team, that can transport both child and chair between ride areas. The carriage provides a safe and easy way for the staff to move the child while still secured within the chair.

The students applied finite element analysis to investigate strength and functionality of the conceptual design. Subsequent physical testing verified that the calculated results produced a safe system for use. In addition to enhancing their design skills, the students also learned about human factors engineering. Ray Walsh, MD, a volunteer physician at the camp and Medical Advisory Board member remarked, "Your students are terrific. Their enthusiasm for this project and the effort they put into it was obvious. The students' attention to the details that were outlined for them and recognition of the challenges we face with these children was impressive." The new chair and carriage will be implemented by Double H Ranch for the Summer 23 camp session.



Specialized chair, currently used for the Adaptive Ropes Course at Double H Ranch, supports campers and their medical equipment. Photo courtesy of Chris Pezzulo, Double H Ranch.

New Measurement Technology for Vaccine Vials



Conceptualization for online blowback measurement

Corning, Inc. is a longtime Design Lab partner, having sponsored numerous design projects for Capstone student teams to solve real challenges for various Corning businesses. Topics have ranged from gesture recognition to robotics and human-machine interfacing. Corning recently opened a new pharmaceutical vial manufacturing factory in North Carolina in response to market demand for pharmaceutical vials, including those used for COVID vaccines. They challenged a student team to develop an inspection technology that can measure the depth and location of blowback in vaccine vials during the manufacturing process. Another objective was the ability to deploy or adapt the technology to a production machine.

A blowback (BB) is an internal groove or undercut in the glass vial used to retain a rubber stopper. It is introduced into the vial geometry during processing; blowback dimensions are critical to its function. Currently, the BB contour is measured after removal from the production line with advanced process controls work, blind to BB depth and uniformity. This project provided Capstone students an opportunity to contribute to adaptation of a measurement technique to the production line.

During the Spring 2022 semester, a multidisciplinary team of nine students investigated the process used to create the blowback and researched existing measurement methods for glass production. They developed a novel method for online measurement of critical product features of the vial. Using lasers, custom fixturing, and an advanced software algorithm, the student team demonstrated a non-contact measurement approach that can function at the production throughput rate. The system uses feature extraction and 3D reconstruction to measure the blowback contour at the micrometer scale. The team also developed a test rig and environment to test the sensing method, generated synthetic data and performed analysis using computer vision. This technique will be further developed by Corning and will allow for real-time insight to any manufacturing issues, and dramatically reduce waste due to nonconforming parts. Dr. Jared Aaldenberg, a Senior Scientist at Corning who interfaced with the team, commented: "I was really impressed with how well the team delivered on this project, both in theoretical design and in practical demonstration of a proof of concept."

RECENT PROJECTS

Capstone Students Test The Waters

As the effects of climate change intensify, understanding and mitigating the impacts of human activity on fresh water are more important than ever. The Jefferson Project at Lake George, a collaboration between Rensselaer Polytechnic Institute, IBM Research, and The Lake George Association, takes a sophisticated technological approach to these efforts. One ongoing aspect of the project has been continuously monitoring water quality throughout the lake.

To monitor water quality, scientists measure conditions at various depths in a single location, known as the “water column.” Taking these readings is a labor-intensive process, requiring researchers to lower and raise a sensor pod manually through the water column, pausing at predetermined intervals to take and record readings. The sensor pods and software currently used are expensive and proprietary, making it challenging to develop and deploy new sensor technology.

Professor Shayla Sawyer (Electrical, Computer, and Systems Engineering) and Jefferson Project Biologist Brian Mattes partnered with the Design Lab at Rensselaer to help address these issues. During the 2021-2022 academic year, two multidisciplinary student teams composed of students from several departments in the School of Engineering designed, built, and tested a new sensor system with guidance from Brad DeBoer, Senior Academic Support Engineer, and Design Lab Director Kathryn Dannemann '80, '82G as project advisors.

“This technology will vastly improve the data collection during our surveys,” said Mattes. “One of our goals at the Jefferson Project is to strive for more and higher quality data than ever before, and this will help facilitate that. We are always looking for novel ways to reduce human error, and the Design Lab is helping us achieve that goal.”

