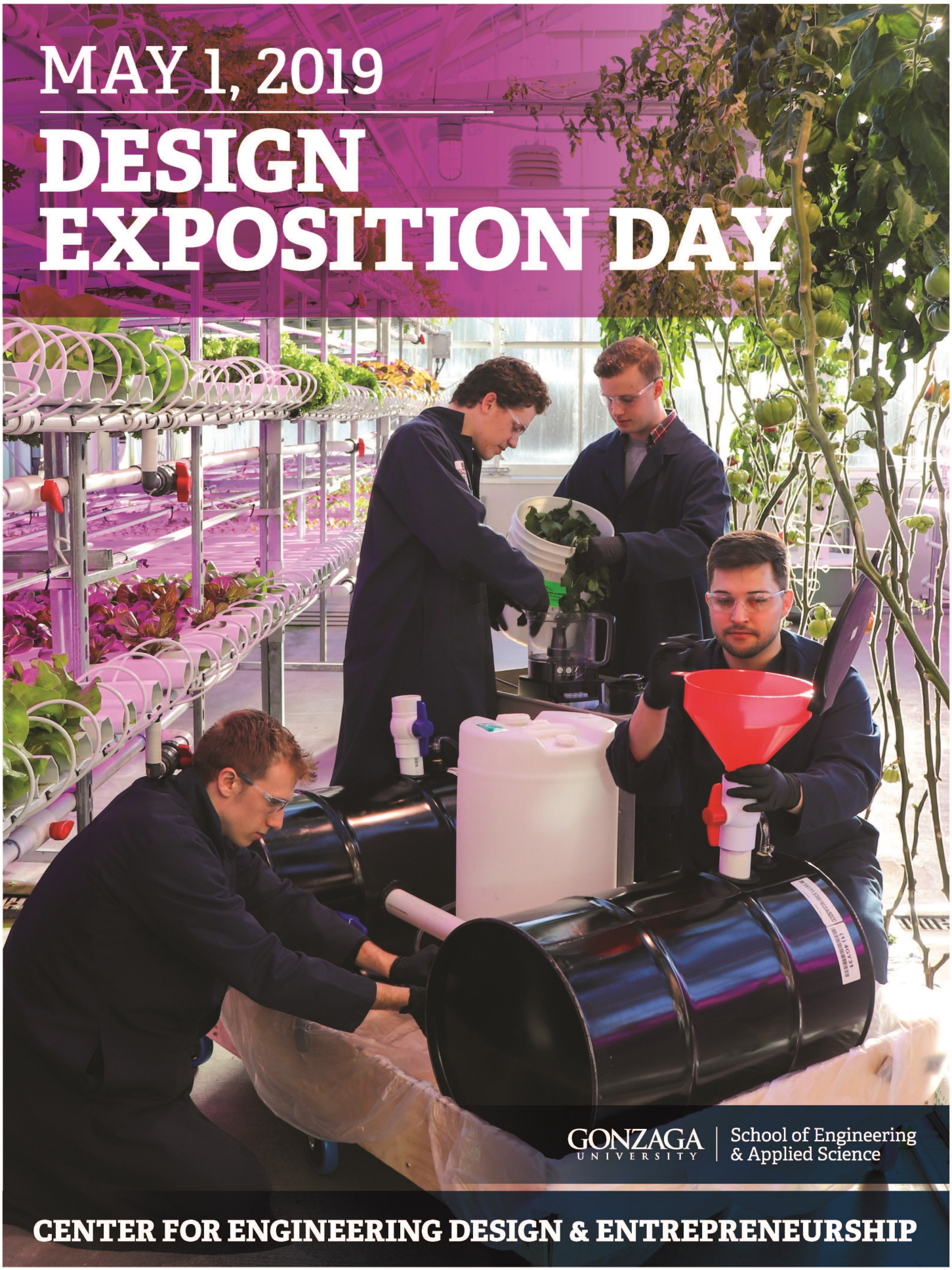
MAY 1, 2019

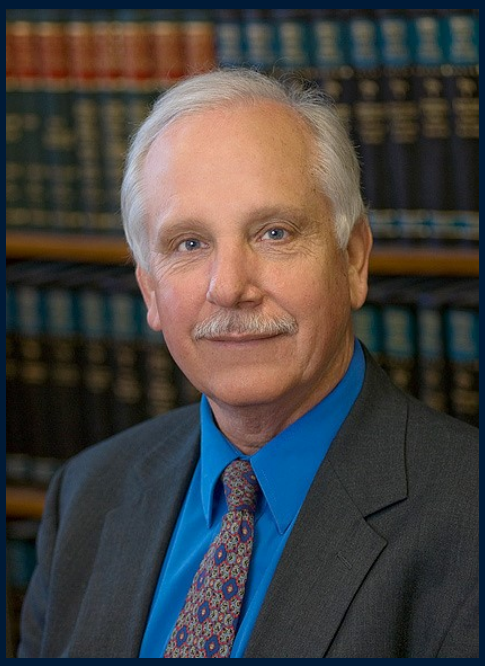
DESIGN EXPOSITION DAY



GONZAGA UNIVERSITY | School of Engineering & Applied Science

CENTER FOR ENGINEERING DESIGN & ENTREPRENEURSHIP

Message from the Dean



SEAS Seniors and Design Exposition Day Attendees:

It is my great pleasure to welcome you to Design Exposition Day on behalf of our School of Engineering and Applied Science.

As a newcomer to the School and to Gonzaga, I have been amazed by the dedication and hard work of all involved that has culminated in this very special day. Specifically, I would like to extend my deep gratitude to our Design Advisory Board members, project sponsors, supervising faculty, and numerous community members who have assisted in developing this wonderful event. All of us within the School hope that you can see how your efforts have allowed our senior students to transform proposal ideas into the works of final designs and products that you witness here today.

I am especially thankful for the commitment of the faculty and staff of the School of Engineering and Applied Science throughout the past year that has contributed to the success of this day. Academic Director, Toni Boggan, and the SEAS Capstone Committee members deserve major kudos for their tireless efforts in bringing this day to fruition.

And to our senior SEAS students, I first want to congratulate you on this milestone achievement of your capstone project. Starting many months ago, you worked closely together with your fellow design team members to take a simple project idea and transform that concept into the physical presentations we see today. Thank you for your dedication and commitment to excel in this challenging endeavor.

I also wish to express my appreciation to all of the students, faculty and staff of this outstanding School for the privilege of serving as your Dean this past year. All of you have contributed substantially to the advancement of SEAS and I know that the future of this great School is a bright one.

Thanks again.

Joseph J. Fedock
Interim Dean, School of Engineering and Applied Science

Message from the Academic Director

Congratulations to our Capstone Class of 2019! We proudly celebrate your success and accomplishments today! We wish you the best in the future and hope that you will keep us updated on your post-graduation engineering and computer science experiences.

Thank you to all the people who support the education of our students and help to foster the next generation of engineers and computer scientists. Your gifts and mentorship help sustain and grow our program. We especially thank the sponsors who supply the capstone projects and the liaisons to guide the students. Thank you to the faculty, staff, Design Advisory Board and Capstone Committee.

Go Zags!

Toni Boggan
Academic Director
Center for Engineering Design and Entrepreneurship

Welcome to Design Exposition Day 2019

Gonzaga University's Center for Engineering Design & Entrepreneurship was established in 1992 to enhance the design experience for senior engineering and computer science students. The Center organizes projects for the academic year and many are commissioned by sponsors in the private and public sectors. Prospective sponsors are sought throughout the year for projects involving all engineering and computer science programs. Many projects are interdisciplinary.

Participating sponsors provide a definition, resources, and funding for the projects. They also commit a liaison from the sponsoring company to guide and support the students throughout the academic year. Sponsors receive several benefits from the Senior Design Program including a project completed by students and faculty members. Additionally, the sponsoring company has the opportunity to work with bright and enthusiastic individuals with innovative ideas. This team experience is an opportunity to evaluate senior students as prospective employees.

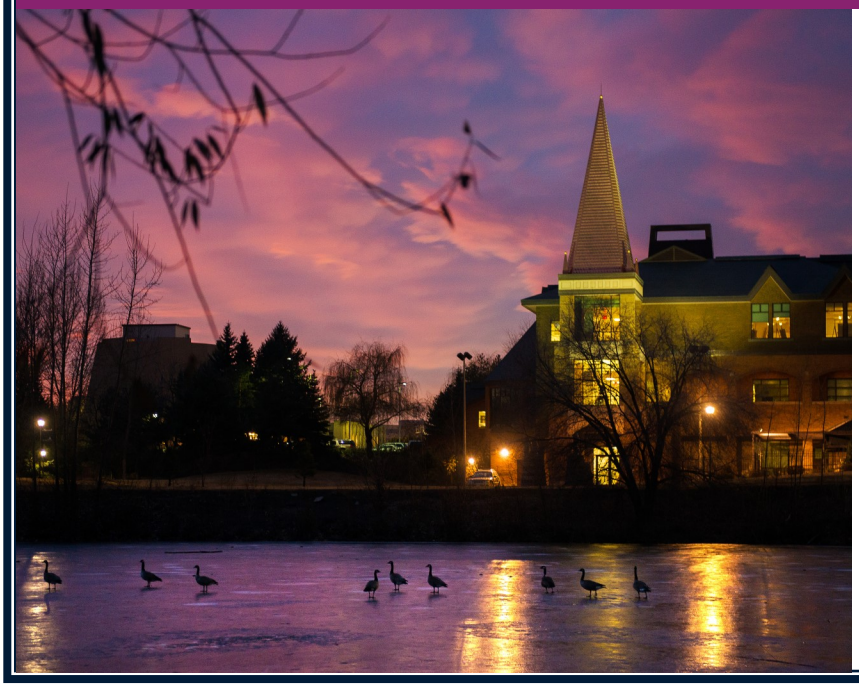
Recently, another type of project developed which is the student proposed project. During their junior year, engineering and computer science students research and refine potential projects which are then reviewed by a faculty committee. If a project is accepted, the students who proposed it work on the project. In the 2018-2019 school year, fourteen of the projects were developed by student teams.

All projects are periodically reviewed by faculty and the Center's Design Advisory Board (DAB). The DAB is comprised of engineering and computer science professionals in both the private and public sectors. They are instrumental constituents for the Center and a major factor in guiding the students. The review process brings an outside perspective to the teams and is a component required to meet design guidelines established by the Accreditation Board for Engineering and Technology (ABET).

Design Advisory Board Members

The Center for Engineering Design & Entrepreneurship is supported by a dedicated group of volunteers from the engineering community who lend their expertise to our students and our program by reviewing our student's presentations and reports.

