
ELECTRICAL & COMPUTER ENGINEERING
UNIVERSITY of WASHINGTON

# MESSAGE FROM **THE CHAIR**

Welcome to the eighth annual Engineering Innovation and Entrepreneurship (ENGINE) Showcase at the University of Washington Department of Electrical & Computer Engineering. It's a delight to invite our donors, industry partners and campus colleagues to join us as we feature and celebrate the hard work of our students, who will soon be graduating to become the next generation of electrical and computer engineers. This year's Showcase features 59 team projects representing around 280 students and covers topics as diverse as digital health, cybersecurity, power systems, quantum technologies, machine learning, communications, electronics, and robotics.

The projects here arise from ENGINE — our engineering entrepreneurial capstone program. ENGINE was created to enable students to work in teams on industry-sponsored projects, and it is the culmination of a student's electrical and computer engineering education. ENGINE got its start in 2015 with leadership from Payman Arabshahi, UW ECE's industry liaison and associate chair for education. Since then, the program has grown from just four projects eight years ago to nearly 60 this year.

This program is generously endowed by UW ECE alum Milt Zeutschel and his wife, Delia, with additional hands-on mentorship provided by Milt's business partner and friend, UW ECE affiliate faculty member John Reece. ENGINE is designed to develop students' skills in collaborative systems engineering, innovation, entrepreneurship, project management and product development. It is also a way for our industry partners to benefit from the rich innovation culture at UW ECE. Additional thanks go to UW ECE alum Ray Kanemori for providing a cash prize for the winning team of the ENGINE showcase.

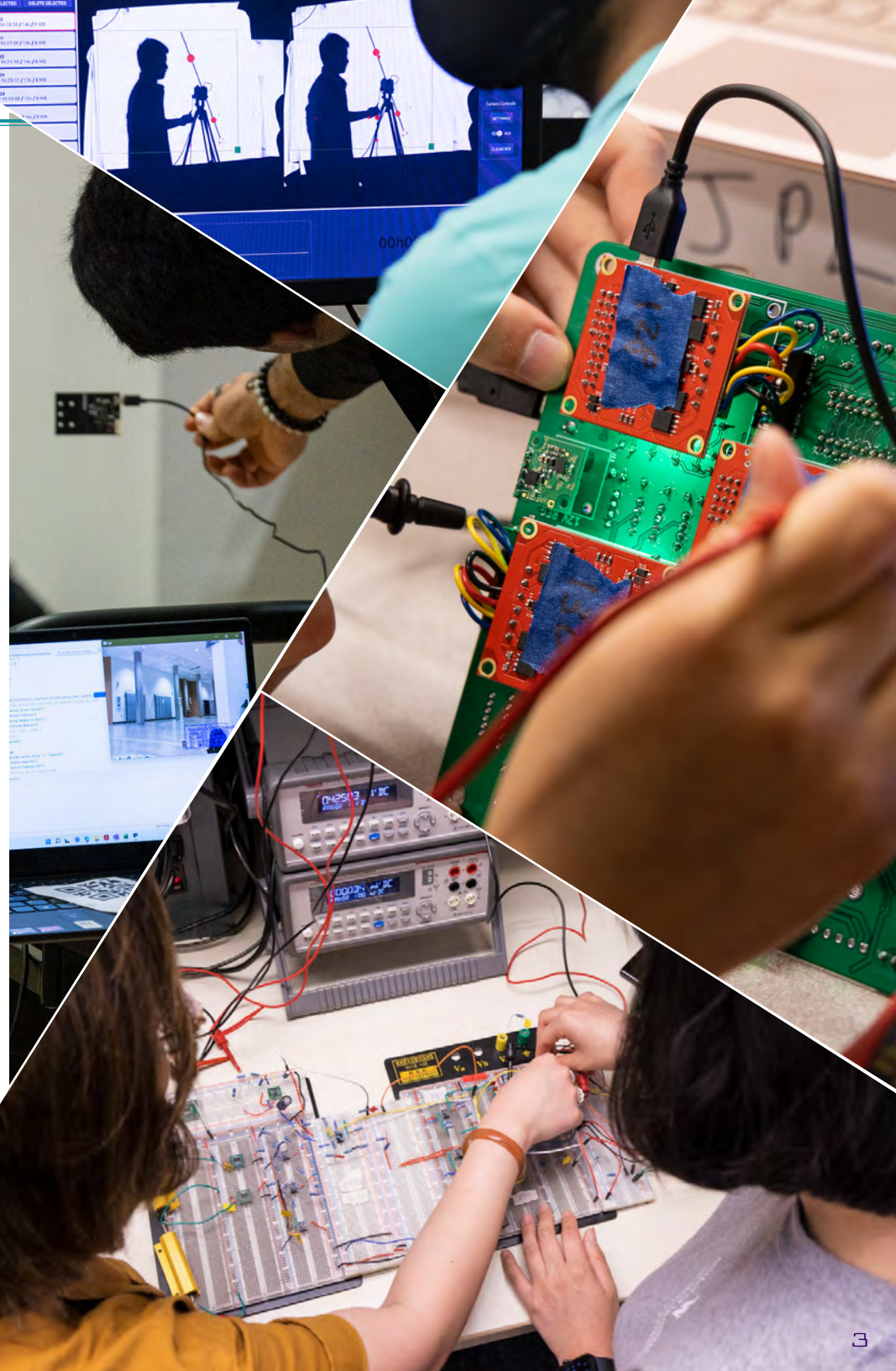
To our industry sponsors, I extend a special thank you for the generous contributions, mentorship, flexibility, and creativity lent to this year's projects. I also wish to thank ENGINE Program Director Payman Arabshahi, College of Engineering Industry Capstone Director Jill Kaatz, and Associate Director Dorian Varga. Together, they are responsible for establishing and coordinating industry partnerships that support the projects you will see today. And finally, thank you to our ENGINE teaching assistants, Shruti Misra, Mingfei Chen, Varun Elango, Kelly Ho, and Harsha Vardhan, for their excellent work and dedication to our students.

Congratulations to all students on the completion of your final capstone projects! The knowledge you have gained from this experience will serve you well in the coming years. I have no doubt that you will build successful and rewarding careers.

To our donors, industry partners and campus colleagues, I look forward to having the chance to talk with you in person at this event. Enjoy the ENGINE Showcase!

Best to all,

Eric Klavins
UW ECE Professor and Chair



CYBERWORKS ROBOTICS

GE Digital

PSE PUGET SOUND ENERGY

UW MCF

Sagetech AVIONICS

BECU

BOEING

IONQ

Pacific Northwest NATIONAL LABORATORY

PACCAR

UNIVERSITY of WASHINGTON COLLEGE OF ENGINEERING

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

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SCHOOL OF AQUATIC & FISHERY SCIENCES

D:ARTS Center for Digital Arts and Experimental Media University of Washington

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ELECTRICAL & COMPUTER ENGINEERING UNIVERSITY of WASHINGTON

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RAI RADIUSAI

NAVSEA WARFARE CENTERS

# ENGINE SHOWCASE

# 2023 PROJECTS

# ENGINE SHOWCASE

# 2023 PROJECTS

## 01 BATTERY ELECTRICAL VEHICLE RANGE ESTIMATION

**SPONSORED BY**
PACCAR

The accurate estimation of the range of a battery electric vehicle (BEV) is critical for the successful adoption and integration of electric vehicles into our daily lives. Unlike traditional internal combustion engine vehicles, the range of a BEV is heavily dependent on several factors such as battery capacity, driving style, weather conditions, and road terrain. Predicting the range of a BEV can be a complex and challenging task.

**STUDENTS:** DYLAN DENQ, YANG LI, FRANKY LIN, XINWEN LIU, YIJIA LU, XIAOHAN ZHANG

**FACULTY ADVISER:** DAVID B. LANING

**INDUSTRY ADVISER:** NICK HERTLEIN

## 02 HOW TO PLAY NICE IN THE SANDBOX

**SPONSORED BY**
BECU

Our project aims to provide BECU with a sandbox environment tool for the analysis and detonation of malware. BECU by nature of being a credit union is a high value target for malware attacks. A sandbox environment allows for BECU engineers to safely detonate and analyze malware files in order to understand them and thereby prevent attacks. We will provide BECU engineers with an easy to use tool which will safely detonate and analyze malware.