The sensor pod that the student teams developed combines commercially available and custom-designed components to measure temperature, pressure (depth), dissolved oxygen, and conductivity (salinity). It can also be expanded to incorporate new sensors as needed. The pod is lowered and raised via a communications tether and an electronically modified crab pot puller that allows users to adjust descent speed based on specific measurement needs.

The system is controlled by a weather-resistant single-board computer and touchscreen display with a student-developed graphical user interface (GUI) that enables researchers to enter key control parameters. The control system displays and records data in real time, eliminating the potential for human tabulation error. It also alerts the user with visual and audible alarms if readings drift outside of normal ranges.



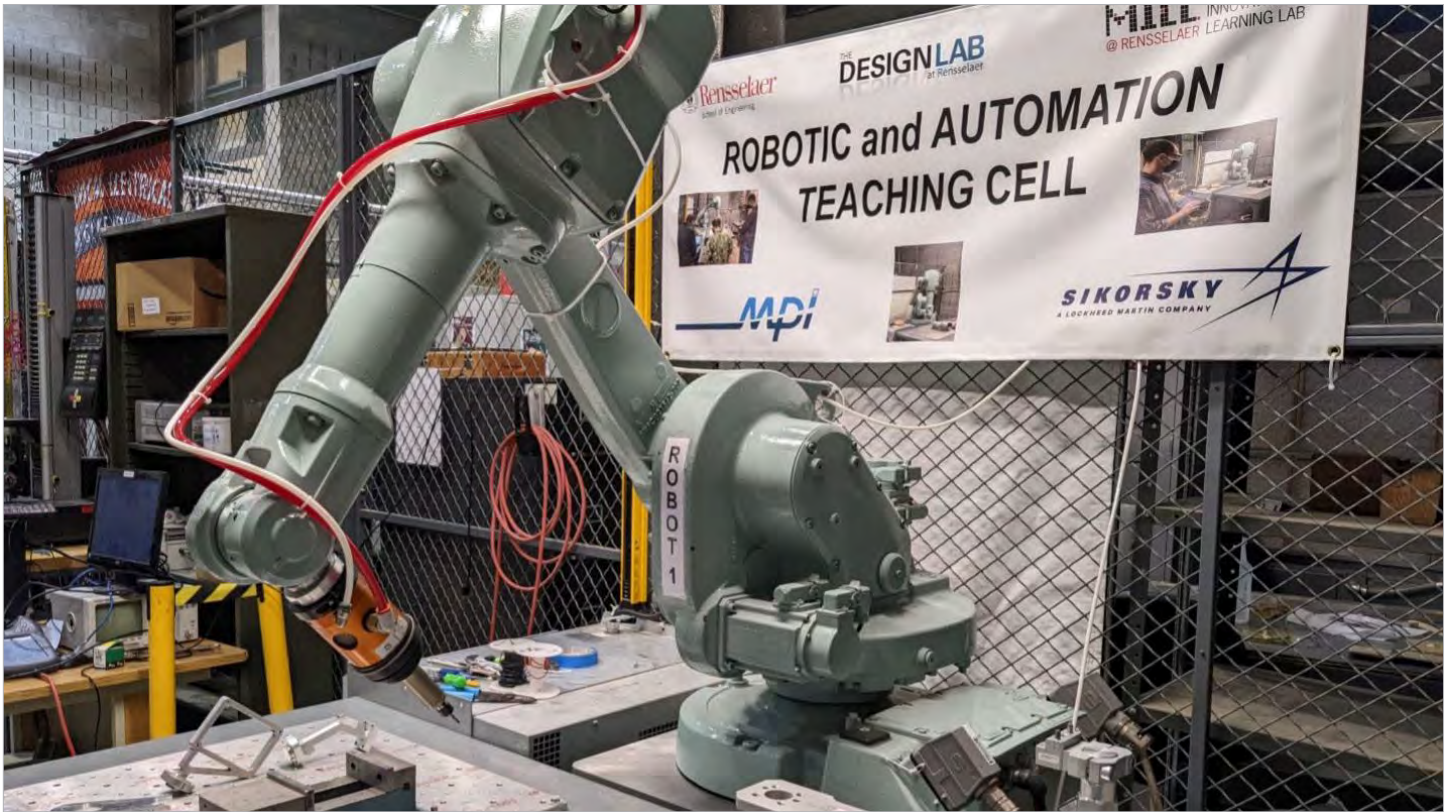
Brian Mattes, Jefferson Project Biologist, takes measurements at Lake George with the current Water Column System