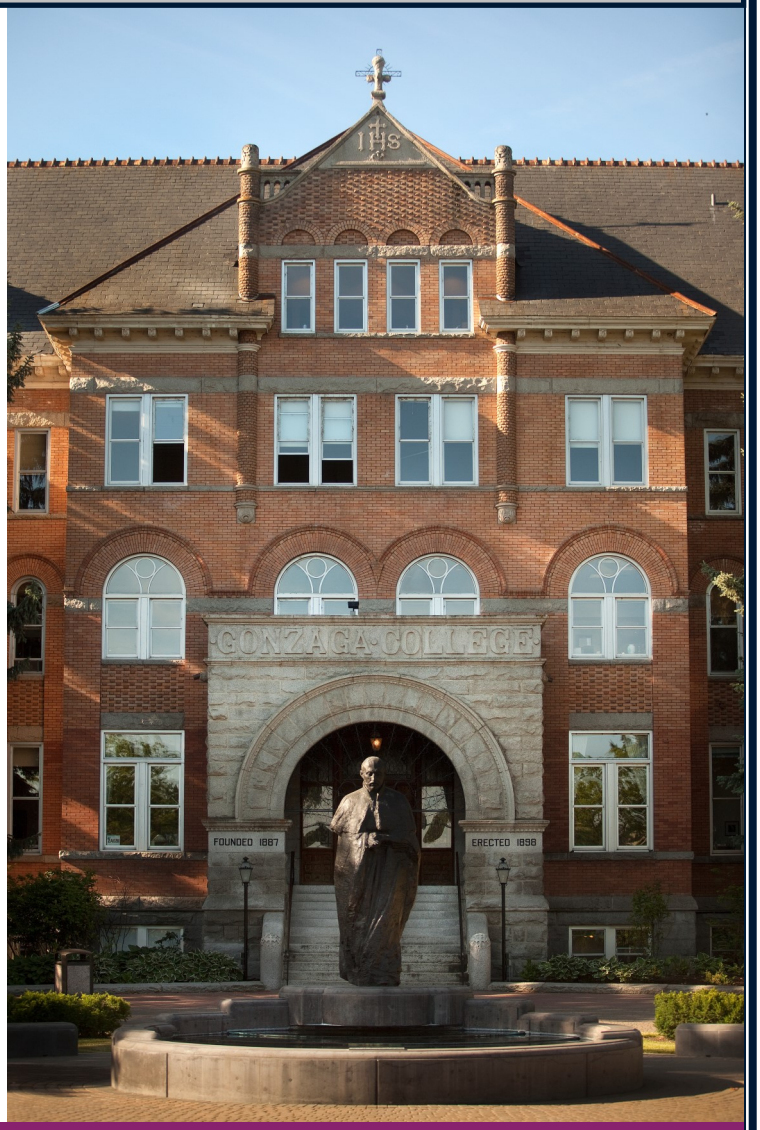
Adam Miles	Anmpllc.com
Alana Wallace	Katerra
Alek Marinos	Keytronic
Andrew Matsumoto	Civil West Svcs
Bill Fees	WA Dept. of Ecology
Bill Galle	Spokane County
Bob Turner	City of Spokane
Chris Sharman	Soft Dev Systems
Colleen Little	Spokane County
Colleen Nolting	Kaiser Aluminum
Dan Lenz	Quad/Graphics
Dannielle Haraldson	Boeing
Dave Duncan	Dept. of Ecology
David Moss	Spokane County Utilities
Doug Pooler	Empire Lab Systems
Eric Ryan	SEL Inc.
Ethan Murnin	Spokane County
Gary Holmesmith	Kaiser Aluminum
Gary R. Weber	Boeing
Greg Lahti	WSDOT
Henry Loehner	WSDOT
J. McCall	Reiff Molding
Jacob Koopmans	Boeing
Jake Saxon	Spokane County
Jeff Nolting	Juno
Jeff Owen	SEL Inc.
Jim Roletto	Enrico Consulting/HMH
Jim Simon	Gonzaga University
Jim Weston	Gonzaga University
Joel Lee	Metro Engineering
John Gibson	AVISTA
John Olsufka	Telect
Katie Larimer	WA Dept. of Ecology



We are so grateful for the invaluable relationships forged with our students and the Design Advisory Board. If you or someone you know would be interested in serving on the Design Advisory Board, please contact Toni Boggan, boggan@gonzaga.edu, 509-313-3913, or visit us on the web at www.gonzaga.edu/cede.

Design Advisory Board Members

Katy Allen	City of Liberty Lake
Les Bohush	Gibby Media
Lindsay Gilbert	CH2M
Luke Blanchart	MW Engineers
Mason Van Lith	KeyTronicEMS
Matt Zarecor	Spokane County
Melissa Verwest	Oldcastle Precast
Michael Maffeo	Boeing
Michael Herzog	Itron Corporation
Mike Mudge	Avista
Nick Questad	Boeing
Paul Robertson	SEL Inc.
Phillip Pintor	Coffman Engineers
Rick Coz	Gonzaga University
Rob Bryant	Gonzaga University
Ryan Leahy	Haakon
Sam Shoemaker	MW Consulting
Scott Marshall	HDR Inc.
Sushi Shenoy	Eclipse Engineering
Terra Donley	HDR Inc
Tom Zysk	Boeing



Gonzaga University President, Dr. Thayne McCulloh, Spokane Mayor David Condon, and Spike the Bulldog take the "PewGo," a solar-powered cart modified by students in the School of Engineering & Applied Science, on an inaugural drive down the redesigned Sharp Avenue in October 2018. Senior Design teams from previous years aided in the research and the design of Sharp Avenue, which runs just north of campus.

CEDE Excellence Award: Dr. Arthur "Art" Miller

The CEDE Excellence Award is presented to recognize an outstanding contribution to the Senior Design Program. The 2019 CEDE Excellence Award is proudly presented to **Dr. Arthur L. Miller,** for his dedicated commitment to the Senior Design Program.

Dr. Miller has been a friend of CEDE since 1998. He is a self-proclaimed late bloomer, earning his doctorate at age 50. Before that time, he worked as an aircraft mechanic and pilot, studied German and Aeronautical Engineering, including air-turbulence research at the Technical University of Berlin. His first engineering job was conducting research on hydraulic fragmentation of hard rock with the US Bureau of Mines in Minneapolis.

For 20 years, Art has worked as a researcher at the NIOSH lab in Spokane, where he currently leads the Automation and Technology team. During that time, he has hosted and advised over 30 teams, in addition to providing valuable internship opportunities for our students and sometimes full-time employment post-graduation. Five of his teams have won the annual ASME National Student-Engineering Safety Award, and three have led to commercialized products.

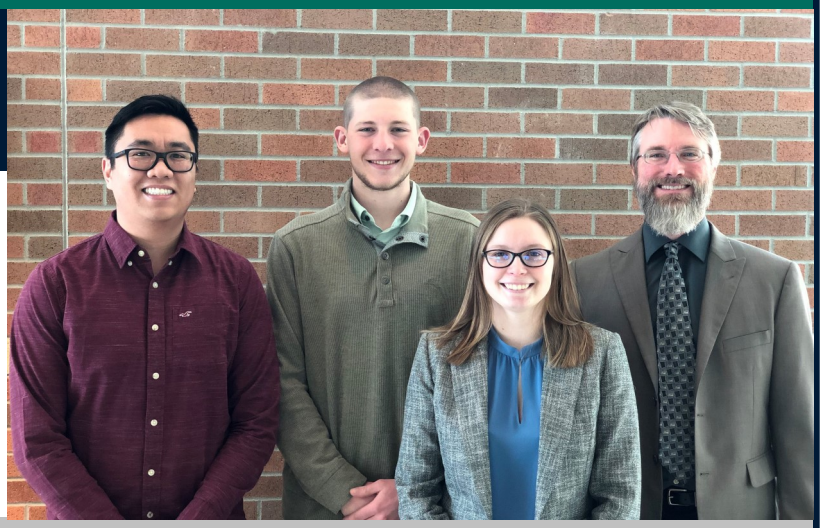
His favorite memories of CEDE are the many innovative and fun "project day demonstrations" his teams have come up with over the years (Design Expo Day!). He claims that almost all of his students are smarter than he is, and lack only the wisdom of age and experience (and the gray hair that goes with it!). He encourages them all to enjoy the learning and build up their toolboxes based on their experiences. Art carries a philosophy of diving into things with a "full steam ahead" attitude, encouraging all to keeping their eye on the goal and to store up all those experiences in their toolbag for later use, because your toolbag is your wisdom.

Student Project Teams

Project teams generally consist of three to five students and a faculty advisory to work with the liaison. The students' initial task is to generate a project plan and define strategies required to bring the project to fruition. Students are required to make effective use of available resources to manage their project activities. Specific milestones are identified including written reports and oral presentations. Faculty advisors lend knowledge and experience to the student team by providing guidance in the technical and managerial decisions required by the project. Liaison(s) monitor progress of the project team and assist in making the best use of the sponsor's resources and facilities.

Student Proposed Projects

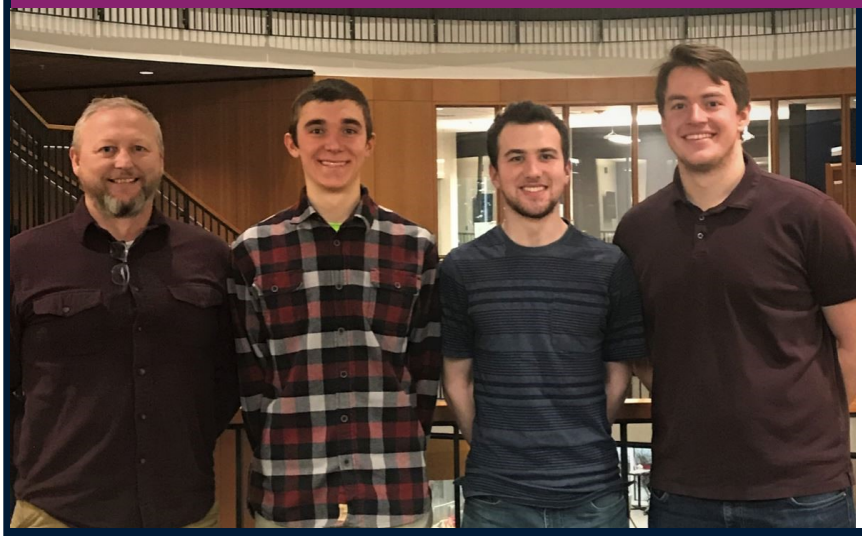
ENSC 01, 2D Seepage Model



Ryan Nguyen
Collin Connelly
Christina Languell

Advisor: Dr. Mark Muszynski

The goal of the 2D seepage model is to construct a visual model for the Soil Mechanics lab to aid Dr. Muszynski in teaching and educational outreach efforts. The primary purpose is to create a visualization of flow nets using food coloring, so students may better understand the interaction of seepage under a barrier, such as a dam. By regulating the incoming flow, the seepage model will ensure a constant head difference so that flow nets may be observed. The secondary purpose of the model is to be used by faculty for outreach efforts to local schools and visiting students to promote the engineering program at Gonzaga University. Outreach efforts may include GEL weekend, campus tours, and STEM outreach.