**STUDENTS:** NATHAN BORN, DANIEL CHEN, HAYDEN GUO, JACOB LUSH, ZHAORUI ZHANG, KAI-JEN ZHENG

**FACULTY ADVISER:** RADHA POOVENDRAN

**INDUSTRY ADVISERS:** SEAN MURPHY, JAMIE SCHADEMAN, DEBORAH WELLS



## 03 SMART DESIGN DATABASE

**SPONSORED BY**
AVTECHTYEE

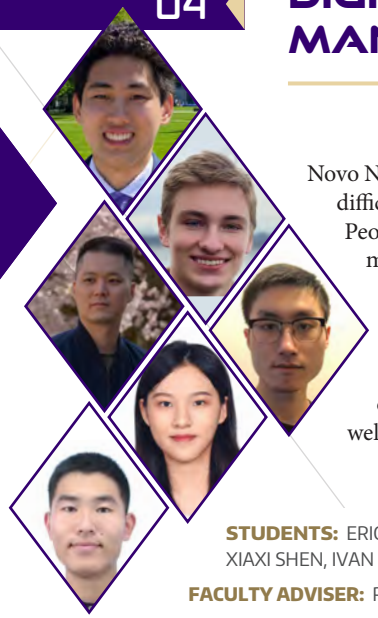
This project, called "Smart Database Design," was completed for Avtechtyee. The objective was to develop a well-designed and normalized database schema for Product Structure, Parts, and Part List tables. User-friendly forms were created for easy data entry and editing, while robust queries with output parameters enabled data transfer to other programs. The system also included a programmable search engine for effective data retrieval and a data transfer system from printed or electronic documents. Additionally, database performance was optimized through indexing tables and ensuring data consistency.

**STUDENTS:** ARIA FU, WEIZHE HU, MOHAN KUKREJA, ALANKAILUN WANG

**FACULTY ADVISER:** JOHN RAITI

**INDUSTRY ADVISER:** IGOR GONIODSKY

## 04 DIGITAL MEDICATION MANAGEMENT



**SPONSORED BY**
NOVO NORDISK

Novo Nordisk's Digital Medication Management project tackles the difficulty of polypharmacy for people with Alzheimer's disease. People with Alzheimer's disease may have difficulty taking medications due to comorbidities along with experiencing memory loss and confusion. These comorbidities may also increase the number of medications they take, which may introduce contraindications posing potential dangers to the patient's health. An app-controlled medication dispenser is proposed to help monitor medication intake as well as detect any contraindications between prescriptions.

**STUDENTS:** ERIC CHANG, ZICHAO CHEN, SHAO-JUNG (JAMES) KAN, YEN-YEN LIANG, XIAXI SHEN, IVAN ZENKOVITCH

**FACULTY ADVISER:** RANIA HUSSEIN

**INDUSTRY ADVISER:** JOHN CANEVARI

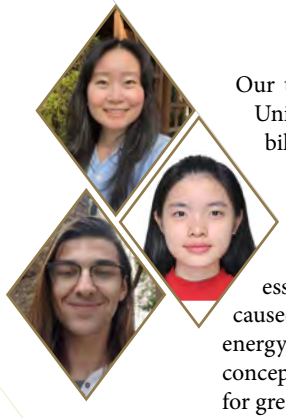
## 05 ANOMALY DETECTION FOR SOLAR PV MODULES INSPECTION USING IR THERMOGRAPHY

**SPONSORED BY**
FLUKE

In this project, we focus on the development and implementation of anomaly detection and classification algorithms for photovoltaic (PV) panels, with the aim of deploying these algorithms on an edge device for real-time monitoring and analysis. Our methodology encompasses both single-stage and two-stage approaches, and we rigorously evaluate their performance. As the project is not only concerned with detecting five types of anomalies, but also classifying them, we utilize metrics such as mean Average Precision (mAP), accuracy, and confusion matrices to assess our results. To achieve this, we employ state-of-the-art deep learning models, including various iterations of You Only Look Once (YOLO), EfficientNet, and ResNet, thereby ensuring optimal performance and robustness in our detection and classification tasks.

**STUDENTS:** FRANK HSU, WESLEY HUANG, TING JONES, RYAN LIAO, ALI SALMAN
**FACULTY ADVISER:** ARKA MAJUMDAR
**INDUSTRY ADVISERS:** MARCELLA BENNETT, NAVID ROOHANI

## 06 JAMESTOWN S'KLALLAM TRIBE COMMUNITY RESILIENCY CENTER



**SPONSORED BY**
JAMESTOWN S'KLALLAM TRIBE

Our team collaborated with the Jamestown S'Klallam Tribe and the University of Washington Clean Energy Institute to assess the feasibility of incorporating a resiliency microgrid with solar energy and battery storage into a tribal campus building. The analysis aimed to identify how the microgrid could enhance tribal sovereignty by offering greater control over energy costs, ensuring sustained operations during power outages, and providing access to essential energy services in the event of prolonged power outages caused by natural disasters. The system design is founded on data and energy usage analysis. Our findings present some preliminary design concepts, and the next steps entail advancing the work with UW students for greater energy resiliency.

**STUDENTS:** VANESSA AFFANDY, AIMEE PHUNG, CODY YOUNG
**FACULTY ADVISER:** DANIEL SCHWARTZ
**INDUSTRY ADVISER:** ROBERT KNAPP



## 07 BATTERY SCHEDULING FOR CARBON REDUCTION

**SPONSORED BY**
GE DIGITAL

Worldwide, a significant share of electricity is produced by burning fossil fuels like coal, oil, or gas. Because of this, electricity generation is a major contributor to carbon emissions. To reduce the negative impacts of these emissions, our project aims to design a controller that will leverage solar production and battery storage to reduce carbon emissions within a commercial building. Our goal is to lower emissions and reliance on grid power while considering real-world constraints. We seek to promote sustainable energy practices to combat climate change.

**STUDENTS:** JOSE CORTEZ, JACKSON MARROTT, FURY MENG, SOURYADEEP MONDAL, CESAR ROBLES, GHOVINDO SIADARI
**FACULTY ADVISER:** BAOSEN ZHANG
**INDUSTRY ADVISERS:** JESSE GANTZ, AVNAESH JAYANTILAL

## 08 RADAR-CUED CAMERA DATA COLLECTION SYSTEM

**SPONSORED BY**
ECHODYNE

Echodyne would like to create a field-deployable system to acquire and store labeled images of objects tracked by a radar. Our team will create a system that utilizes a PTZ camera and a radar. The system must allow a user to select a track detected from the radar and see a camera image feed of the respective object. The final product will aim to have a radar-cued camera feed, off/on-line labeling, and a database containing collected images and track IDs.

**STUDENTS:** CHRISTIAN BLEVENS, PAUL CHUNG, SIDHARTH DAGA, AKHIL MANDALA
**INDUSTRY ADVISER:** JACK HUNT

## 09 FPGA SYSTEM FOR RF POWER SUPPLY CONTROL

**SPONSORED BY**
UW MEDICAL CYCLOTRON FACILITY

The University of Washington Medical Cyclotron Facility is a cancer treatment and research facility with the world's only hospital-based, 50 MeV multi-particle, variable energy cyclotron capable of delivering fast neutron therapy and supporting innovative cancer research programs. The RF Power Supply Control (RPSC) is composed of 15 individual cards handling command, status, and interlock signals for the power supplies in the RF system as well as their integration into the overall cyclotron control and IO system. The goal for our capstone is to convert the current RPSC implemented with analog circuits into an equivalent FPGA system. The project involved the conversion of relevant logic cards into Verilog code and the modernization of analog cards. The end-product includes 5 PCBs linked to a Xilinx FPGA to enhance reliability and signal integrity.

**STUDENTS:** GEORGE BEATTY, ROUWEI CHEN, KEVIN LEE, RAFAEL LII PINEDA DE LA ROSA, JOSIAH WAN, JEFFERY XU

**FACULTY ADVISER:** MAHMOOD HAMEED

**INDUSTRY ADVISER:** MARISSA KRANZ

## 10 AN ACOUSTIC BEAM FORMING DEVICE FOR PERSONALIZED AUDIO EXPERIENCES

**SPONSORED BY**
UW DXARTS

Juan Pampin previously developed an audio beam forming device that can send sound in a narrow beam, creating unique audio experiences. However, it used large rack-mounted electronics that made it hard to transport. Our team worked with Professor Pampin and Professor Klavins to create a miniaturized version of the device. The new design uses surface mount circuit components and a custom DAC board to miniaturize the electronics. The sound generation is controlled remotely over wifi, which can be configured over bluetooth using an Android app. And everything is encased in a 3D-printed enclosure.

**STUDENTS:** CONNOR BOWERS, JOSEPH CONCEPCION, ABDIKAFI HERSI, YUAN LI, TYLER PIPPIN

**FACULTY ADVISERS:** ERIC KLAVINS, JUAN PAMPIN



## 11 BASE STATION FOR SOCIAL DISTANCING SENSOR

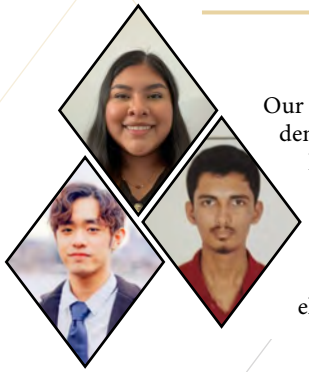
**SPONSORED BY**
ALEXANDER MAMISHEV

This project aims to address the limitations of current social distancing sensors, which are not easily integrated into living spaces, have weak battery life, and cannot function independently. In response, our team developed a "Base Station for Social Distancing Sensor" to hold the sensor as well as increase its battery life. This product has the potential to make the social distancing sensor more marketable as it addresses its current limitations. Overall, this project provides a potential solution to the challenges faced by current social distancing sensors.