Chris Nieves ME'22 and Danny Baudisch ME'22 work on the sonde and the deployment system in the Design Lab

“My work on the water column sensor was a wonderful experience,” said August Gehrman '22, a member of the fall 2021 team. “It allowed me to understand the practical application of engineering theory to real-world projects.”

This semester, a third capstone team is completing assembly and integration work, conducting initial testing, and refining the GUI before transferring the system to the Jefferson Project for field testing.



New Robotic Cell in the Design Lab

RECENT NEWS

New Robotic Cell Expands Design Lab Capabilities

The Design Lab at Rensselaer has recently expanded its capabilities with the addition of a robotic work cell to support student design projects. The robotic work cell was made possible through the generosity of Sikorsky Aircraft Corporation, a Lockheed Martin Company, and MPI Systems. MPI donated the robot equipment. Funds from Sikorsky Aircraft enabled construction of the cell and outfitting the robot for use by student project teams. Design, layout, and installation of the robotic cell was conducted by RPI staff from the Design Lab and the Manufacturing Innovation Learning Laboratory (MILL).

The new robotic cell adds to existing Design Lab fabrication facilities and provides state-of-the-art capabilities for senior engineering students to address design challenges in robotics and automation. The cell consists of an ABB six-axis robot arm with 5 kg payload and 1.5 m working radius. An optional remote seventh axis can provide additional flexibility in accessing difficult geometry with end-of-arm tooling. A two-station worktable and end-of-arm tool changer enables multiple Capstone project teams to utilize the robot without significant changeover. The robot cell includes digital and analog input/output systems for controlling tooling and fixtures. Compressed air and vacuum systems enable use of pneumatic actuators and suction cups for pick-and-place systems. To ensure student safety, the cell is equipped with occupancy-detection systems. Advanced software for offline robot programming and simulation allows development and visualization of robot programs before implementing them on the cell.

Sikorsky also provided a real-world design challenge for students in the Multidisciplinary Capstone Design Course. Several Capstone project teams have worked to help Sikorsky address a current challenge in their manufacturing operations. The overall goal is to automate a time-intensive fine machining process to reduce the need for highly trained manufacturing technicians and associated repetitive motion injuries. To date, four student teams have contributed to two separate projects focused on the vision/algorithm and machining aspects of the project and demonstrated proof-of-concept solutions. A fall '22 team is integrating these to demonstrate a cohesive overall solution. When complete, the automated process will utilize a vision system and student-developed algorithms to identify specific geometric features of a part, compare the locations of the features to a baseline, nominal CAD model, and generate a part-specific tool path to machine desired features. The findings will be utilized by Sikorsky to develop a production-ready system.

Ryan Patry '00, '08G, a Lockheed Martin Technical Fellow, shared these comments following his participation in the Final Design Reviews in May. "It was a great experience to be on campus as a sponsor to see first-hand the robotic capabilities available to the student teams. The interactions with the teams were essential to the successful execution of the problem statement. The students at RPI have brought novel solutions to a problem that has been challenging to our industry."

Student Awards: Multidisciplinary Capstone Design Course

The Design Lab instituted Capstone awards in 2018 to recognize both individual students and teams. Individual awards are presented to students for outstanding achievements on their Capstone projects. Team awards recognize the entire team for specific accomplishments. Congratulations to awardees and all Capstone design students for their hard work and team efforts in advancing their projects.