ENSC 02, Bike Safety Smart Sensor: Smart Helmet

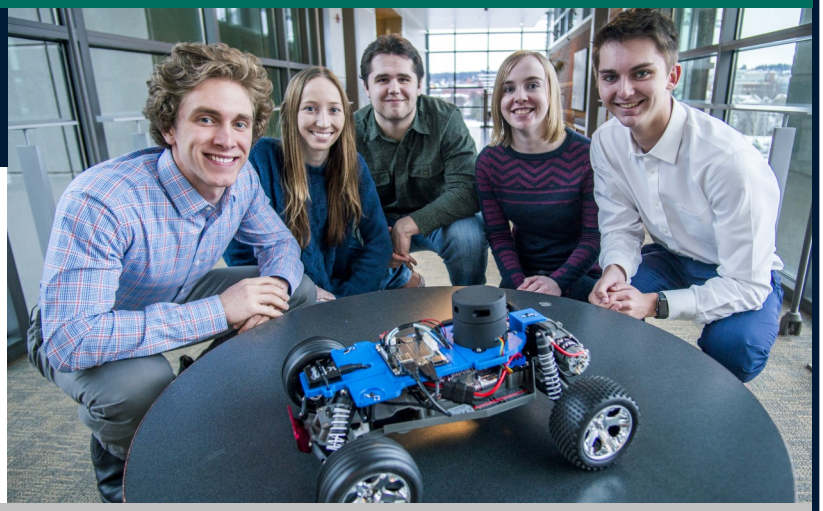
Arthur Lane
Robert Brajcich
Damon George

Advisor: Tim Ecklund
Liaison: Kamil Agi

The Smart Helmet enhances cyclist and driver safety by utilizing wireless communication channels to transmit direction, location, and speed data between road users. Vibration and audio notifications keep the cyclist up to date with nearby threats while vehicles also receive critical information about the cyclist. As autonomous and smart vehicles begin to roll out, they can use this technology to supplement their decision-making since the product design involves integration with the new Vehicle-to-Everything (V2X) communication standards.

Student Proposed Projects

ENSC 03, Driving Optimization for Autonomous Vehicles



Blake Casagranda
Victoria Sample
Brady Whetsel
Cheyenne Stefan
Samuel Atkinson

Advisor: Debra Offill

The goal of our project, Optimization for Autonomous Vehicles, was to build & test a retrofitted RC car capable of driving itself along a predetermined track & maximizing its speed along that track. Because autonomous driving is a cutting-edge technology continually being developed, we intended to utilize senior design as an opportunity to learn & experiment with it, as we want to be more knowledgeable on the topic upon beginning our respective careers. We began the project by retrofitting an RC car with a microcontroller, enabling communication with the vehicle via software, and a suite of sensors, enabling data collection to be used once the car drives autonomously. A mathematical model was then created, yielding the car's maximum angular velocity. Code enabling autonomous driving & speed-optimization was written, allowing the car to use the data from its initial, manual run around the track & reproduce the route autonomously at maximum speed.

ENSC 04, Energy Storage in the Northwest

Josh Holcomb
Nathan Jamsa
Erik Crouch
Shawn Marshall-Spitzbart

Advisor: Andy Johnston
Liaison: Phil Pintor

Renewable energy sources will be key as the world transitions away from traditional fossil fuels. Hydrogen is a promising renewable energy fuel that shows great potential. A sustainable method of producing hydrogen is through electrolysis, or running a current through two submerged electrodes to separate water into hydrogen and oxygen. Unfortunately, this process is very energy intensive and electrolysis efficiency is often very low. Many factors effect this efficiency and several of these factors are being studied and optimized. One efficiency factor that has not received any industry attention is fluid flow over the surface of electrodes. Until now! Our group recognized many similarities between electrolysis mass transfer and traditional convective heat transfer. To this end, we have conducted a research project to measure how different fluid flow schemes effect the efficiency of an electrolysis system.

Student Proposed Projects

ENSC 05, Hold That Cup of Joe

Ivan Jimenez
Breyana George
Payton Rothlin
Kendall Monson

Advisor: Dr. Noel Bormann
Liaison: Dr. David Cleary, Gonzaga

The purpose of this project is to investigate the performance of activated carbon (AC) made from spent coffee grounds (SCG) in removing lead from drinking water. This will create a way to reuse and reduce SCG waste, as well as produce a cost-effective alternative to other water filtration processes. The procedure to turn SCG into AC includes pyrolysis, carbonization, and activation. Converted activated carbon was applied to water sources containing elevated levels of lead. This project initially focuses on testing synthetic contaminated water and was then tested on private water systems in the greater Spokane area. The result was the production of an activated carbon bio-adsorbent capable of a 90% removal rate of lead in our water sample, as well as a business implementation strategy for integration into modern coffee culture.

ENSC 06, Hybrid Rocket Engine Test Instrument

David Barnes
Nicholas Fritschler
Jordan Haliday
Gabe Leopold

Advisor: Dr. Marc Baumgardner

In the field of rocket propulsion and combustion, one area that is severely lacking in research is hybrid propulsion systems. Four mechanical engineering students were tasked with designing and fabricating a test stand and proof-of-concept motor for Dr. Marc Baumgardner. After reviewing several configuration options for this new test instrument, the team decided on an easily transported cart-style test stand that would hold the motor in a horizontal orientation while under operation. The motor for this project is a solid-fuel-gaseous-oxidizer hybrid rocket motor yielding approximately ten pounds of thrust. The test stand records crucial data including: chamber pressure, thrust, and oxidizer flow rate for performance analysis and review after each test is completed. It is the hope of the team that this project will provide Dr. Baumgardner and the University with a useful tool that will allow for new opportunities in hybrid propulsion research for both faculty and students.

Student Proposed Projects

ENSC 07, Infinity Ladder

Jarid Bennett
Dillon Bull
Kimbrell Larouche

Advisor: Jacob Laete
Liaison: Doug Pooler

We created a piece of exercise equipment called The Infinity Ladder. This machine simulates the motion of ladder climbing and provides the user a full body workout. When we designed our project, our intent was to create a machine that could be more easily transported, and to add a factor of safety of at least 2 throughout for the weight requirement of a fire-person (typically 350 pounds in full gear). It can split into more manageable sized parts to allow for easier assembly. We estimate that the machine could be built and marketed for about $1,000. Current competitors offer similar machines for a retail price over $5,000 that are slightly heavier and cannot be disassembled for convenience purposes.

ENSC 08, Liquid Cooled Brakes

Thomas Kourtis
Mark Luciano
William Brazeau

Advisor: Jim Weston

Throughout the year, we have been on a mission to develop a system to retrofit to cars that cools brakes through a liquid cooling system in addition to air cooling. Our team has learned many things throughout the different approaches we have taken to find a solution, which has brought us to our final design that meets our goals. We have successfully mounted a brake assembly to a display/test stand and integrated our liquid cooling system to the brakes, which ultimately achieves our goal of maintaining high brake performance under severe use by keeping brakes from overheating.

Student Proposed Projects

ENSC 09, Modular Children's Prosthetic

Wesley Houser
Michael Shiraishi
Matthew Lugo
Luis Gonzalez-Flores

Advisor: Rich Thomas
Sponsor: Fabtech Systems
Liaison: Greg Mattson

The goal of our project is to help in the area of children prosthetics. Currently there are two major issues with children's prosthetics, the first being that the prosthetics are expensive and the second being that children grow rapidly. The combination of these two issues deter families from buying prosthetics for their child until the child stops growing. Our design extracts the functionality of an expensive prosthetic and makes it less expensive so that families can afford the prosthetics. This is accomplished by housing the electronics of the prosthetic in a capsule that can be transferred from one prosthetic to the other. With our design, families would only pay for the electronics up front which will be reused in future prosthetics. The skeleton of the arm is 3D printed, allowing for rapid iteration and low manufacturing costs.

ENSC 10, Wind Design of Tall Buildings

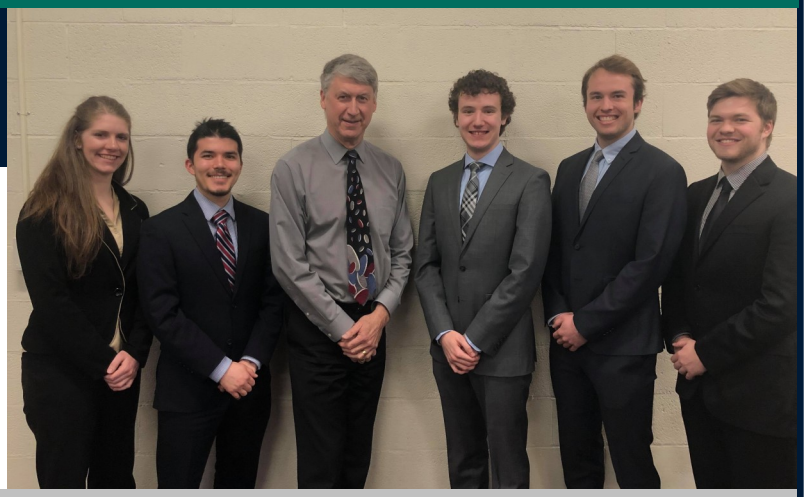
Logan Cayton
Alex Pihl
Jonnie Teman
Kyle Lerch

Advisor: Dr. Joshua Schultz

Performance based wind design (PBWD) is an alternative design method used for tall buildings in seismic zones. There is currently disagreement among professionals about the applicability and potential benefit of PBWD over traditional wind design. This project applied PBWD to a slender building using software for non-linear analysis to determine if PBWD is beneficial for the given aspect ratio and location. Future studies could use this procedure as a template to perform analysis on other aspect ratios and locations to determine scenarios in which PBWD is most applicable.

Student Proposed Projects

ENSC 11, Personal Desalination Device



Mikaella Croskrey
Ross Leung-Wagner
Sebastian Berven
Josh Aspinwall
Matthew Moen

Advisor: David Moss

Our team wanted to provide a solution to the issue of global water scarcity and worked to create a personal desalination device capable of providing clean, potable water from sea water. We aimed to move away from cost prohibitive multi-billion dollar desalination plants and instead focus on a small-scale product with an emphasis on a smaller unit cost and more portability that could still produce enough water to adequately provide for 1-4 people. Our device is capable of filtering enough water to support a family in a matter of hours, so we hope that by making the desalination process cheap, easy, and accessible, more people worldwide can get access to the water they need, regardless of the source.

ENSC 12, Roasting Efficiency (Coffee)

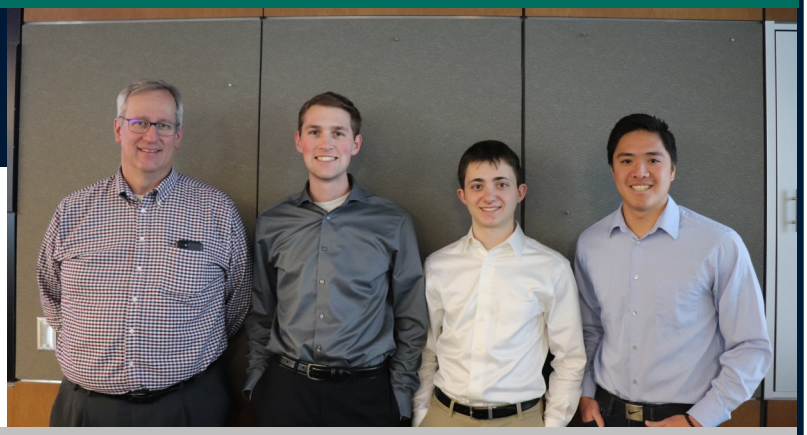
Christopher Ward
Daniel Seats
Christopher Rizzuti
Andrew Swift

Advisor: Dr. Marc Baumgardner

ENSC 12 started with the goal to increase the efficiency in the coffee roasting process by addressing the issue of waste heat. The energy dissipated through heat loss was to be partially recovered by use of a turbine implemented in an energy recovery cycle. A Tesla Turbine was chosen to recover the energy due to its ease of manufacture and unique characteristics of operation. The project scope included the design, fabrication, and testing of a Tesla Turbine in an environment simulating a coffee roasting cycle. ENSC 12 completed a detailed analysis of the recoverable waste heat and designed the turbine to operate with the conditions produced by the roasting cycle. The Turbine was manufactured, assembled and tested to compare its performance against the theoretical model. The Turbine's torque, rotations per minute, and electrical power were all measured during the experimental trials.