**STUDENTS:** ERKAM CAKMAK, XULIN HU, MATT LEAHY, LENNY TRAN, ARDEN WALCOTT

**FACULTY ADVISER:** ALEXANDER MAMISHEV

## 12 DESIGN A BUILDING ELECTRIFICATION DEMONSTRATION VEHICLE



**SPONSORED BY**
SEATTLE CITY LIGHT

Our objective is to design a mobile building electrification demonstration vehicle with zero carbon emissions. The vehicle will incorporate a heat pump, water heater, breaker, stove, sink, faucet, solar panel, and battery. Additionally, we will create a control panel dashboard to monitor energy consumption and production from the solar panel. This installation will be implemented on an electric truck to achieve our goal of sustainability.

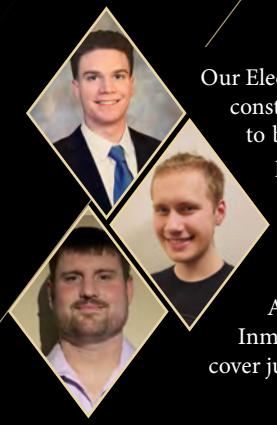
**STUDENTS:** KRISTAL GONZALEZ, BEN LI, NAVEEN RAVISHANKAR

**FACULTY ADVISER:** DANIEL KIRSCHEN

**INDUSTRY ADVISER:** ERIC STRANDBERG

## 13 ELECTRONICALLY STEERABLE ULTRA-WIDEBAND ANTENNA

**SPONSORED BY**
NATIONAL SECURITY INNOVATION NETWORK /
US ARMY SPACE AND MISSILE DEFENSE COMMAND



Our Electronically Steerable Ultra-Wideband Antenna project aims to construct an antenna array to allow a Software Defined Radio (SDR) to be capable of tracking satellites using their S-Band telemetry, perform as a monostatic or multistatic radar for tracking aircraft, and provide military communications while still being compatible with existing MILSPEC waveforms. This project has been broken up into different phases with the first phase being focused on a SDR being used for receiving ADS-B signals to track aircraft, receive GPS signals, and receive Inmarsat signals for satellite communications. Our project will cover just the first phase.

**STUDENTS:** AUSTIN HAAS, SAM HANSON, KENNETH OLIVER
**FACULTY ADVISER:** MATT REYNOLDS
**INDUSTRY ADVISER:** CRAIG BOUCHER

## 14 RESILIENT POWER FOR JEFFERSON COUNTY EMERGENCY MANAGEMENT, SHERIFF, AND 911 CENTER

**SPONSORED BY**
JEFFERSON COUNTY DEPARTMENT
OF EMERGENCY MANAGEMENT

Due to poor electricity reliability and slow restoration of power, the Olympic Peninsula is vulnerable to natural disasters. According to FEMA, the civilian response time for a regional event is 3 months to a year. Therefore, the goal is to design a microgrid that will provide power to Jefferson County's Department of Emergency Management in case of a regional blackout. Our research will provide insight into the daily operations of the department and provide load profiles for simulations and analysis. The design will show the economic analysis and resilience of the microgrid in emergency events.

**STUDENTS:** RAHUL GUBBALA, SAMUEL LUONG, DAVID SCHULMAN, THAI TRAN
**FACULTY ADVISERS:** BOSONG LI, DANIEL SCHWARTZ
**INDUSTRY ADVISER:** DAVID CODIER



## 15 POWER FOR A RESILIENT FAIRCHILD AIRPORT

**SPONSORED BY**
UW CLEAN ENERGY INSTITUTE

The Clallam County Sheriff's Department will be in charge of co-ordinating emergency management for the Olympic Peninsula in the statistically significant probability of a major Cascadia earthquake event. The Fairchild International Airport will be the FEMA hub for resources post earthquake emergency. To support these operations, the Sheriff's Department wanted a feasibility report investigating a renewable microgrid to be installed at the Fairchild Airport that could operate independently from the grid. The feasibility report will also show the microgrid's resilience, climate, and financial benefits during daily operations.

**STUDENTS:** EVAN BOWMAN, JOHNATHAN GRADY, WESLEY KING, CHENYANG TIAN, SOPHIA VOTAVA, TANNER WEAVER
**FACULTY ADVISER:** DANIEL SCHWARTZ
**INDUSTRY ADVISER:** DIANE HARVEY

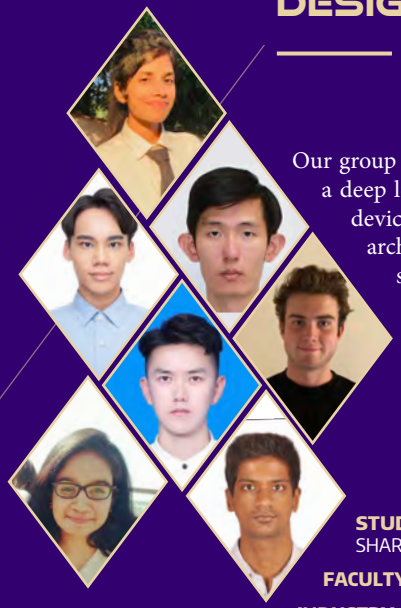
## 16 TRANSMISSION SYSTEM HOSTING CAPACITY MAP

**SPONSORED BY**
PUGET SOUND ENERGY

Create a publicly viewable map that provides an estimate of how much additional energy transmission, from new production, each area of the grid can support. This will allow prospective developers to have access to information much earlier in the proposal process so that development can be more readily focused on areas that can support new generation.

**STUDENTS:** SAM AYARS, ERIC HANS FREITAG, MENELIK HAILU, VEDANT MODAK, STEVEN ZHOU-WRIGHT
**FACULTY ADVISER:** DANIEL KIRSCHEN
**INDUSTRY ADVISER:** BEN WALBORN

## 17 NEURAL ARCHITECTURE DESIGN FOR HUMAN DETECTION



**SPONSORED BY**
AMAZON

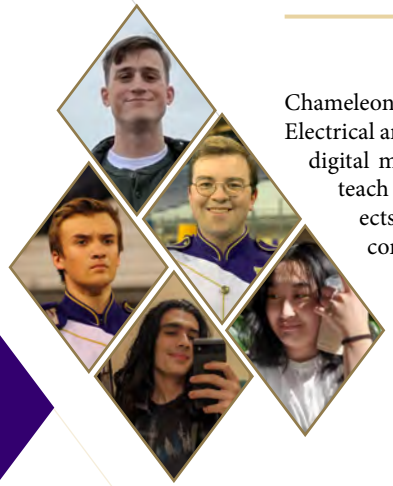
Our group was tasked with designing architecture and implementing a deep learning neural network for human classification on edge devices. Our project makes use of a customized MoblieNetV2 architecture on a curated dataset to classify humans for home security. Accuracy, size, and frame-rate have been prioritized to optimize for real world application.

**STUDENTS:** LOGAN KRUMHOLZ, WEIJING LI, MOUNICA RAMREEDY, SHARAN RANJIT S., HARSHEETA VENKOBA RAO, JASON WU, LINYU YANG

**FACULTY ADVISER:** NATHAN KUTZ

**INDUSTRY ADVISER:** MANSI MANOHARA

## 18 CHAMELEON: AN ELECTRICAL MUSICAL INSTRUMENT PLATFORM



**SPONSORED BY**
UW ECE

Chameleon is an ENGINE project sponsored by the UW Department of Electrical and Computer Engineering that aims to create an open-source digital modular synthesizer platform. The platform will be used to teach and enable student-created digital signal processing projects. The objective is for the Chameleon to be reprogrammable, communicate with traditional Eurorack modular synthesizers, communicate with other Chameleons, and implement a variety of digital audio processing functions. This platform will allow engineering students to emulate different musical instruments and implement signal processing algorithms to provide a more creative outlook on learning about sound synthesis and signal processing.

**STUDENTS:** TODD BLOOM, MAX CHASTAIN, NATHAN FORD, JULIAN JAMES, TRINA KHA

**FACULTY ADVISER:** ERIC KLAVINS



## 19 PRIORITIZING AND HARVESTING EXCESS SOLAR POWER

**SPONSORED BY**
PATH

This project designs a prioritization device for humanitarian situations to deliver excess power from solar water pumps to secondary loads using an Arduino microcontroller and switching relay. Components like ACS712 current sensor and LM2596 DC-DC converter are used. The device can improve access to power in emergencies and refugee camps and can be applicable to other solar applications with excess power.