Fall 2022 – Individual Awards

Dominic Flores, MECL – Heel Measurement and Inspection
Garret Gagnon, ELEC – Robotic Deburring
Julian Matthews, MECL – Robotic Deburring
Dean Montesano, MECL – Design and Fabrication of Hemp Rebar for Structural Applications
Daniel Myers, ESCI – Wheel Indexing Mechanism and Design
Holly Rohlfs, MECL – Wheel Indexing Mechanism and Design
Aiden Smith, MECL – Heel Measurement and Inspection

Fall 2022 – Team Awards

Robotic Deburring Team – Systems Integration

Luke Earl – ELEC **Lauren King** – NUCL
Madeline Epstein – CSYS **Julian Matthews** – MECL
John Foney – MECL **Jeena Shrestha** – ELEC
Garrett Gagnon – ELEC

Wheel Indexing Mechanism and Design Team – Most Progress in One Semester

Piro Gusho – CSYS **Holly Rohlfs** – MECL
Yifeng Huang – MECL **Nate Spina** – MECL
Daniel Myers – ESCI **Yihui Wu** – MECL
Matt Perez – MECL

Spring 2022 – Individual Awards

Emilee Fortier, MATL – Continuous Pulp Digester Pressure Vessel
Sonya Khudyakov, MGTE – IoT for Industry
Jason Lin, MECL – Continuous Pulp Digester Pressure Vessel
Zachary Orris, ELEC – Scanner Based Path Generation

Spring 2022 – Team Awards

Scanner Based Path Generation Team – Outstanding Achievement

Dawson Cohen – MECL **Felicia Ramos** – ELEC
Anthony Fappiano – ITWS **Brandon Red** – CSYS
Chris Garuti – ELEC **Hayden Spock** – MECL
Luke Jones – MECL **Connor Wooding** – CSYS
Zachary Orris – ELEC

Biomedical System on Flexible Substrate Team – Best System Development

Patrick Berne – CSYS **Kevin Li** – ELEC
Brendan Dunn – ELEC **Leon Li** – ELEC
Adrian-James Gevero – CSYS **Yingqu Ma** – ELEC
Ben Haft – ELEC **Ryan Wanner** – ELEC
Cynthia Li – CSYS

Online Blowback Measurement Team – Best Systems Integration

David Barocas – MECL **Frank Triolo** – CSYS
Caitlin Bennett – ELEC **Alex Wu** – MECL
Justin Eng – MECL **Kevin Yee** – CSYS
Sean Greatorex – MECL **Curtis Zgoda** – ELEC
Ivan Hammel – CSYS

Physical Systems for Control Systems Course Team – Most Progress in One Semester

Jacob Abrams – ELEC **Matthew McCabe** – AERO
Joseph DeGaetano – CSYS **Bryan McKeever** – MECL
James Johnson – ELEC **Fiona Murphy** – MECL
Joseph MacCreery – MECL **Marvin (Youmin) Lee** – MECL

Continuous Pulp Digester Pressure Vessel Team – Best Teamwork

Mehmood Aslam – MECL **Crow Rogez** – MECL
Jackie Carroll – MECL **Ethan Tanguay** – MATL
Emilee Fortier – MATL **Hancheng Wang** – MATL
James Gomez – MATL **Michelle Yang** – MECL
Jason Lin – MECL **Haolei Zhou** – MATL

Low-Cost Solar Thermal Team – Most Improved

Fern Bahr – ELEC **Hamzah Muhammad** – MECL
Everett Collins – MECL **Matthew Paoli** – ELEC
Joseph Gessler – MECL **Zhiheng Su** – ELEC
Abby Higgins – MECL **Chris Weigle** – MECL
Ryan Lam – MECL

LEGEND:

AERO - Aeronautical Engineering **MATL** - Materials Science and Engineering
CSYS - Computer and Systems Engineering **MECL** - Mechanical Engineering
ELEC - Electrical Engineering **MGTE** - Industrial and Management Engineering
ESCI - Engineering Science **NUCL** - Nuclear Engineering
ITWS - Information Technology and Web Science



GET INVOLVED!

Sponsor a project, mentor a team, or donate to the future of the Design Lab at: giving.rpi.edu/design-lab