Student Proposed Projects

ENSC 13, Virtual Touchscreen



Ryan Zenoni
Joseph Bruckner
Nathaniel Ng

Advisor: Rodney Pickett

Today, the world is filled with computers and smartphones. They are found in work places, schools, homes, pockets, museums, and come in a wide range of sizes. With the amount of different devices a single person owns, it is common for that person to have to carry around all of their devices. The devices they are carrying around have a lot of overlap with their functionality and can be an expensive investment. The dependent virtual touchscreen is simply an idea for removing the need for multiple devices with the same functionality. The dependent virtual touchscreen allows a user to be mobile with their desktop computer, and with the same device, be able to increase the screen size of their smartphone. Using a projector in unison with an array of sensors, the virtual touchscreen is capable of tracking a user movement on a table and relaying the information to the computer.

ENSC 14, Trafixx: The Smart Traffic Grid

Nick Hopwood
Trevor Flynn
Tyler Willis

Advisor: Shane Pacini

The Trafixx Project started three years ago as an ambitious effort to replace the outdated traffic grid infrastructure with modern computing technology with the purpose of drastically improving the efficiency of the grid. We have developed two products in the past year to achieve this goal. First is a real time data analytics software that pulls sensory data from across the entire grid to determine optimized timing for light patterns at intersections. Second is hardware that will replace the outdated controllers at each intersection. Off the shelf hardware has been modified to run our data analytics software at the intersection to make efficiency decisions in real time. Since our data analytics software operates using a machine learning AI, it will continue to improve its efficiency decisions over time and be able to account for a wider range of traffic conditions.

Civil Engineering Projects

ENSC 15, Spokane Bicycle Network

Patrick Benjamin
Jay Pullen
Will Thompson

Advisor: Dr. Rhonda Young
Sponsor: City of Spokane
Liaison: Inga Note

The Spokane Bicycle Network project analyzed the existing bicycle network in Spokane using a data-driven analysis, as well as provided design recommendations in three focus areas around Spokane: the Downtown and University District connectivity, the Mission Corridor, and the Northeast Spokane Corridor with the future Children of the Sun Trail. The project team used facility, usage, and crash data in three types of analysis. These analyses looked at physical qualities of the roadway, existing facilities and destinations for cyclists, and origin-destination census data. These analyses methods helped identify roadway segments that would benefit the most from the addition or enhancement of bicycle facilities. The project team then selected roadways and connectivity areas within the three focus areas to provide design recommendations as case studies showcasing methods used throughout the project. These methods were then documented and provided to the City of Spokane to encourage proactive bicycle infrastructure planning.

ENSC 16, Wyoming Connected Vehicle: Phase III

Megan Zollars
Dominic Vernon
Ian Rypkema
Drew Segren

Advisor: Dr. Rhonda Young
Sponsor: McFarland Management
Liaison: Fred Kitchner

The Wyoming Connected Vehicle Pilot is a USDOT project located along a 402 mile stretch of Interstate-80. The goal of the third phase was to create analysis methods that would be used to analyze the effectiveness of Connected Vehicles (CVs), through 10 different performance measures. The performance measures consisted of actions CVs took after receiving an alert, speed data from pre-deployment compared to post-deployment, CV speeds compared to non-connected CV speeds, and crash data from pre-deployment compared to post-deployment. Our team has successfully created analysis methods and analyzed preliminary data with the release of Connected Vehicles.

Civil Engineering Projects

ENSC 17, Spokane Local Government Operation Greenhouse Gas Emissions Inventory

Wesley Davis
Jena Jadallah
Luke Schumm

Advisor: Dr. J. Alexander Maxwell
Sponsor: City of Spokane
Liaisons: Cadie Olsen, Deb Bisenius, Nathan Groh

As of July 2017, the City of Spokane adopted Ordinance C35519, mandating that the City take action to achieve its goal of reducing GHG emissions by at least 30% (below the 2005 baseline level) by 2030. As part of the ordinance, the City is required to account for and publish the GHG emissions created by the local government operations and the community. Using the Educational Partnerships for Innovation in Communities (EPIC) model, our team of environmental studies, civil engineering, and engineering management students worked with the local government to develop a greenhouse gas emissions inventory within the scope of local government operations for the 2016 calendar year. The team utilized the Local Government Operations Protocol (LGO) as the framework for the accounting methods. The team presented their results at the Washington and Oregon Higher Education Sustainability Conference in February and will also make presentations to the Mayor's Cabinet, the City's Public-Infrastructure-Environment-Sustainability Committee, and City Council. The team hopes this work will also help lay foundation for future collaboration between the local Spokane Government and educational institutions.

ENSC 18, Spokane Community-Scale Greenhouse Emissions Inventory

Chelsey Hand
Austin Kaesemeyer
Frederick Winter
Dawson Matthews

Advisor: Dr. J. Alexander Maxwell
Sponsor: City of Spokane
Liaisons: Cadie Olsen, Deb Bisenius

As of July 2017, the City of Spokane adopted Ordinance C35519, mandating that the city take action to achieve its goal of reducing GHG (Greenhouse Gasses) emissions by at least 30% (below the 2005 baseline level) by 2030. As part of the ordinance, the City is required to account for and publish the GHG emissions created by activities (e.g., residential, commercial, industrial, transportation, etc.) from within the City of Spokane boundaries. Through the Educational Partnerships for Innovation in Communities (EPIC) model, our team of environmental studies and civil engineering students worked with the local government to develop a community-scale greenhouse gas emissions inventory within the municipal boundary for the 2016 calendar year. The team utilized the Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories (GPC) as the framework for the accounting methods. The team presented their results at the Washington and Oregon Higher Education Sustainability Conference, the Mayor's Cabinet Meeting, Public-Infrastructure-Environment-Sustainability Meeting, and a Spokane City Council meeting.

Civil Engineering Projects

ENSC 19, Beaver Dam Analogs

Corey Johnson
Brian Wise
Dominic Barashkoff
Trenton Nett

Advisor: Dr. Sue Niezgoda
Sponsor: U.S. Fish and Wildlife Service, The Lands Council
Liaisons: Brian Walker, Joe Cannon

The first goal of this project was to continue previous year's monitoring efforts to examine the effectiveness of Beaver Dam Analogs (BDAs) at trapping sediment in California Creek and reduce downstream sediment loads in Hangman Creek. Our team, along with sponsors, The Lands Council and U.S. Fish and Wildlife, met this goal by collecting and analyzing monitoring data that shows initial signs of aggradation around the BDAs. Additionally, as a second project goal, our team has developed a repeatable method for using a DJI Phantom 3 Standard drone and camera, structure from motion aerial photogrammetry, and geomorphic change detection software to document changing channel morphology in California Creek. A third project goal was to apply Stage 0 restoration methodologies to a reach within the Hangman Creek Watershed. Design plans were developed to transform a valley containing an incised single threaded channel to a spread-out, multi-threaded stream with a diverse ecosystem.

ENSC 20, Putting Food Waste to Work

Christopher Klahr
Drew Mosman
Philip Dantas Whitney
Miles Sustad

Advisor: David Moss
Sponsor: WA Department of Ecology
Liaisons: Bill Fees, John Cleary

The Washington State Department of Ecology tasked our team with investigating the technical and economic feasibility of a campus-scale, two-stage anaerobic digester. Anaerobic digestion is a biochemical process in which organic waste breaks down without the presence of oxygen to create methane gas. Our team is applying anaerobic digestion to food waste because the current disposal of food waste misses the energy, nutrient, and carbon cycling benefits of recycling and energy recovery. By using two-stage anaerobic digestion, we can reduce the final volume of food waste, and the methane gas can be captured and burned as an energy source. Our team researched, designed, built, and tested a two-stage anaerobic digester and used our findings to determine if a larger scale digester would be beneficial on Gonzaga's campus.

Civil Engineering Projects

ENSC 21, Wenatchee Housing Complex

Nichole Brannan
Karla La Torres Alvarez
Courtney Maciolek
Alexander Schneller

Advisor: Tony Stenlund
Sponsor: TD&H Engineering

The Wenatchee Housing Complex is a project to design a 70,000 square foot, four-story, multi-family building in the City of Wenatchee, Washington. The structure will be built with energy efficiency in mind and will incorporate wood framing, and structurally insulated panels. The team was responsible for the structural design of the building, including gravity systems, lateral systems and the foundation. Calculations were completed for major structural components including framing members, beams, joists, walls, shear walls, foundations, and connections. The building was designed to resist design loads including dead, live, snow, wind, and seismic loads. The final product of this project is a design development level set of drawings that include framing and foundation plans, as well as construction details.

ENSC 22, Stormwater Treatment Monitoring Project

Nicole Chen
Leland O'Hanlon
Bella Burzynski

Advisor: Dr. Aimee Navickis-Brasch
Sponsor: Spokane County
Liaisons: Ethan Murnin

Aquatech has assessed the stormwater treatment performance of a dual cell bioretention pond located on Gonzaga's campus in Spokane, Washington, and evaluated the pond's pollutant removal effectiveness during cold climate conditions, specifically with the use of deicer on the contributing basin area. The team compared runoff treatment performance of a bioretention cell constructed to the required minimum depth of 18-inches and the other to a depth of 12-inches. The required bioretention soil media for Washington State has been extensively tested in Western Washington. Stormwater samples were collected to determine if the bioretention pond was successful in reducing pollutant concentrations of selected pollutants, including total suspended solids, total petroleum hydrocarbons, total phosphorus, and total and dissolved copped and zinc.

Civil Engineering Projects

ENSC 23, Multi Story Steel Frame Design

William Hietter
Ariana Felix
Lindsey Peterson

Advisor: Dr. Joshua Schultz

Engineering design is heavily dictated by the various codes that engineers are held accountable to; namely the American Society of Civil Engineers: Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7). This project is focused on the progression of wind loading provisions and their subsequent impacts on design. Design wind pressures were determined using relevant code publications dating back to the early 20th century. The multitude of computed wind loads were then applied to a 10-story steel frame to evaluate how the various loadings impact column sizes. The observed increase in length and complexity of codes poses the question, are these changes resulting in more economical designs or are engineers potentially overburdening themselves by trying to understand and apply these codes. More specifically, this project evaluates how the changes in code provisions affect the economic design and efficiency.

ENSC 24, Underground Vault for Downtown Spokane

Jacob Schmidt
John Cary
Adam Hallerman
Rebecca O'Sullivan

Advisor: Doug Forkner
Sponsor: Avista

The Underground Vault for Downtown Spokane was completed by civil engineering students John Cary, Adam Hallerman, Rebecca O'Sullivan, and Jacob Schmidt through the sponsorship of Avista and Doug Forkner. The goal of the project consisted of the design and construction of an underground utility vault, in replacement of an aging vault near the intersection of 2nd and Wall Street in downtown Spokane. Three phases were finalized in the time span of September 2018 through the end of May 2019 including field inspection and analysis, design, and lastly construction management. The underground utility vault was successfully constructed and is currently operable to the downtown Spokane region.