**STUDENTS:** YASH AGGARWAL, VIRAAJ BANSAL, AERRYN BOHNSTEAD, KATHY DENG, JAMES XU, RONGJIE YANG

**FACULTY ADVISER:** JUNE LUKUYU

**INDUSTRY ADVISER:** STEVEN DIESBURG

## 20 WIRELESS EMBEDDED SENSOR MONITORING

**SPONSORED BY**
NATIONAL SECURITY INNOVATION NETWORK / NAVAL SURFACE WARFARE CENTER

Developed a prototype of a low-cost wireless embedded sensor network for the monitoring of naval equipment and infrastructural components. The network consists of different sensors to measure the current, voltage, temperature, pressure, flow, and vibration. The long-ranged wireless device supports high data transfer rate, with Secure Wireless Local Area Network (SWLAN) to comply with best practice for data security.

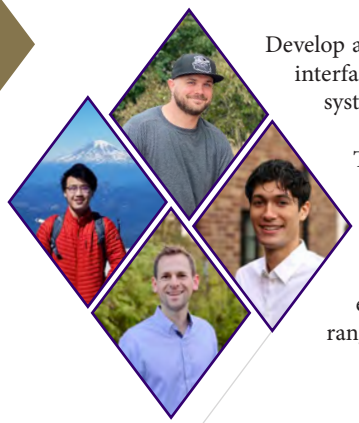
**STUDENTS:** OWEN CHANG, ROBYN JUNG, ANDREW LIU, KENNETH RUSLIM

**FACULTY ADVISER:** TAI-CHANG CHEN

**INDUSTRY ADVISER:** SHERWOOD POLTER (WOODY)

## 21 MARINE RANGE ESTIMATION CALCULATOR FOR EV SYSTEMS

**SPONSORED BY**
PHOTON MARINE



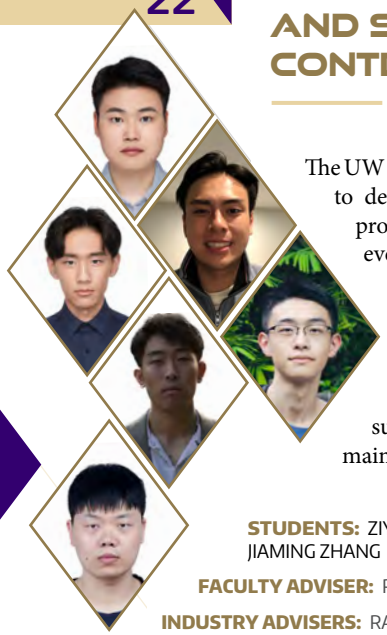
Develop an algorithm that will be implemented onto the vessel's user interface where it will display range remaining from the battery system.

This project is focused on developing a model for estimating the range of an EV-propelled vessel. To achieve this, we implemented an algorithm onto the vessel's control interface that takes into account a variety of factors such as real-time motor performance, battery status, and varying environmental conditions, to produce a practical use nautical range for the vessel.

**STUDENTS:** EAN BARNAWELL, ELLIOT LIU, RYAN OSTRANDER, THEO REID
**FACULTY ADVISER:** JOHN REECE
**INDUSTRY ADVISERS:** MARCELINO ALVAREZ, BRIAN BOSHES

## 22 ANALYZING AIRPLANE SYSTEM AND SECURITY LOGS FOR CONTEXT AWARENESS

**SPONSORED BY**
BOEING



The UW senior capstone team is tasked to define and develop a process to detect cybersecurity events on aircraft using an automated process. • Develop automated process to detect cybersecurity events on aircraft and build a GUI for displaying analyzed data / metrics. • Define what security events should be identified as indicators of attack / compromise (Authorized access, software loading, network traffic violations, etc.) • Detect security events in an automated and cost efficient process. • Evaluate other aircraft systems that may support identification of security events (ground systems, maintenance tools, or other log files.

**STUDENTS:** ZIYANG GONG, ZIMU LI, NAM NGUYEN, STEVE SU, CHENGZHI XU, JIAMING ZHANG
**FACULTY ADVISER:** RADHA POOVENDRAN
**INDUSTRY ADVISERS:** RAFKA DAOU, DAVE MIER, EMILY ZHANG



## 23 DATA INSIGHTS APPLICATION FOR OBESITY

**SPONSORED BY**
NOVO NORDISK

We aim to create an app that shows quantitative insights into obesity and social determinants of health (SDoH) on patients' risk of comorbidity and related costs. Our approach includes market research, data analysis, and app development. The app predicts a patient's likelihood of developing a comorbidity and its associated cost based on their clinical and SDoH history. Our project addresses the need for better understanding of the relationship between obesity, SDoH, and comorbidity risk factors to support healthcare providers in developing new interventions and policies.

**STUDENTS:** MICHAEL GIOVANNI, GARRETT G. LEUNG, ESH SATHIYAMOORTHY, RICHARD TRAN, TONG WANG
**FACULTY ADVISERS:** ARINDAM K. DAS
**INDUSTRY ADVISERS:** JOHN CANEVARI, SHABANA MOTLANI

## 24 PHOTOREALISTIC SYNTHETIC IMAGE GENERATION

**SPONSORED BY**
RADIUSAI

Over the years, there has been growing interest in incorporating computer vision into the retail industry. One crucial challenge in this field is the Automatic Checkout (ACO) problem, which involves creating a shopping list from images of products that have been purchased. The main challenge comes from the seasonal, large scale and fine-grained nature of the product categories as well as the difficulty of collecting training images that reflect the realistic checkout scenarios due to continuous updates of the products. The different orientations of the objects in the checkout scene also add to the complexity of the problem.

**STUDENTS:** FENGRUI CHENG, JIAHUAN HE, NITHIN PHILIP JOSEPH, FATWIR SHEIKH MOHAMMED, TEJORAM VIVEKANANDAN, SHIKAI ZHUANG
**FACULTY ADVISER:** ANDREA FANELLI
**INDUSTRY ADVISER:** DANIEL KING

## 25 MBSE THREAT TREES

**SPONSORED BY**
BOEING

We develop an intensive and flexible Threat Tree generation software integrated with Model-Based Systems Engineering (MBSE) environment for enhancing cyber-physical security in-flight systems. We adopted a graphical editor to build a flight-system-specific threat tree modeling tool, allowing security engineers to define attack strategies and quantify the impact. We developed a parser for seamless integration into the MBSE environment to analyze the complex system through Systems Modeling Language (SysML). We generated Python scripts to run threat analysis algorithms and predict the impact of a compromise. The script allows systems engineers to define threat mitigation and re-evaluate the cyber-physical system.

**STUDENTS:** KAVYA BALASUBRAMANIAN, TING CHEN, YUNFEI HE, ANGUS HSIEH
**FACULTY ADVISER:** RADHA POOVENDRAN
**INDUSTRY ADVISER:** DAVID C. MATTHEWS

## 26 DEVICE MOVEMENT DETECTION

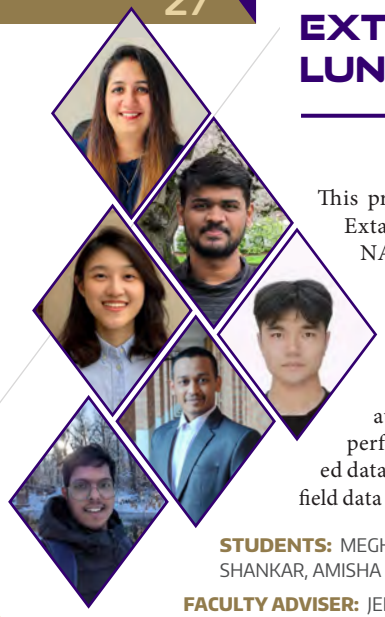
**SPONSORED BY**
AMAZON

The device movement detection project aims to develop an algorithm that can detect and track the movement of the device using MM-wave radar. The project involves preprocessing the point cloud from radar data at each frame to remove noise and then applying a motion detection algorithm to identify the existence of the movement as well as the exact rotating angle and translational distance. The algorithm then tracks the feature points across frames, using techniques such as nearest neighbor association and KD-Tree to improve tracking accuracy. An IMU is used as ground truth for result verification.

**STUDENTS:** JERRY CHEN, XINQI CHEN, RYAN CHING, ZHENGYANG LI, AARON LIN, PEI-HSUAN LIN, YUANHAO LUO
**FACULTY ADVISER:** MAHMOOD HAMEED
**INDUSTRY ADVISER:** PRASAD SHAMAIN



## 27 MACHINE LEARNING FOR EXTREME TRAVERSE LUNAR EXPLORER

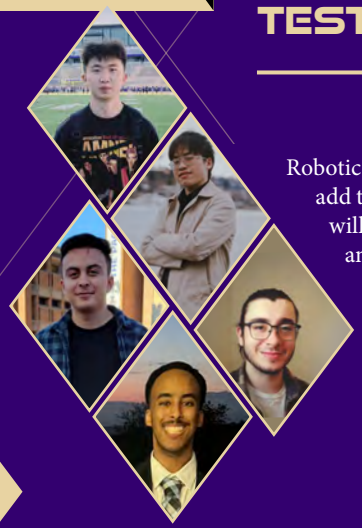


**SPONSORED BY**
NASA JET PROPULSION LABORATORY

This project incorporates Machine Learning algorithms into the Extant Exobiology Life Surveyor (EELS) robot, developed by NASA-Jet Propulsion Laboratory, to autonomously identify potential hazards in subterranean environments on Earth and the Moon. The focus is on analyzing vision data collected from ice crevasses and other glacial-like environments to perform tasks such as semantic terrain segmentation. As data in space missions is limited, the project explores automating zero-shot data generation with semantic labels and performing Unsupervised Domain Adaptation on real unannotated data. The goal is to enhance the capabilities of EELS for real-world field data collection and characterization in subterranean environments.

**STUDENTS:** MEGHA CHANDRA NANDYALA, SAMARTHA RAMKUMAR, NIKHIL KASHYAP SHANKAR, AMISHA HIMANSHU SOMIAYA, CHRISTINE SZU-YAO WU, WENZHENG ZHAO
**FACULTY ADVISER:** JENQ-NENG HWANG
**INDUSTRY ADVISERS:** JACK LIGHTHOLDER, MASAHIRO ONO

## 28 AUTOMATION OF DASH TESTER CONNECTIONS



**SPONSORED BY**
PACCAR

Robotic automation is a flourishing process that PACCAR wants to add to its Manufacturing Support Team. An automatic solution will free up test operators to use their time more efficiently and reduce the time required to test each dash, saving time and money for the plant and the company. The student team worked to incorporate a Kawasaki robotic arm capable of accurately connecting a plate containing multiple cable connectors to the plugs of the rear of a semi-truck dashboard.

**STUDENTS:** EDDI ARENAS, WARFA IMAN, YUHUA NIE, LANCE SATHER, SAM TAM
**FACULTY ADVISER:** SEP MAKHSOUS
**INDUSTRY ADVISER:** JEFF SMALL

## 29 MAKING ELECTRIC VEHICLE CHARGING FUN

**SPONSORED BY**
FORD AND ENVORSO

The project "Making Electric Vehicle Charging Fun" is sponsored by Ford and Envorso. This project aims to create a solution that can monitor and analyze the data generated by EV chargers, to determine their health and performance. The system will gather charging data from the car, such as charging voltage, current, and other relevant parameters, and use various algorithms to analyze the data and make inferences about the state of the charger. The goal of this project is to provide a reliable and accurate assessment of the chargers, to generate a more positive charging experience

**STUDENTS:** GERIN THOMAS GEORGE, MOSKA JAMALI, RICO LI, BRENDAN OQUIST, KEVIN SHAO, DIANA VERDUZCO, BRYAN VO

**FACULTY ADVISER:** DAVID B. LANING

**INDUSTRY ADVISERS:** PARKER JONES, GAVARRAJU NANDURI

## 30 NEURO-MECHANICAL INTERACTIVE SIMULATION PLATFORM FOR CAENORHABDITIS ELEGANS

**SPONSORED BY**
NEUROAI LAB

Caenorhabditis elegans (C. elegans) is a model organism in the field of neuroscience and genetics for neuronal development and behavior. Consisting of around 300 somatic neurons, it is the only organism with completely mapped neural connections and data for muscles and body. To facilitate efficient investigation of how neural dynamics translate to behavior, we have built a Neuro-mechanical Interactive Simulation Platform which accompanies neuro and body simulation with real-time interpretable visualization of the worm's body. Our simulation would provide the means for users to conduct experiments to manipulate the neurons of C. elegans and view and study response behavior in real time.

**STUDENTS:** JAMES JHONG, TIMOTHY LEE, WUJIARUI ZHENG

**FACULTY ADVISER:** ELI SHLIZERMAN

**INDUSTRY ADVISER:** JIMIN KIM



## 31 ROBOTIC FUSELAGE INSPECTION FOR DENTS AND SCRATCHES

**SPONSORED BY**
AIRBUS ROBOTICS

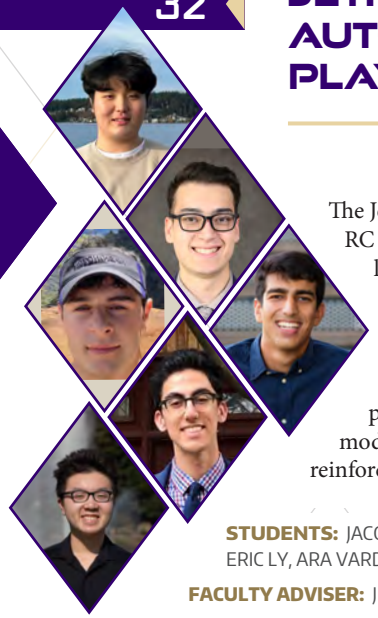
The objective of the fuselage inspection project is to enhance the efficiency of fuselage inspection by developing a vision system. The system, utilizing the Fanuc CRX-10iA/L robot and Keyence LJ-X8400 scanner, will automate the inspection of fuselage surfaces. It will employ a scanner-based end effector and an additional mechanism to mark defects on the panel. The collected scanner data will be used to train a deep learning model for defect classification and identification. The information and location of surface defects will be displayed on an augmented reality (AR) application.

**STUDENTS:** ANAEL AGUAYO-CHONG, RAY CHEN, SHREEYA GADGIL, HAO LIN, TOMMY LE, SANJAR NORMURADOV

**FACULTY ADVISER:** JOHN RAITI

**INDUSTRY ADVISER:** MICHAEL WOOGERD

## 32 JETRACER SOCCER LEAGUE: AUTONOMOUS SOCCER PLAYING AGENTS



**SPONSORED BY**
LOCKHEED MARTIN

The JetRacer Soccer League project aims to develop autonomous RC vehicles capable of playing competitive soccer using machine learning. Goals include training RC cars (JetRacers) with reinforcement learning to adopt soccer game dynamics such as shooting, passing, playing defense, and cooperating or competing with other agents to win the soccer game. The agents perceive their environment through cameras, process visual information through an object detection model, and act upon the environment with a simulation trained reinforcement learning model.

**STUDENTS:** JACOB BAKHSHIAN, DYLAN IMAYAMA, ANDREW KIM, NICK KHORMAEI, ERIC LY, ARA VARDANYAN

**FACULTY ADVISER:** JEFFREY HERRON

**INDUSTRY ADVISER:** MATT NGUYEN, DAKEN STARKENBUR, PETE SULCS, JAMES WALTNER

## 33 AN OPTOELECTRONIC CLOSED-LOOP CONTROL SYSTEM FOR RF AMPLIFIERS

**SPONSORED BY**
ACCESS LASER

Our capstone project from Access Laser implements a closed loop control system between the laser and the RF driver unit which powers it. During the plasma initiation inside a laser, there can be an impedance mismatch between the source and load, which can damage the RF driver components running the laser. In order to solve this issue, we developed a three-part circuitry that involves VSWR detection, Optical detection, and microcontroller with RF communication. The VSWR detector samples and measures the reflections on the main line and the optical circuit detects the plasma in the range of 700-1000nm in the laser. The Microcontroller firmware is used to process the digital outputs of the VSWR and optical detectors and send in appropriate signal to the driver. These work in tandem to protect the RF driver unit and its components from unwanted high-power reflections.

**STUDENTS:** RAYMOND HUANG, ANASTASIYA MAKAREVICH, HONGMING PING, JOHN LEO VELPUGONDA

**FACULTY ADVISER:** SAJJAD MOAZENI

**INDUSTRY ADVISERS:** CHRISTOPHER MAU, IRIS TSAI

## 34 FLIGHT CREW AUDIO SOUNDSPACE

**SPONSORED BY**
AVTECHTYEE

The objective of this project is to create a more comfortable audio communication system for pilots and co-pilots during flight. This is achieved by combining ultrasonic transducers transmitting communications into a region with far-field microphone assemblies capable of picking up words over a distance. By eliminating the need for traditional headsets and instead creating a personalized audio environment for each pilot, this system aims to reduce fatigue and improve comfort.

**STUDENTS:** SUHEYB ADEN, JOSEPH ARTURA, RYAN HIGGINS, GRAYSON HOFFMAN, AUSTIN KENNEDY

**FACULTY ADVISER:** JOHN REECE

**INDUSTRY ADVISER:** TODD BULDOC



## 35 DEEP CONTACT GRAPH ROUTING FOR LUNAR OPERATIONS

**SPONSORED BY**
UW SENSOR SYSTEMS LAB / NASA

When deploying an autonomous rover on the moon, consistent network connectivity is not guaranteed. Our solution is to allow the rover to predict unknown signal strength in its area. With a map of known and predicted signal information, the rover can then judge whether to transmit data or move to a location with better connectivity. Our group aims to create an ML-enhanced version of Contact Graph Routing based on RF information. This will allow for successful and efficient data transmission to other nodes and eventually back to Earth, minimizing travel and transmission time, even in situations where signal is limited.