Civil Engineering Projects

ENSC 25, Super Bridge Girder Design

Matthew Govig
Ryan Collins
Rise Gutierrez
Nicholas Corigliano

Advisor: Sushil Shenoy
Sponsor: Oldcastle Infrastructure
Liaison: Rob Holland

As requested, a group of student engineers from Gonzaga University designed a new state of the art bridge girder abutment system to be utilized at the Spokane location of Oldcastle Infrastructure. The company will be using this project to increase manufacturing capacity in order to support the development of the upcoming North-South Corridor project. The design was made in accordance with Department of Transportation requirements from Washington, Oregon, Montana, and Idaho. The end goal was to design a fully functioning abutment system with shop drawings to send to Oldcastle Infrastructure by the semester. The project team has completed long hours of FEA modeling and design iterations to get a final design.

ENSC 26, Fiber-Based Construction Materials

Erik Allen
Coral Ng
Cassidy Lomas
Anthony Adamek

Advisor: Dr. Lauren Heine
Sponsors: Hempitecture, Zila Works

The need to use more sustainable building materials in society has motived this project. This year the team worked with a revolutionary building material made primarily out of hemp. Hemp is sustainable due to its quick grow time, variety of habitats and high level of carbon sequestration during the growing process. For this material hemp is combined with lime binder, pozzolan, and water to create a non-structural insulation material known as lime-hemp concrete (LHC). The team varied the various components of LHC to find a mix design with the most desirable qualities. This LHC was tested and analyzed with ASTM standards, FAA standards and qualitative information gathering. With the help of Boeing's laboratories, Oregon State University and Gonzaga's campus laboratories strong data was acquired regarding the thermal resistivity, flammability and hygroscopic properties of LHC. With the results of these tests and literature review of others' experiments a strong understanding of lime-hemp concretes was established and reported on.

Civil Engineering Projects

ENSC 27, SCC Building 15 Expansion

Ian Smith
Steven Nickolas
Sebastian Ferraro

Advisor: Aaron Zwanzig
Sponsor: Integrus Architecture

Spokane Community College wishes to expand on the current Institute for Extended Learning and Student Services Center by creating an approximately 25,000 square foot structure connected to the current building by a covered walkway. The new center will include classrooms and computer labs for student learning along with offices for the student services center. The goal of this project is to supply Integrus Architecture with a comprehensive set of schematic level structural design documents and a supporting calculation book. Over the course of the project we followed a schedule and budget that we developed at the beginning of our project in order to have an on-time deliverable. The design team developed gravity and lateral loads, selected a structural system for framing, and designed the framing system including the lateral and gravity for resisting systems.

Mechanical Engineering Projects

ENSC 30, Generator Trailer

Rob Levine
Clay Larson
Corey Wallyn

Advisor: Bryan Woodbury
Sponsor: Commuter Cars

Over the past year, our group has explored the feasibility of a generator trailer for an electric vehicle. We have tested the concept of using a generator trailer to increase the electric vehicle range toward 500 miles. The trailer holds a 1990 Honda Pacific Coast motorcycle engine attached to a surplus Boeing alternator. A considerable amount of work has gone into getting the engine up and running as it had been sitting for over ten years. Once running we moved onto testing the alternator power output. Unfortunately, the engine's gearbox was not geared high enough to produce significant power. Therefore, we began the process of researching alternative gearboxes, motors, and alternators. We discovered that the primary two options became to add a planetary gearbox to the current setup to increase the gear ratio or to replace the engine with a small turbine.

Mechanical Engineering Projects

ENSC 31, Laser Induced Spectroscopy Ari Monitor

Theodore Mangrum
Jordan Cossette
Joseph Wilson
Crystal Murray-Weston
Patrick Juaregui

Advisor: Art Miller
Sponsor: NIOSH

Our design team developed a means of measuring the elusive overexposures to harmful diesel particulate matter (DPM) in underground mines. To this end, we assisted NIOSH researchers in developing the overall design for a new field-portable air monitor system called “LIBSAM 2” which quantifies and analyzes respirable particulate matter using Laser Induced Breakdown Spectroscopy (LIBS). Our team specified all of the major components of the design, created a full model in SolidWorks, and built a “benchtop system” to demonstrate the functionality of this air monitor. Our goal was a fully functional system, programmed to demonstrate how all the components would communicate and interact to perform successful air quality analyses. Our research and development of this benchtop system will contribute to the development of a future commercially viable air monitor that can be used to protect mine workers from inhalation of hazardous airborne particulate matter.

ENSC 32, Research & Innovation in Molten Aluminum

Gabriel Edge
Isabella Verdugo
Zachary Hill
Cameron Aishin

Advisor: Gabe Achenbach
Sponsor: Novelis
Liaison: Alana Wallace

The purpose of the project was to develop a system for a mold table assembly that lifts and easily integrates into the current system at Novelis Molten Metal Processing to provide a safer environment with easy access for maintenance. The ease of access and design will inherently avoid the current process of being in a potentially dangerous, confined space. We accomplished our deliverables which include a finished design accompanied by quotes for specified parts as well as the assembly and installation procedure. In addition to this, we created multiple safety measures to ensure continued safety with the use of our system.

Mechanical Engineering Projects

ENSC 33, Scrap Tub Dumper

Olivia Brandel
Michael Bacon
Kevin Wall

Advisor: Christopher Nicol
Sponsor: Kaiser Aluminum

Kaiser Aluminum's Trentwood facility produces a large amount of scrap aluminum that is produced internally from planned and unplanned losses in the manufacturing process. The scrap is put into steel tubs that are transported and dumped into charge metal pits by specialty forklifts equipped with rotary heads. This team designed a material-handling device for dumping the steel tubs that replaces the rotary forklifts in order to make the process less labor intensive, more reliable, and cost effective. They produced fabrication and installation drawings as well as a 3D scale model of the final design.

ENSC 34, Good Vibrations

Quinn Nash
Zachary Fackelman
Nathaniel Wiley

Advisor: Dr. Timothy Fitzgerald

Good Vibrations is a project proposed by our sponsor Dr. Timothy Fitzgerald. The purpose of the project is to build a functional and categorized horizontal slip table. The equipment that we were given was an exciter and its necessary equipment such as an amplifier and a DAQ. With these parts, the scope of the project became clear. We need to design the horizontal table and all of the supporting equipment. The project required many choices of bearing building materials. After the table is built, the table requires a data sheet that must be created.

Mechanical Engineering Projects

ENSC 35, HVAC Design for Building 15

Abraham Hobson
Jacob Nabors
Matthew Richardson-Holzgang
Sean Smith

Advisor: Anthony Schoen
Sponsor: MW Consulting
Liaison: James McCue

MW Consulting Engineers tasked us with developing an HVAC system for Building 15 at Spokane Community College. This undertaking helped us develop our abilities of approaching and finding a viable solution in a real-life setting. Our goal was to design an operable HVAC system which could be implemented if needed. We started at the very beginning, researching different components of HVAC systems and their correlating codes. After gaining a basic knowledge of how HVAC provides essential comfort and ventilation within a structure, we chose to implement the active chilled beam design. We sized its components and identified appropriate locations, along with placing ductwork and chilled beams within the building. Throughout our research, we coordinated with Team 27, which was responsible for the structural aspect of the building. This gave us firsthand experience with inter-communication with a different discipline, and considering their design, while still realizing the same goal.

ENSC 36, Boot Sole Glue Material

John Minder
Alexandra Burke
August McCambridge
William Barber

Advisor: Chris Wood
Sponsor: Nick's Boots

Nicks Boots is the premier manufacture of National Fire Protection Association (NFPA) Wildland Firefighter work boots. As expected, these boots see harsh operating conditions and have been constructed with special adhesives to withstand the high temperature and moisture conditions. Nicks has a goal to find more environmentally friendly adhesives. Nicks has enlisted the help of team ENSC 36 to better understand the baseline strength of materials within the sole construction of their NFPA Wildfire Fighting Boots. ENSC 36 is running through a series of rigorous tests. We have gathered data through tensile testing, altering environmental conditions, and fatigue testing. These tests are designed to see how well these handcrafted boots can withstand to the trials of time. With the data collected and repeatable testing process we provide future Gonzaga teams with a testing protocol and baseline minimum strength of material specifications to allow them to test new alternative adhesives as possible solutions to Nicks goals.

Mechanical Engineering Projects

ENSC 37, Carbon Fiber Repurposing Tool II

Tris Tanaka
Julian Kenton-Braden
Robert Prouty
Benjamin Eiden

Advisor: Gerry Snow
Sponsor: Boeing
Liaison: Laura Campbell, Jacob Koopmans

The Carbon Fiber Repurposing Tool project is a Boeing sponsored project that began in the fall of 2016 with the object of designing and constructing a proof of concept that would be capable of repurposing remaining carbon fiber from Boeing's Composite Wing Center (CWC). Team ENSC 37 has continued to work on the previous team's design and fabricate a working prototype capable of laying up six, half-inch carbon fiber tows at 0°,45° and 90° to create a square carbon fiber panel. The team performed research, a site visit to the CWC, modification to previous designs, creation of new designs in Solidworks, purchase orders and worked in the Gonzaga machine shop in order to construct a working prototype.

ENSC 38, Point of Care Diagnostic Reader

Navath Nhan
Megan Seifert
Siniva Areta
Megan Larson

Advisor: Jeff Nolting
Sponsor: GenPrime
Liaison: Jason "Buck" Somes

GenPrime is a company that provides microbial diagnostic analysis technologies. GenPrime's software relies on high quality images of lateral flow tests to provide clear, definitive results. The current diagnostic reader is going out of production and we were tasked with creating a working prototype alternative. We designed experiments, developed code, and performed statistical analysis to select an imaging device equivalent to the one they currently have. In addition, we designed a housing unit that encapsulates the imaging device, the lateral flow test securing mechanism, and a pseudo-integrated HP tablet to enhance the end user's experience. Our Point-Of-Care reader has uniform lighting and accommodates for lateral flow tests of different shapes and sizes. Throughout the project, we also maintained detailed documentation ensuring that our design is high quality, low-cost, designed for manufacturability (DFM), and has the potential to be cleared by the FDA as a Class II medical device.

Mechanical Engineering Projects

ENSC 39, Lug Torque Ergonomics

Michael Tome
Nicholas Tranquill
Jason Bru

Advisor: Colleen Nolting
Sponsor: UTC Aerospace Systems
Liaison: Roy Wortman

UTC Aerospace manufactures brake disks for use on aircraft. During the manufacturing process the strength of the lugs on the brake disks are tested by loading them until failure. Heavy steel fixtures are used to hold the brake disks in place while this test is performed. Our goal is twofold; first, we were to design a new fixture that is lighter and less difficult for the operators to transport while still maintaining all requirements for fitment, strength, and durability; second, we were to develop a mechanical assist system that will allow the operators to safely transport the fixtures to and from the lug testing machine. To meet our first objective, we have designed an optimized fixture utilizing 3D CAD software complete with a stress analysis and for our second objective we have identified a suitable crane-arm system to lift the fixtures that also fits within the existing workspace.

ENSC 40, Axe Shock Control

J. Abraham Lopez
Conor Leyden
Brandon DuBois
Daniel Fredrickson

Advisor: Dr. Timothy Fitzgerald
Sponsor: Buck Knives
Liaisons: Mark McLean, Lee Althen

In continuation of last year's attempt to narrow down the best hatchet handle for minimizing the shock felt at impact, our team compared the most successful design from last year to the default design currently being used by Buck. This time using human trials, our team conducted an experiment in order to find any correlations between the sting felt by the user and the maximum force and strain at impact. The goal of this year's attempt was to measure and analyze the real use shock levels at the handle of the hatchet.