**STUDENTS:** LYLA CAIN, MARCUS CHEN, HANH DANG, ROHAN MENON, ISAAC REMY, ALEX SKLAR, ANDREW TETTAMANTI, PAOLO TORRADO

**FACULTY ADVISER:** JOSHUA SMITH

## 36 IOT POSITION APPLICATION OF IN-HOME ROBOTS

**SPONSORED BY**
AMAZON LAB126

Our project aims to develop a system for creating a radio map by collecting wireless signal strength (RSSI) data. Using this map, we will create an IoT localization algorithm with +-10 cm accuracy for locating IoT devices. We will employ Machine Learning or Reinforcement Learning algorithms to predict device locations based on RSSI values. Additionally, we will devise a routing mechanism for directing an in-home robot to the located IoT device using the most efficient path. The algorithm's generalizability will enable its application in various homes and environments.

**STUDENTS:** SOUMITH REDDY BUSIREDDY, YUAN CHEN, ANDREW HSIEH, SUSHREE S JENA, BRINDHAA VIJAYA RAGHAVAN, RUI YAN, BOYUAN YAO

**FACULTY ADVISER:** AKSHAY GADRE

**INDUSTRY ADVISER:** AMIT KACHROO

## 37 BLUETOOTH CONVERTER MODULE WITH INTEGRATED GPS

**SPONSORED BY**
SAGETECH AVIONICS

Avionic devices such as drones need a reliable method to track their location via GPS, Altitude and Heading. Data should accessible to professionals effortlessly. In an attempt to address this issue, we use Microcontrollers, Ethernet Protocols, Bluetooth BLE, in addition to the MXS transponder series which connects to this drone. This data is then displayed on our IOS app, allowing the user to change the heading and other flight settings, as well as getting on-the-go debug messages. After changing details as needed, the MXS transponder device maintains that information until the completion of the mission, or modifications are made.

**STUDENTS:** HOWARD HER, SAI JAYANTH KALISI, TRUOMG PHAM, JIAXIN XIE

**FACULTY ADVISER:** JAMES RITCEY

**INDUSTRY ADVISER:** RILEY BARNES, DAVID DAY

## 38 DIGITAL COMPANION FOR CHRONIC DISEASE PATIENTS

**SPONSORED BY**
NOVO NORDISK

The objective of this project is to develop a standstill digital companion device that can provide information, support, and companionship to help a chronic disease patient manage their condition (primarily focusing on mental, physical, and emotional support). The device should be able to encompass a wide variety of patients and conditions and provide personalized feedback based on each patient's unique needs.

**STUDENTS:** SAJJAD ATABI, VALERIE CHAN, ISHAN DANE, ZONGJIN LI, MARK LONG, EVAN O'NEILL, JIN WHITE

**FACULTY ADVISER:** KIM INGRAHAM

**INDUSTRY ADVISER:** JOHN CAVENARI



## 39 INTERTIDAL SENSOR ARRAY FOR MONITORING OCEAN CHANGE STRESSORS IN OYSTER FARMS

**SPONSORED BY**
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) AND UW FISHERIES

Climate change and ocean acidification is a currently a threat to farm-grown oysters and shellfish in the Pacific Northwest. Environmental changes in the intertidal regions of our PNW coastlines are leading to increased fatalities with farm grown-oysters. Our project aims to develop an instrumentation platform for scientists and shellfish farmers to monitor environmental metrics in real-time on the cloud. By obtaining metrics like pH and salinity the goal is to develop an understanding of what factors are leading our precious oysters to die.

**STUDENTS:** TYLER BECKER, ANDREW BUCKINGHAM, KEVIN NEATHERY, GEN SAKURA, ANDY XIONG

**FACULTY ADVISER:** TAI-CHANG CHEN

**INDUSTRY ADVISER:** PAUL MCELHANY

## 40 APPLICATION FOR EARLY ALZHEIMER'S DISEASE DIAGNOSIS

**SPONSORED BY**
NOVO NORDISK

Alzheimer's is a neurodegenerative condition affecting over 55 million individuals worldwide. Despite research advancements, imaging technologies used in early detection, such as CT, MRI, and PET scans, remain inaccessible to the general public. Partnering with Novo Nordisk, Stanford Biodesign, and Dem@Care, we developed Cognix: a cutting-edge digital tool leveraging smartphones and smartwatches to identify early signs of Alzheimer's. Cognix integrates biometric data such as heart rate, sleep, and physical movements with machine learning algorithms using a combination of pattern recognition and statistical analysis to identify physiological markers that may indicate the onset of Alzheimer's and provide personalized diagnostic recommendations.

**STUDENTS:** NATHANAEL JUDAH HARTANTO, SABRINA HWANG, AAKASH NEVE, EUGENE NGO, LINH TRUONG, ZE XIA (LUCAS) WANG, BOLE YI

**FACULTY ADVISER:** RANIA HUSSEIN

**INDUSTRY ADVISER:** JOHN CANEVARI

## 41 DRIVER CLASSIFICATION

**SPONSORED BY**
PACCAR

When a truck drives on a road, it is surrounded by multiple vehicles and reckless behavior from one such vehicle can cause a major accident, causing severe damage. Our project aims to develop a model framework for evaluation, classification, and prediction of behavior of surrounding vehicles using multi-sensor input. We have broken down the task into multiple modules such as lane detection, lidar scanning and traffic sign reading for evaluation, license plate reading for classification and discuss how those features can be combined into identifying reckless drivers.

**STUDENTS:** ADITHYA ARVIND, YINGYI CHEN, YAO HWANG, ABHISHEK R. MANDAPMALVI, HANA G. MCVICKER, TZU-HUA PENG, KEVIN ZHAO

**FACULTY ADVISER:** SEP MAKHSOUS

**INDUSTRY ADVISER:** CHARLES SWART

## 42 AUTONOMOUS SELF-DRIVING WHEELCHAIR

**SPONSORED BY**
CYBERWORKS ROBOTICS

Autonomous Wheelchairs increase freedom and ease of mobility for the most vulnerable peoples in society. Regular wheelchairs typically require a caregiver who has to push the individual on the wheelchair thereby placing constraints on the individual's autonomy.However, autonomous navigation of a power wheelchair faces numerous corner case confounds ranging from loss of localization due to feature-sparsity to human motion sickness. This project aims to identify and address corner cases that allow for robust persistent navigation over vast indoor regions and fleet integration to the cloud for remote monitoring, user authentication and over-the-air updates. Low hardware cost is essential to mass adoption of such technology.

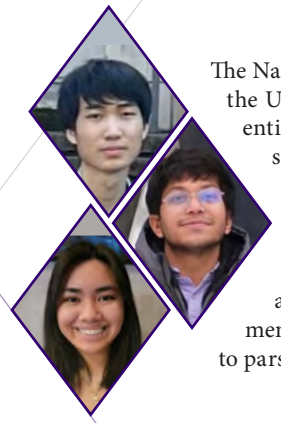
**STUDENTS:** PORTER FUNSTON, HUY HUYNH, YEN-YEN TENG, ANIRUDH ANAND VELAMORE, CHENGYU ZHANG, BRYAN ZHOU

**FACULTY ADVISER:** SEP MAKHSOUS

**INDUSTRY ADVISER:** VIVEK BURHANPURKAR



## 43 NAVY REQUIREMENT MARKUP LANGUAGE



**SPONSORED BY**
NATIONAL SECURITY INNOVATION NETWORK / US NAVY

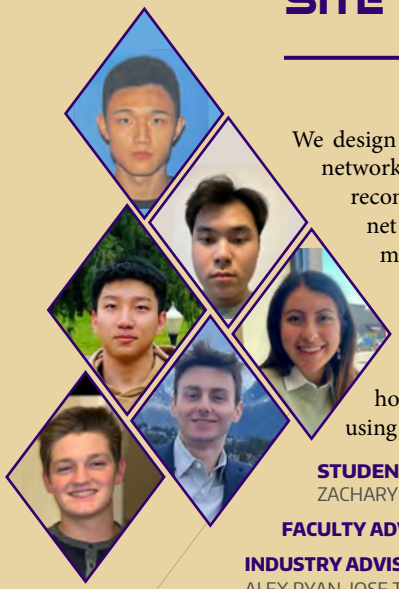
The National Security Innovation Network (NSIN) is a network in the U.S. Department of Defense (DOD) aimed to connect DOD entities with academic and venture partners to innovate new solutions for DOD-member challenges. This project intakes PDF narrative requirement files to be processed through a data preparation pipeline and then uses a trained machine learning algorithm for entity extraction. This extraction obtains the required key-value pairs to produce a machine-readable file as an output. These narrative requirements are hard to parse through visually and nearly impossible to parse using machines in a timely manner.

**STUDENTS:** JENNA FLORES, RITIK SHRIVASTAVA, BAO VAN

**FACULTY ADVISER:** HAIXUN WANG

**INDUSTRY ADVISER:** KEVIN MURPHY

## 44 AUGMENTED REALITY CELL SITE VISUALIZATION APP



**SPONSORED BY**
T-MOBILE

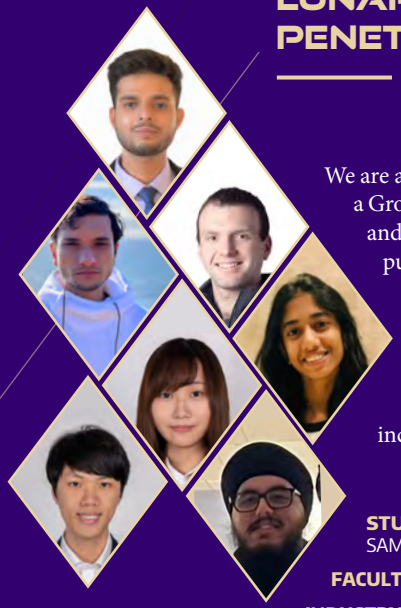
We design an augmented reality Android app that can improve network service quality and enhance the user experience by recommending optimal placement of T-Mobile home internet devices. The app can display the nearby cell sites in the map view and the AR view. In addition, by using the radio frequency conditions of the cell phone and an ML-based model the app will predict the network service quality at the location of the user's phone. Through this, the app can recommend optimal placement for T-Mobile home internet devices to the user, which is implemented using AR interaction.

**STUDENTS:** LOUIS AGUSSOEGITO, STEFAN ANDREEV ARSOV, PEILLEN LI, ZACHARY CLAYTON MEEK, SARA REYES, CHUQIAO YAO

**FACULTY ADVISER:** AKSHAY GADRE

**INDUSTRY ADVISERS:** RYAN COLTER, TIMUR KOCHIEV, NICK LAMBERT, ALEX RYAN, JOSE TAPIA-RUIZ

## 45 MACHINE LEARNING FOR LUNAR MULTI-STATIC GROUND PENETRATING RADAR



**SPONSORED BY**
NASA JET PROPULSION LABORATORY

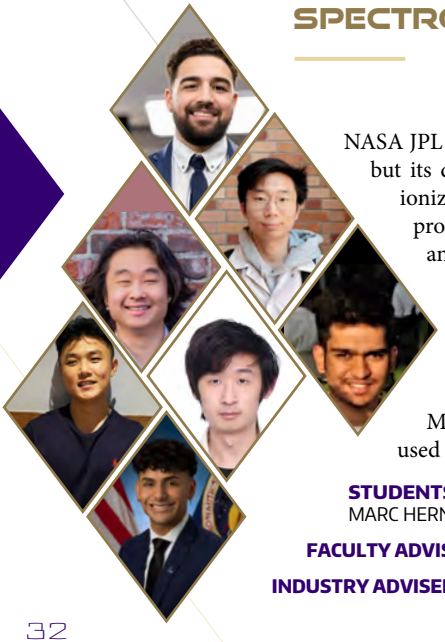
We are a team of 7 developing an ML algorithm to detect features in a Ground Penetrating Radar. It will help scientists identify surface and subsurface features on the moon. GPR devices send radar pulses into the ground and use antenna to capture signals that have returned as pulse is reflected, refracted, scattered back to the surface. • Strongest signal strength of antennas occurs close to the ground. • EM properties of materials can limit penetration depth of radar. • We are primarily looking at 2D image data derived from signal processing of incoming radar responses.

**STUDENTS:** CHI CHEN, JYOTHIRMAYEE DONTHINENI, CHANG HAO, SAMUEL KINN, BHANU SHARMA, MEHARLEEN SINGH, PIYUSH TANDON

**FACULTY ADVISER:** JENQ-NENG HWANG

**INDUSTRY ADVISERS:** JACK LIGHTHOLDER, DANIEL NUNES

## 46 MACHINE LEARNING FOR SMART SPACE-BASED RADIATION AND X-RAY SPECTROMETER INSTRUMENTS



**SPONSORED BY**
NASA JET PROPULSION LABORATORY

NASA JPL plans to launch MicroRAD, a radiation detector, in 2024, but its data may be affected by the operating environment and ionizing radiation. JPL seeks to automate the recalibration process using machine learning to improve data reliability and reproducibility. The ML model will detect anomalies to verify data integrity and, if necessary, recalibrate the device to nominal parameters. The group will use radiation detection equipment from the University of Washington to develop and optimize the ML model's performance on hardware similar to that on MicroRAD. This will create an agnostic system that can be used on multiple sensors.

**STUDENTS:** ANTHONY CHAR, PARESH CHAUDHARY, LEO GUO, MARC HERNANDEZ, KEVIN IBARRA, IAN LIU, ZHIWEI ZHONG

**FACULTY ADVISER:** ELI SHLIZERMAN

**INDUSTRY ADVISER:** SABAH BUX



## 47 PLATFORM ARCHITECTURE OPTIMIZATION USING INSIGHTS FROM USER AND PROCESSOR DATA

**SPONSORED BY**
INTEL

Data analytics, the process of analyzing raw data to find meaning and conclusions from massive datasheets, is a key process in optimizing technology. Data analytics is a key component of our project and its objectives. The goals of this capstone project is to study web and PWA usage and growth over time across different categories, study impact on client platform resources utilization, and deliver actionable insights for architecture & SW improvement. There has been an increasing trend in web platform capabilities, and better understanding platform resource utilization would help invent/modify designs that can improve user experiences.

**STUDENTS:** PO-CHIN HO, ANEESH KARPOOR, JUSTIN PIERRE-TREMBLAY, LOGAN SUN, AISHWARYA VENKATESH, PINYI WANG, DONGYU WEI

**FACULTY ADVISER:** ARINDAM K. DAS

**INDUSTRY ADVISERS:** BIJAN ARBAB, MOH HAGHIGHAT, SRUTI SAHANI

## 48 DEEP LEARNING BASED LOCALISATION FOR RNA SPATIAL TRANSCRIPTOMICS

**SPONSORED BY**
NANOSTRING TECHNOLOGIES

The goal of this project is to integrate the DECODE software into the current CosMx pipeline for gathering information about RNA localization from images. To achieve this, the DECODE software needs to be modified to support multichannel data and utilize temporal context. Additionally, the software needs to be compatible with C#, despite being originally written in Python. The integration process involves preprocessing the images to make them compatible with the DECODE software and incorporating the modified software into the existing CosMx pipeline. Overall, this project aims to improve the accuracy and efficiency of the CosMx pipeline for RNA localization by implementing the DECODE software.

**STUDENTS:** PAVAN KUMAR ANAND, MICHAEL BARGENDA, SHREEMIT GARIMELLA, KYLE HERBRUGER, MEGHAN RILEY SCHMIDT, ZHENGHANG WANG

**FACULTY ADVISER:** GEORGE SEELIG

**INDUSTRY ADVISER:** JOHN CHANDLER

## 49 MIXED-PRECISION QR WITH CUDA

**SPONSORED BY**
AMAZON

Mixed-precision computing is a promising approach for improving the performance of numerical algorithms by reducing the precision of some computations while maintaining accuracy. A mixed-precision block QR decomposition algorithm that decomposes a matrix into an orthogonal matrix and an upper triangular matrix. Our approach uses lower-precision floating-point formats for the majority of the computations, while switching to higher precision when necessary to maintain accuracy. Additionally, we propose a block-wise parallelization scheme that further improves the performance of our algorithm on modern parallel architectures.

**STUDENTS:** FULIN LI, WAN HSUAN LIN, JAIDON LYBBERT, MIKE PAO, SHASHANK S.
**FACULTY ADVISER:** NATHAN KUTZ
**INDUSTRY ADVISER:** TONG QIN

EE522: Graduate Quantum Practicum

## 50 CHARACTERIZING AND OPTIMIZING QUANTUM GATES

**SPONSORED BY**
IONQ

In a quantum computing system, the fidelity of the quantum gates is affected by physical parameters of the system which have stochastic noise within the gate timescale as well as mean value drifts over long timescale.s These physical parameters are usually not well monitored, which results in challenge of maintaining quantum gate performance. This project aims to design a control framework to correct the quantum gate error caused by the drifting of the physical parameters in IonQ's trapped-ion quantum machines through frequent and light-weight calibration.

**STUDENTS:** ERFAN ABBASGHOLINEJAD, HAOQING DENG, NINGZHI XIE
**FACULTY ADVISER:** NATHAN KUTZ
**INDUSTRY ADVISER:** JOHN GAMBLE



EE522: Graduate Quantum Practicum

## 51 INTEGRATE AUTOMATIC ORACLE SYNTHESIS INTO QDK FOR RESOURCE ESTIMATION

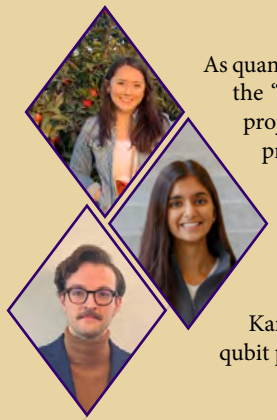
**SPONSORED BY**
MICROSOFT

Automatic oracle synthesis (AOS), which generates quantum oracle operations using classical arithmetic functions, can lower users' barriers in implementing quantum algorithm. In this project, we integrate AOS into Microsoft quantum development kit (QDK) and implement Grover quantum search algorithm. The AOS compiles classical arithmetic functions in Q# into quantum-equivalent operations in quantum intermediate representation (QIR), making oracle generation easier. Our prototype, available online, provides a proof of concept for this approach.