Mechanical Engineering Projects

ENSC 41, Knife Blade Opening Rate Meter

Christopher Hatten
Daniel Kates
John O'Connor
Jeremy Hoefer

Advisor: Samuel Shoemaker
Sponsor: Buck Knives
Liaison: Mike McDonald

The team was assigned to design and implement a standalone device that could measure and log the opening speed(rate) of various spring-assisted knives. This product consists of an aluminum baseplate, upon which a clamp and semicircle of infrared photogates are mounted. The knife, once placed into the clamp and triggered to open, passes through each of 24 photogates, allowing an Arduino microcontroller to log the time the knife blade took to move from one gate to the next. This data is sent to a Raspberry Pi computer board, where the average angular velocity, angular velocity over various arcs, and other values are calculated and logged for the user to view.

ENSC 42, MultiPurpose Layup & Cure Cart

Ashley Wood
Josef Best
Janelle Maguire

Advisor: Bob Reed
Sponsor: Unitech Composites

ENSC 42 designed and built a multipurpose layup and cure cart out of aluminum for Unitech Composites. The multipurpose layup and cure cart will be used in the manufacturing process of composite aerospace parts. The cart is adjustable in the x, y and z axis and fully collapsible. The cart can withstand: a 2,000lb load, 450°F, and 100 psi. The adjustability of the cart accommodates for a variety of part molds and will be used to help satisfy a variety of contracts Unitech holds with companies such as Boeing, Lockheed Martin, and even the U.S. Military. Come check out all the features of the multipurpose layup and cure cart.

Mechanical Engineering Projects

ENSC 43, Wall Assembly Improvements

Emily Harrison
Jacqueline Gazett
Ryan Matunas

Advisor: Ryan Leahy
Sponsor: Haakon Industries

Haakon Industries is a world leader in custom designed and manufactured heating, ventilation, and air conditioning (HVAC) units. They strive to continuously improve production safety and efficiency in order to remain competitive in the industry and provide the highest quality air handling equipment to their customers. An important part of the manufacturing process is the construction of wall sub-assemblies that will later be installed onto a completed unit base, comprising the general structure of the equipment. The fabrication of these sub-assemblies is complex due to part geometries and sizes, department layout, space constraints, and material type. The ENSC 43 team observed the wall department manufacturing processes and provided recommendations for improvements that will make the construction of these sub-assemblies safer, more efficient, and result in a more consistent and quality product.

ENSC 44, Thermoplastic Composites for Aerospace

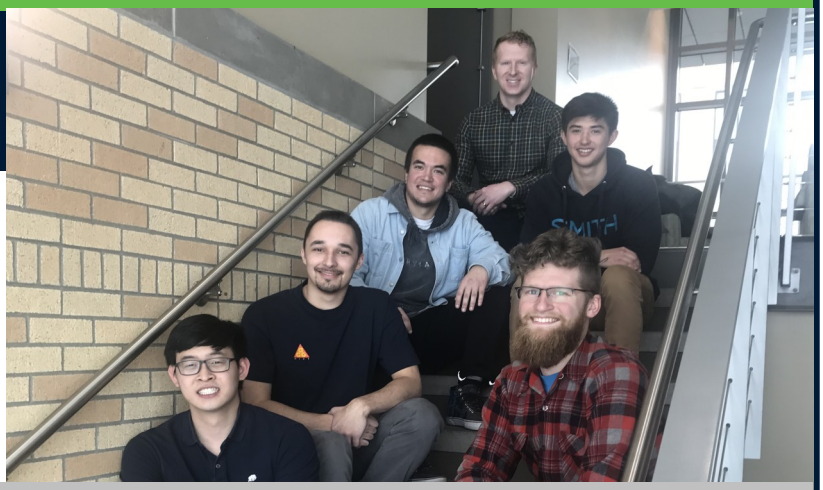
Michael Hoeller
Shane Sakai
Monica Ripple
Delaney Hall

Advisor: Dr. Pat Ferro
Sponsor: Triumph Composite Systems
Liaison: Luis Rodriguez

Over the course of the past year, team 44 completed material testing on a new and rising thermoplastic composite in the aerospace industry. The goal was to provide Triumph Composite Systems with a proof of concept of this new material in a shear clip application. A shear clip is a high stress joint connecting the frame of an airplane to the upper skin of the wing. Using the mechanical properties established from testing and classical lamination theory, the team designed the optimal ply layup sequence of a thermoplastic composite shear clip. The optimization process required limiting the weight of the part while enabling the greatest strength.

Electrical & Computer Engineering Projects

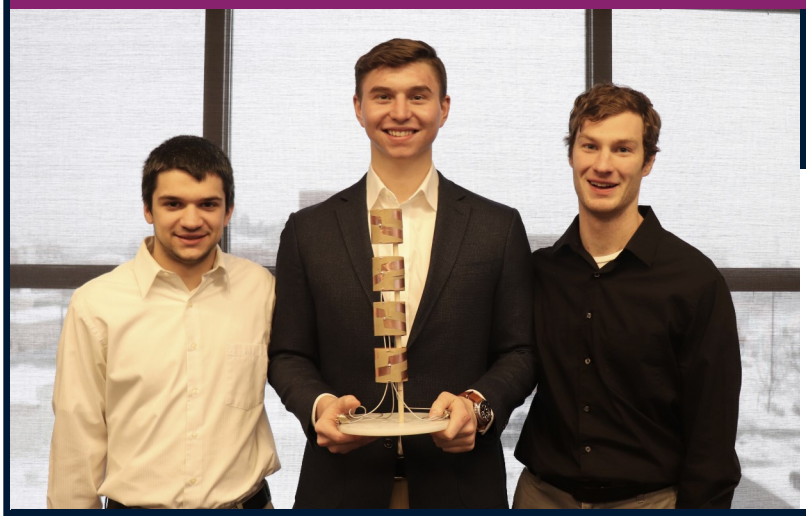
ENSC 50, Robotic Ag Implement



Ari Tani
Daniel Mobley
Grant Hjelte
Paxton Malek
Aaron Wong

Advisor: Shane Pacini
Sponsor: Dryland SA
Liaison: Chris Wood

ENSC 50 worked to design and build a centralized autonomous restocking station for agriculture implements. Our system is composed of an electric actuator driven connection and refueling nozzle which is coupled with a software system to interface between the Ag implement and the restocking station. Throughout the course of the semester our team has been able to accomplish nearly everything we set out to do. The refueling system is completely functional including: an electrically actuated autonomous refueling nozzle, secure implement connection through precision limit switches and auto-locking gas cap, proof of software communication between the station and the implements, and laser sensors which verify with the station that the implement is in place for refueling. The nozzle system is currently available to be industrially scaled should the Dryland SA agricultural implement project be completed in the near future.



ENSC 51, Helical Antenna Array

Henadz Krukovich
Jeff Varness
Zachary Weber

Advisor: Bob Conley
Sponsor: Gonzaga SARL
Liaison: Dr. Steve Schennum

There are many different wireless communications systems in use today such as cellular devices, wireless internet, emergency communications, and more that all share the same bandwidth. The usage of different antenna polarizations is one method of minimizing the interference between different signals. ENSC 51 addressed this issue by developing a prototype Omnidirectional Helical Antenna Array that can send or receive any polarization due to the orthogonal pairs of left and right hand circular polarized elements. To satisfy the requirements of the sponsor, the antenna array was designed to minimize cost and size footprint while maximizing manufacturability. Additionally, a radome was designed to protect the antenna array from the elements while also providing rigidity and a mounting solution. The project is considered a success as the array satisfied all the requirements of the sponsor.

Electrical & Computer Engineering Projects

ENSC 52, Lab-Volt Transmission Line Design

Alexis Glogiewicz
Brian Snyder
Adam Bagley

Advisors: Kevin Damron, Peter McKenny
Sponsor: Schweitzer Engineering Lab, Inc.
Liaison: Doug Taylor

The goal of this project was to design and build a variable parallel line transmission system using Lab-Volt Equipment to move power from two generators to a load; followed by the development and implementation of a protective scheme allowing for fault simulation and analysis. The power system included series capacitance, shunt capacitance, phase shifting transformer, and Generator Step-Up (GSU) transformers, as well as the parallel transmission lines. Mathematical and PowerWorld models were created to verify results of the completed system. For the second stage, a protection scheme was modeled using Aspen software. Schweitzer Engineering Laboratories (SEL) relays were then used to create POTT schemes for the two transmission lines, along with differential schemes for the first GSU and the second bus. Various faults were applied to the system and these results were compared to mathematical predictions.

ENSC 53, EBike Traction Control

Liam Jones
Alex Tang
Joan Llompart

Advisor: Debra Offill
Liaison: Tim Ecklund

Electric Bicycles, or EBikes, travel at high speeds with more momentum than traditional bikes but lack the effective braking systems consumers have come to expect in automobiles. In particular, EBikes without disk brakes lack braking power. Our goal for this project was to create a prototype which would demonstrate that any EBike with a direct-drive motor can be used as a generator to provide additional braking power while leaving the existing brakes intact and fully functional. For this project, we have proven this concept.

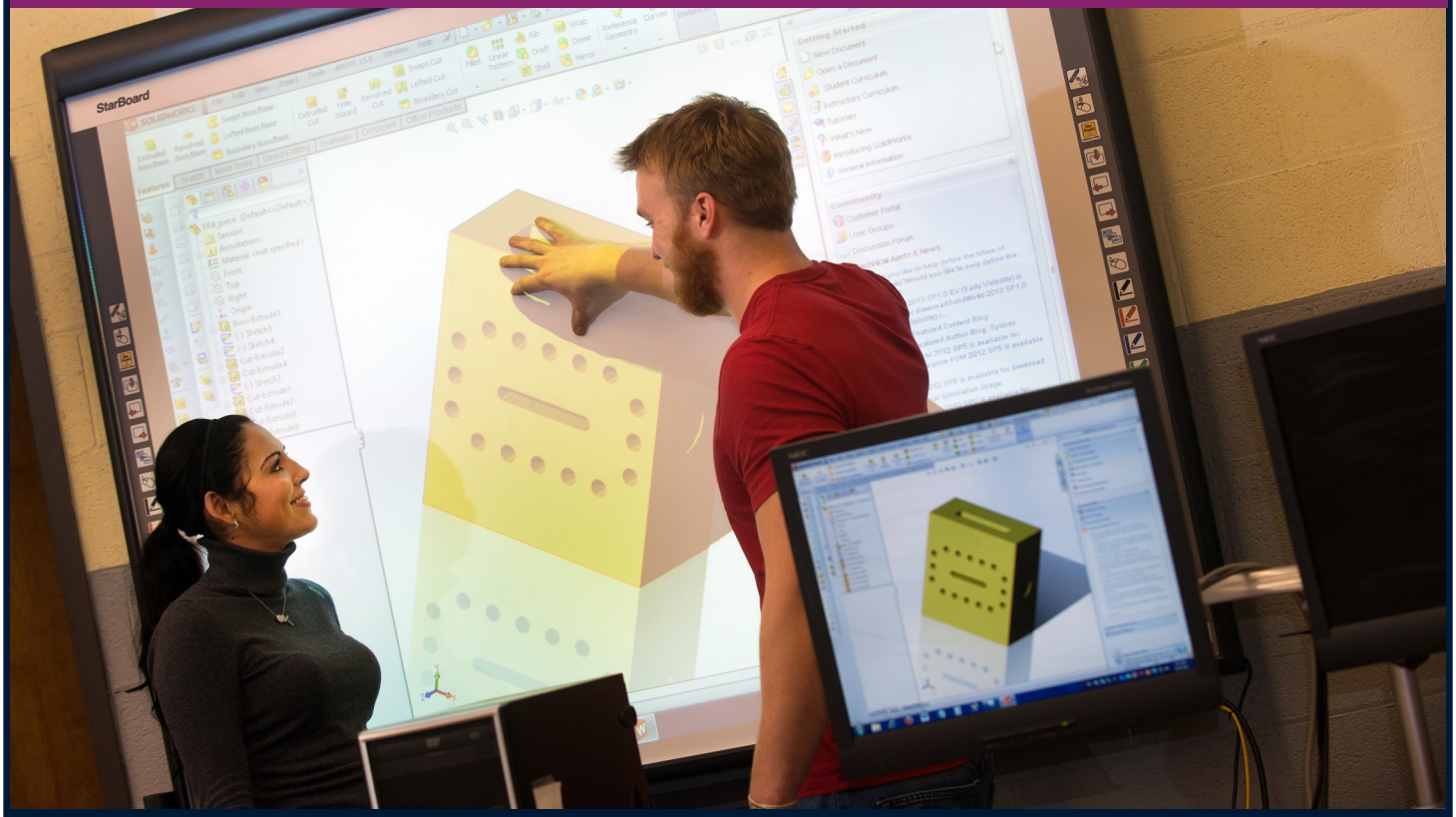
Electrical & Computer Engineering Projects