**STUDENTS:** I-TUNG CHEN, CHAMAN GUPTA
**FACULTY ADVISER:** ARTHUR BERNARD
**INDUSTRY ADVISERS:** MARIIA MYKHAILOVA, MATHIAS SOEKEN

EE522: Graduate Quantum Practicum

## 52 QUANTUM RESOURCE ESTIMATION OF ARITHMETIC PRIMITIVES



**SPONSORED BY**
MICROSOFT

As quantum computers progress towards a larger scale, it is imperative the "Top" of the computing-technology stack is improved. This project investigates the quantum resources required to compute primitive arithmetic algorithms, like multiplication. By using various quantum resource estimators, like Microsoft Azure Quantum's Estimator, we can determine the resources required for numerous quantum algorithms. In this project, we will provide a comprehensive resource analysis of numerous quantum multiplication algorithms such as Karatsuba, Schoolbook, and Windowed Arithmetic for different qubit platforms (trapped ion, superconducting, Majorana).

**STUDENTS:** ETHAN HANSEN, SANSKRITI JOSHI, HANNAH RARICK
**FACULTY ADVISER:** BORIS BLINOV
**INDUSTRY ADVISER:** WIM VAN DAM, MARIIA MYKHAILOVA

EE522: Graduate Quantum Practicum

## 53 QUANTUM MESSAGE PASSING ALGORITHM IMPLEMENTATION

**SPONSORED BY**
PACIFIC NORTHWEST NATIONAL LABORATORY

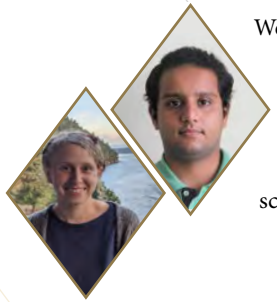
Distributed quantum computing can increase the number of usable qubits by connecting different quantum nodes. This project aims to build the Quantum Message Passing Interface (QMPI) in qiskit to take advantage of quantum teleportation to communicate between different quantum nodes using point-to-point and collective operations. Optimizations regarding these operations are investigated and tested on applications that can leverage the QMPI framework including the transverse field Ising model and quantum phase estimation.

**STUDENTS:** TOMMY NGUYEN, YUE SHI
**FACULTY ADVISER:** PETER PAUZAUSKIE
**INDUSTRY ADVISERS:** TORSTEN HOEFLER, ANG LI, MARTIN ROETTELER, TIM STAVENGER, SAMUEL STEIN, MARVIN WARNER

EE522: Graduate Quantum Practicum

## 54 ERROR ROBUSTNESS OF QUANTUM ADIABATIC ALGORITHMS

**SPONSORED BY**
UW ECE



We examine the error robustness of adiabatic quantum computing compared to traditional gate based quantum computing algorithms. We do this by using a toy model of gaussian free-fermion states which are easy to simulate and scale classically, and introduce a randomized error in both the adiabatic and non-adiabatic model to study how these errors scale as the number of qubits increase.

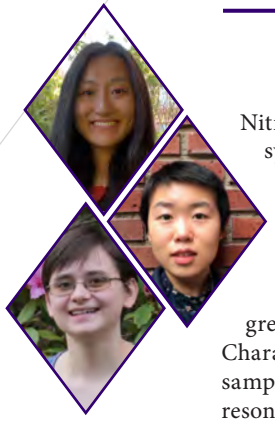
**STUDENTS:** UTHKARSH ADYA, ADINA RIPIN
**FACULTY ADVISER:** RAHUL TRIVEDI



EE522: Graduate Quantum Practicum

## 55 POLARIZATION OF 14N NUCLEAR SPINS NEAR NITROGEN VACANCY CENTERS IN DIAMOND THROUGH EXCITED LEVEL ANTI-CROSSING

**SPONSORED BY**
UW ECE, QUANTUM TECHNOLOGIES TRAINING AND TESTBED LAB



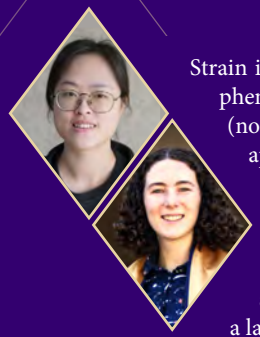
Nitrogen vacancy (NV) centers in diamond provide a suitable system for quantum computing and sensing applications at room temperature. NV qubit states can be encoded in the electronic spin states which have hyperfine coupling with nuclear spins of neighboring atoms. Utilizing the resources of the UW Quantum Technologies Training and Testbed (QT3), this project aims to achieve a high degree of polarized ensemble nuclear spins at room temperature. Characterization of the ground state of our ensemble NV diamond sample is accomplished using laser optically detected magnetic resonance with a confocal microscope.

**STUDENTS:** ROSE JOHNSON, MORGAN SHERER, XINGYI WANG
**FACULTY ADVISER:** MAX PARSONS

EE522: Graduate Quantum Practicum

## 56 MODIFYING CRYSTAL SYMMETRIES IN QUANTUM MATERIALS VIA SHEAR DISTORTION

**SPONSORED BY**
UW PHYSICS



Strain is a powerful tool for studying how electric and magenetic phenomena arise from crystal symmetries and creating flexible (no pun intended) solid-state devices for a wide range of practical applications. While many methods for applying lateral strain and pressure have been well documented, the ability to reliably apply small-scale shear strain in physics research applications is uncommon. This poster reports progress on the construction of a device for applying shear strain to bulk crystals and its pilot application to FeTe, a layered material which has the potential for strain-switchable antiferromagnetic ordering.

**STUDENTS:** SARAH EDWARDS, QIXUAN LIN
**FACULTY ADVISER:** ARTHUR BARNARD

EE522: Graduate Quantum Practicum

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## COMPUTATIONAL AND EXPERIMENTAL EXPLORATION OF NV– QUBIT PROCESSORS USING QUANTUM OPTIMAL CONTROL THEORY

**SPONSORED BY**
UW ECE, QUANTUM TECHNOLOGIES TRAINING AND TESTBED LAB

Diamond NV- centers are a promising platform for quantum computation due to their optical accessibility, experimental simplicity, and robustness. However, implementing gate operations on a physical system can present difficulties. Cross talk and instrument limitations can be compensated for by employing quantum optimal control (QOC) strategies. In this project, we employ QOC to optimize control pulses for the NV based quantum processor being developed in the QT3 lab. Utilizing the gradient ascent pulse engineering (GRAPE) method, we optimize two-qubit entangling operations of the NV- electron and nuclear spins, laying the groundwork for more complex pulse sequences and gate operations.

**STUDENTS:** RITHI ANANDWADE, ERIC ANDERSON, JANE GUNNELL

**FACULTY ADVISER:** MAX PARSONS

EE522: Graduate Quantum Practicum

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## IMPLEMENTING AN ACCORDION LATTICE TO CREATE TUNABLE VERTICAL SPACING IN A KAGOME LATTICE EXPERIMENT

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UC BERKELEY

This project focuses on the design and implementation of an optical accordion lattice to provide a vertical lattice dimension for a Kagome lattice experiment. The objective is to create a lattice with spacing that can be tuned between 2 and 10 μm. All optics will need to be mounted in a narrow gap between existing breadboards and lattice beams, and the design of a vertically mounted breadboard to accomplish this is also discussed.

**STUDENT:** CARSON PATTERSON

**FACULTY ADVISER:** DEEP GUPTA

**INDUSTRY ADVISER:** DAN STAMPER-KURN



EE522: Graduate Quantum Practicum

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## CAVITY-MODULATED QUANTUM CONTROL OF CHEMICAL REACTIONS

**SPONSORED BY**
PACIFIC NORTHWEST NATIONAL LABORATORY

In this study, we investigate the unique properties of polaritons, quasiparticles arising from the strong coupling between light and matter, with a particular focus on their potential for controlling chemical reactions. By employing quantum electrodynamics calculations, we explore the influence of cavity coupling on proton transfer reactions in malonaldehyde and 10-hydroxybenzo[h]quinoline. Utilizing first-principles methods, we demonstrate the feasibility of harnessing cavity coupling to manipulate and control proton transfer processes.

**STUDENT:** ZHAOYUAN YANG

**FACULTY ADVISER:** MUNIRA KHALIL

**INDUSTRY ADVISER:** NIRI GOVIND

2023 ENGINEERING INNOVATION ENTREPRENEURSHIP


ELECTRICAL & COMPUTER ENGINEERING

UNIVERSITY *of* WASHINGTON

program design: Ryan Hoover