ENSC 54, Scrap Tub Management System

Jeff Mulderink
Robert Johnson

Advisor: Robert Zavrel
Sponsor: Kaiser Aluminum
Liaison: Ben Lengrich, Gary Holmesmith

Inventory tracking can cause huge efficiency problems if not done adequately. Kaiser Aluminum currently has the problem of tracking over 800 large metal tubs throughout their 80+ acre facility. When a certain tub with a certain content is needed, the best solution they have is to have people manually looking throughout the facility to find what they need. Time would be saved if the location of these tubs was both known and easily searchable. An RFID (Radio Frequency Identification) system can be used to track these tubs throughout the facility. RFID tags will be placed on the tubs they are trying to track and when these tubs pass by antennas set at tracking locations in their facility, an automatic log will be made. This way, when a tub is needed, it can be searched for and found faster.



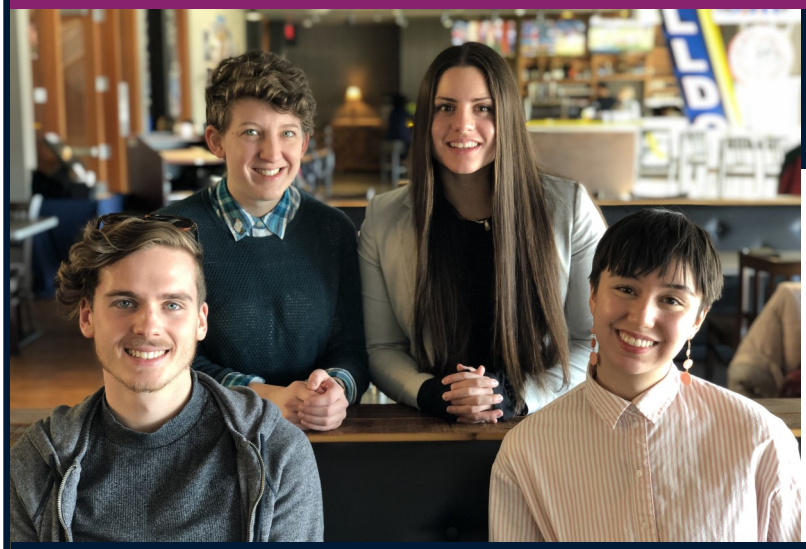
Computer Science Projects

CPSC 01, Zags Abroad

Claire Norman
Lucy Tibbetts
Kristen Burgett
Katrina Baber

Advisor: Dr. Gina Sprint
Liaison: Alisha Lombardi

Zags Abroad is a web application built to simplify and improve the study abroad planning process for both administrators and students. Previously, Alisha Lombardi, the Assistant Director of Study Abroad, had to manually create PDFs for each study abroad program that list the courses that have been approved for credit at Gonzaga. Now, Alisha is able to use the database provided by Zags Abroad to manage this information, and students can immediately view the changes she makes. Students can search for a study abroad program based on where they can take courses in a certain department, e.g. Computer Science. Zags Abroad also provides an online form that students who have already studied abroad can fill out to share their experiences. Thus, Zags Abroad will help students make more informed decisions about studying abroad based on both academics and the insight of other students.



CPSC 02, Cake: Food Guide

Carol Joplin
Emma Delucchi
Kevin Lamon
Ariana Hibbard

Advisor: Dr. Gina Sprint

Cake is a unique food guide tailored to those with dietary restrictions. Cake caters to allergies, diets, and preferences alike. Our goal was to create a mobile-responsive web application that allows individuals to select specific ingredients and ingredient groups, then curate menus accordingly. This also involved establishing rapport with restaurants so we can host their basic restaurant information and menu ingredients on our site. We developed functionality for restaurants to update all profile information, including hours, location, price point, kid-friendliness, and menu information including name, description, categories, menu items, and ingredients. Our app allows users to search for restaurants based on city or name. Each search returns all details about restaurants in our database on their publicly-available restaurant profile, and view full menus, as well as menus tailored to each user's individual dietary preferences and restrictions.

Computer Science Projects

CPSC 03, Pharmaceutical Blockchain

Jacob Krantz
Max Dulin
Jeb Kilfoyle
Andrew Yang
Mehak Bharagava

Advisor: Dr. David Schroeder
Sponsor: Xavier Collantes

Pharmacies currently do not share sensitive customer data amongst competing companies. Consequently, filling a patient's prescription at a new or different pharmacy is a complicated, time consuming, and restricting process. The separation of patient data can also lead to miscommunication and erroneous prescriptions. Moreover, current prescription tracking systems fail to meet the government mandate of an interoperable, electronic system by the year 2023, and an industry standard has yet to be adopted. Our project presents an alternative to the problematic data silos of pharmaceutical companies. Pharmachain is a cross-company data management web application that facilitates the writing, fulfilling, and recording of patient prescriptions. Prescription data will be stored as an anonymized transaction history on a blockchain, a decentralized list of records secured cryptographically. Utilizing blockchain technology in the pharmaceutical drug space establishes a system that unifies patient data while maintaining both privacy and security.

CPSC 04, CleverNews

Jason Conci
Katie Wraith
Chris Delaney
Kevin Tran
Daniel Gallab

Advisor: Dr. David Schroeder
Sponsor: Scott Broder

With the overabundance of news published every day, it has become increasingly difficult to know where to look for relevant articles. Checking select publishers directly can lead to overlooking valuable news, and current news recommendation services offer the consumer little control over what articles they see. CleverNews is a web application that uses machine learning to recommend personalized news to each individual user based on both personal and global preferences. Users are able to view trending news, search for articles by keyword, filter news by category, and view news that has been recommended to them. Users are given more control within our application, in being able to adjust their recommendations by choosing between three different machine learning models, based on what model they think provides the best personalized news.

Computer Science Projects

CPSC 05, KennelNow

Sammy Vowles
Emma Woodburn
Nicole Howard
Ellis Fischer
Advisor: Nadra Guizani
Sponsor: Gonzaga University
Liaisons: Kelsey Crawford, Lindsey Lessing, Satish Shrestha

KennelNow will approach the problems of manual management of Gonzaga men's basketball tickets by monitoring and managing student ticket requests through Zagweb. In the Zagweb portal, students will be able to request a ticket, deactivate a ticket, and get added to a waitlist for each men's basketball game. This process will alleviate the manual work currently completed by Gonzaga Athletics staff members. Students will have one central location to make any type of ticket request or modification, which is more efficient than their current time-consuming process of managing a ticket through emails or going down to the Ticket Office. Overall, KennelNow would not only make it easier for students to attend men's basketball games, but also reduce the amount of unnecessary work ticket administrators perform managing tickets.

CPSC 06, Fresh All

Amy Larson
Quinlan Bingham
Bennett Falkenberg
Angela Rae
Kevin Bruce
Advisor: Nadra Guizani
Sponsor: TechnoServe
Liaisons: Daniel Bladow, Paulo Dichone

Our team was asked to design an Android phone app to help solve inconsistent produce pricing across Mozambique. Since there is no centralized market where prices are posted and kept in check by competition, farmers can artificially inflate prices. As a result consumers aren't able to buy enough of what they need, leading to malnutrition and other health issues. Our app allows farmers to post photos and descriptions of their products, including price and farm location. Buyers can then search for desired stock by keyword, or filter by attributes including date posted, quantity, and location. When they've found a product they want to buy, they can use our in-app messaging system to get in contact with the farmer. Users can also mark their products as sold, edit and delete posts, add a post to their favorites, add another user to their friends list, and set up notifications for a product.

Computer Science Projects

CPSC 07, Tools for Learning Biochemistry

Stephen Joyce
Kayla Larson
Makayla Monix
Garett Palm

Advisor: Dr. Rob Bryant
Liaison: Dr. Jeff Watson, Gonzaga

The overall problem our website, BioPath, addresses is the lack of quality interactive tools present in the biochemistry teaching community. Specifically, the tools used to help students learn about different biochemical pathways, such as Glycolysis, can be difficult to comprehend and be unclear. Additionally, the standard biochemistry study materials are often non-interactive or visually complex and confusing, which may make learning more difficult for students. To address these issues, we are creating an interactive website that allows the user to create models of different intracellular pathways and show how the molecules may flow through each pathway in a graphical interface. The goal of our product is to provide a platform on which users can build interactive simulations of pathways to improve learning and data retention.

CPSC 08, ComSem Web Modules

Daniel Richard
Trevor Greenside
James Ronderos
Chin Huynh
Dominic Gianatassio

Advisor: Dr. Rob Bryant
Liaison: Dr. James Hunter, Gonzaga

Our goal was to expand an existing tool for English as a Second Language (ESL) classes, called Communication Seminar (ComSem). ComSem is intended to offer instructors a simple, easy-to-use interface through which they can manage classes, give students feedback, and avoid technical roadblocks that impede learning. In its initial version, instructors could create simple worksheets that test their students' progress with English comprehension. Students could record themselves speaking English, and the instructor could provide feedback on these recordings. However, the user interface was very confusing for first-time users, there was no help functionality, and several necessary tools were missing. Our project was to address these concerns. We refined several existing features, added a walk-through component for first-time users, and implemented several new features. These included a dashboard with course statistics and worksheet links (student and teacher version), a class discussion board, and a feature to automatically generate new worksheets.

Computer Science Projects

CPSC 09, Gonzaga Tenting Rewards

Matt Carter
Carlos Villagomez
Scott Kopczynski
Andrew Zenoni

Advisor: Dr. Shawn Bowers
Sponsor: Gonzaga Kennel Board

Our group wanted to revolutionize the Tent City experience for students attending Men's Basketball games by developing an Android/iOS app to streamline the process and make it less tedious, confusing, and frustrating for students and the Kennel Board alike. We have also helped cut down on paper consumption by digitizing the entire tenting process. This was made possible by integrating QR-code technology to streamline the process for everyone involved.

CPSC 10, YesWorkflow Web Components

Brewer Slack
Carl Lundin
Anthony Niehuser
Brooke Huntington
Mackenzie Brown

Advisor: Dr. Shawn Bowers
Sponsor: Tim McPhillips

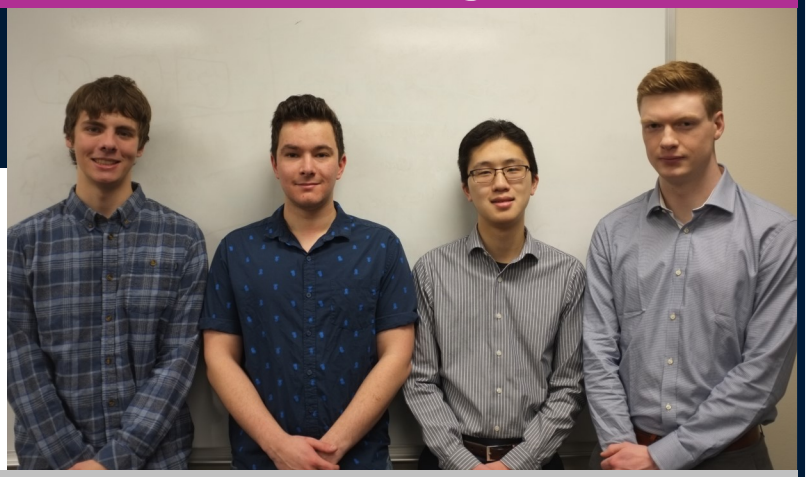
The goal of YesWorkflow Web Components is to create software to visualize data analysis scripts for data scientists. Working under the supervision of Professor Sean Bowers and Timothy McPhillips, we have created a web app that allows uploading of visualized workflow scripts to a web server which acts similarly to GitHub. The web app was created on top of the existing YesWorkflow code base with the intent of moving people who are uncomfortable with the command line interface into a easy to use web based client. Admins can deploy YesWorkflow Web Components onto a web server so that scientists working in a lab can upload and collaborate together. This software will help bridge the gap between script based analysis and data visualization.

Computer Science Projects

CPSC 11, IEC CIM Distribution Model

Max Mckee
Andrew Italo
Matthew Lee
Daniel Abrahms

Advisor: Dr. Shawn Bowers
Sponsor: Avista
Liaison: Eric Lee



Avista Utilities wants to convert their electrical grid data into the IEC CIM format, but has no tool to validate the files in this format. We have created a web application that validates the CIM data for structure, as well as visualizing the data on a map to verify that the conversion preserved all of the original data. Our application supports multiple concurrent users as well as persistent projects so that multiple engineers can use the application at the same time, save CIM files they have uploaded, and come back to them later using their login ID. It also supports custom CIM profile definitions, so that as the CIM format is updated every few years, and Avista engineers can easily update the application so it remains usable.

CPSC 12, Dynamic System Monitoring Engine

Tyler Tiedt
Conner Brown
Erik Fox
Will Fraisl
Eloisa Serrano

Advisor: Dr. Shawn Bowers
Sponsor: Schweitzer Engineering Labs
Liaison: Ryan Hendrickson

Schweitzer Engineering Labs (SEL) has tasked us to develop the Dynamic System Monitoring Engine (Sysmon Engine). The Sysmon Engine will replace a current monitoring software that SEL deploys on their machines worldwide. This software is limited to monitoring basic hardware information and displaying current data to the user on the machine. This engine is not scalable or flexible enough to fit the needs of SEL's clients. Our Sysmon Engine will allow the user to monitor arbitrary data. This Engine is a pluggable monitoring system that will allow users to insert their own custom code into the application. One plugin is to fetch input data, another plugin for the user to define custom mathematical operations on data and a third plugin that sends the data to a data consumer. The user will write these plugins and configure the data flows to monitor the data that meets the needs for their system.

CEDE Senior Design
Final Presentations
Wednesday, May 1, 2019

Location & DAB Members	Project	Time	Faculty
Jepson 103—ME			
DAB: Jacob Koopmans	ENSC 37 Carbon Fiber Repurposing II	3:10pm	Gerry Snow
Michael Maffeo	ENSC 42 MultiPurpose Layup & Cure Cart	3:40pm	Bob Reed
Jeff Nolting & Alek Marinos	ENSC 39 Lug Torque Ergonomics	4:10pm	Colleen Nolting
Colleen Nolting	ENSC 38 Point of Care Diagnostic Reader	4:40pm	Jeff Nolting
Jepson 111—ME			
DAB: Phil Pintor	ENSC 04 Energy Storage in the NW	3:10pm	Andy Johnston
Phil Pintor	ENSC 06 Hybrid Rocket Engine Testing Ins.	3:40pm	Marc Baumgardner
Les Bohush	ENSC 08 Liquid Cooled Brakes	4:10pm	Jim Weston
Les Bohush	ENSC 12 Roasting Efficiency (Coffee)	4:40pm	Marc Baumgardner
Paccar 103—ME			
DAB: Les Bohush	ENSC 43 Wall Assembly Improvements	3:10pm	Ryan Leahy
John Olsufka	ENSC 41 Knife Blade Opening Rate Meter	3:40pm	Sam Shoemaker
Sam Shoemaker	ENSC 40 Axe Shock Control	4:10pm	Timothy Fitzgerald
Ryan Leahy	ENSC 34 Good Vibrations	4:40pm	Timothy Fitzgerald
Herak 301—CE/ME			
DAB: Doug Pooler	ENSC 07 Infinity Ladder	3:10pm	Jake Laete
Katy Allen	ENSC 21 Wenatchee Housing Complex	3:40pm	Tony Stenlund
	ENSC 27 SCC Building 15 Expansion	4:10pm	Aaron Zwanzig
Luke Blachart	ENSC 35 HVAC Design for Building 15	4:40pm	Anthony Schoen
Paccar 001—ME			
DAB: Dave Duncan	ENSC 31 Spectroscopy Air Monitor	3:10pm	Art Miller
Alana Wallace	ENSC 32 Research in Molten Aluminum	3:40pm	Gabe Achenbach
Gibson & Holmsesmith	ENSC 54 Scrap Tub Management	4:10pm	Bob Zavrel
John Olsufka	ENSC 33 Scrap Tub Dumper	4:40pm	Christopher Nicol
Herak 237—CE			
DAB: Matsumoto & Zarecor	ENSC 22 Stormwater Treatment Monitoring	3:10pm	Aimee Navickis-Brasch
Greg Lahti	ENSC 15 Spokane Bicycle Network	3:40pm	Rhonda Young
Adam Miles	ENSC 16 WY Connected Vehicle: Part III	4:10pm	Rhonda Young
Lindsay Gilbert	ENSC 19 Design of Beaver Dam Analogs	4:40pm	Sue Niezgoda
Herak 245—CE/En. Mgmt			
DAB: Dave Moss	ENSC 05 Hold That Cup of Joe	3:10pm	Noel Bormann
Joel Lee	ENSC 11 Personal Desalination Device	3:40pm	Dave Moss
Bill Fees & Katie Larimer	ENSC 20 Putting Food Waste to Work	4:10pm	Dave Moss
Andrew Matsumoto	ENSC 01 2D Seepage Model	4:40pm	Mark Muszynski
Herak 123—CE			
DAB:	ENSC 10 Wind Design of Tall Building	3:10pm	Joshua Schultz
Jim Roletto	ENSC 23 Multi Story Steel Frame Design	3:40pm	Joshua Schultz
Melissa Verwest, Jim Roletto	ENSC 24 Underground Vault for Spokane	4:10pm	Doug Forkner
Doug Forkner	ENSC 25 Super Bridge Girder Design	4:40pm	Sushil Shenoy
Tilford 405—EE/CPEN			
DAB: Kaitlyn Helsing	ENSC 13 Virtual Touchscreen	3:10pm	Rodney Pickett
Jake Saxon, Bob Turner	ENSC 14 Trafixx: Smart Grid Traffic Guide	3:40pm	Shane Pacini
Eric Ryan	ENSC 51 Helical Antenna Array	4:10pm	Bob Conley
Terra Donley, Paul Robertson	ENSC 50 Robotic Ag Implement	4:40pm	Shane Pacini

Presentation Schedule, Continued

Location & DAB Members	Project	Time	Faculty
Jepson 123—CE			
DAB: Colleen Little	ENSC 18 Spokane Comm. Green. Gas Inven.	3:10pm	Alex Maxwell
Dannielle Haraldson	ENSC 26 Fiber-Based Construction Materials	3:40pm	Lauren Heine
Jim Simon	ENSC 17 Spokane Greenhouse Gas Emission	4:10pm	Alex Maxwell
Herak 244—EE/CPEN			
DAB: John Gibson	ENSC 52 Lab-Volt Transmission Line Design	3:10pm	Kevin Damron
Rick Cox	ENSC 02 Bike Safety Smart Sensor	3:40pm	Tim Ecklund
Henry Loehner	ENSC 03 Driving Opt. for Auto. Vehicles	4:10pm	Debra Offill
Jeff Owen	ENSC 53 EBike Traction Control	4:40pm	Debra Offill
Jepson 124—ME			
DAB: Pat Ferro	ENSC 36 Boot Sole Glue Materials Study	3:10pm	Christopher Wood
J McCall	ENSC 09 Modular Children's Prosthetic	3:40pm	Rich Thomas
Questad & Van Lith	ENSC 44 Thermoplastic Composites for Aero-space	4:10pm	Pat Ferro
Dannielle Haraldson	ENSC 30 Generator Trailer	4:40pm	Bryan Woodbury
Tilford 108—Computer Science			
DAB: Sharman, Helsing	CPSC 03 Pharmaceutical Blockchain II	3:50pm	David Schroeder
Dan Lenz	CPSC 05 KennelNow	4:20pm	Nadra Guizani
Dan Lenz	CPSC 04 Machine Learn. Web Based Search	4:50pm	David Schroeder
Chris Sharman	CPSC 06 Fresh All	5:20pm	Nadra Guizani
Tilford 109—Computer Science			
DAB: Dan Lenz	CPSC 09 Gonzaga Tenting Rewards	3:50pm	Shawn Bowers
Chris Sharman	CPSC 11 IEC CIM Distr. Model Validation	4:20pm	Shawn Bowers
Mike Mudge	CPSC 01 Zags Abroad	4:50pm	Gina Sprint
Mike Mudge	CPSC 02 Cake—Food Guide	5:20pm	Gina Sprint
Tilford 107—Computer Science			
DAB: Mike Mudge	CPSC 07 Tools for Learning Biochemistry	3:50pm	Rob Bryant
Mike Herzog	CPSC 08 ComSem	4:20pm	Rob Bryant
Mike Herzog	CPSC 10 YesWorkflow Web Components	4:50pm	Shawn Bowers
Mike Herzog	CPSC 12 Dynamic System Monitoring Engine	5:20pm	Shawn Bowers

Thank you to our Sponsors!

The design projects and resources required to implement the many engineering and computer science projects during the 2018-2019 academic year were generously provided and supported by the following sponsors:

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