# EMPOWER

## Cal Poly Student Association

# WINTER NEWSLETTER 2023

**INSIDE THIS ISSUE:**



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CAL POLY

**E**NDEAVORS TO
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**P**EOPLE
**O**WARD
**W**ITH
**E**NGINEERED
**R**ESULTS

# WINTER QUARTER IN REVIEW

The EMPOWER Student Association had a wonderful winter quarter and hosted a variety of opportunities for learning & collaboration. Between workshops, information sessions, preliminary design review, and critical design review, it was quite busy! We hosted club socials, a heart dissection workshop, a SolidWorks workshop, a 3D printing workshop, and a composite fiberglass workshop! Additionally, Formal Design Project teams have been well underway and they have been prototyping all quarter, so we are eager to see where each project goes in the rest of the academic year. LLEAP has also had a busy quarter as they continue to engineer an exoskeleton.

We couldn't have done any of the awesome events mentioned above without our officer board, who is pictured below. Thank you for putting your time & efforts into making EMPOWER what it is!

President | Senior Vice President | Vice President of Operations | Treasurer | LLEAP CEO | LLEAP COO

Technical Director | Quartermaster | Corporate Ambassador | Manufacturing Director | Community Outreach

# LLEAP

## LOWER-LIMB EXOSKELETON ASSIST PROJECT

During the Winter 2023 quarter, LLEAP has been hard at work! LLEAP is creating a lower limb exoskeleton for an individual with no function of their lower body so they can walk. LLEAP's first single-leg prototype was built in the 2021-22 school year. It has an adjustable height and weight design, allowing for physical testing this year. A new refined prototype will be completed this year. This year, LLEAP has 5 interdisciplinary teams: Prototyping, Software and Simulation, Mechatronics, Kinesiology, and Sensing and User Interface.

The mechatronics team works to control the motors on the suit. They have been working towards their year-end goal of testing the 2022 prototype, having precise motor position and velocity trajectories at the knee and the hip motors. This quarter, they worked on getting controlled movement through PID, which allows precise motion from one point to another.

The prototyping team has three sub-teams: ankle, hip, and structures. Each team has been working on refining last year's design and creating new and improved components. The hip team has designed a cycloidal gearbox, the ankle team has designed a leaf-spring joint, and the structural team has designed the back shell and connections points. The sub-teams will gain professor feedback early winter quarter, perform analysis, and begin manufacturing at the end of winter quarter. The knee joint is being designed and manufactured through ME senior project and will be a four-bar linkage powered by a linear actuator.

# LLEAP CONTINUED

A new addition to LLEAP is the kinesiology team. This research-based team works to optimize the suit for the user, ensuring the user is safe and comfortable. They have researched topics such as potential clinical concerns, a safe fall system, user preparation for using the suit, and much more. From this, they have created a set of design requirements for each team to ensure LLEAP is designing around the user. They will work with the teams to integrate all chosen requirements for the remainder of the year.

The software and simulation team works to have all the different components of the suit talk to each other through a middleware called the Robot Operating System (ROS). This allows the organization and compartmentalization of all LLEAP components. The team is finishing up the simulation of the suit and has migrated all of their data to ROS2. They plan to communicate the sensor data to the motors and transform it into a usable format by year-end.

he sensing and user interface team works for the user to have complete control of the suit and feedback on the status of the exoskeleton. This includes buttons on the crutches, the display of data, and helping the user learn the operation of the suit. This quarter, the team got wireless communication working, inertial measurement units (IMUs) working, and created a python script to capture data from all of the sensors on the suit. They plan to create a java app for the user and interface the IMU sensors to ROS2 by the end of the year.

LLEAP has made a significant amount of progress this quarter, and we look forward to continuing our club into the new year. In addition to the technical advancements made, students of all experience levels and backgrounds have been able to positively contribute to our project, and most of all, have fun doing it!

# FORMAL DESIGN PROJECTS

**2022-2023**

## WINTER QUARTER PROGRESS

Our Formal Design Projects (FDPs) are the cornerstone of our organization. Each FDP team works with a "challenger" who presents a given challenge as an opportunity to create an innovative solution. These challengers can be individuals with disabilities, organizations, and, in past years, even pets! Three projects from the 2021-2022 school year are continuing and coming to completion at the end of the year. Additionally, three new projects are starting this quarter: Skateboard for Carlo, Protective Suit for Princess, and the Dolphin Biopsy Tool project, collaborating with the National Marine Mammal Foundation. Additionally, two of the musical instrument Quarterly Design Projects from last quarter are becoming FDPs for the rest of the year. Two of the other projects are sponsored by EnCompass, and will allow two teams to get involved with stent inspection and testing. In the past few weeks, teams have been prototyping hard on their projects. We look forward to the innovation and discoveries that are to come from these teams for the remainder of the academic year!

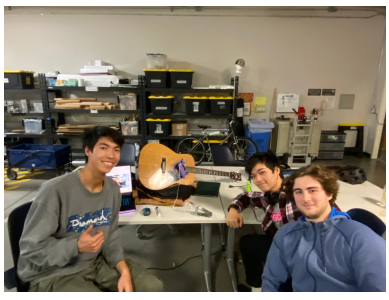
**2022-2023 FDP TEAMS:**

# FORMAL DESIGN PROJECTS

## FUITAR AND TRIUMPHANT

Fall 2022's quarterly design challenge involved creating instruments that can be used by individuals with limited mobility. The designs can be traditional instruments with added modifications, or teams can let their imagination run wild and come up with brand-new musical creations.

These two teams are named "Fuitar" and "The Triumphant". The Fuitar, or Foot Guitar, allows a guitar to be strummed by using a foot pedal. It is shown below, on the image to the right. They have been working all this quarter to begin prototyping the strumming mechanisms. This allows people with limited arm and finger mobility to play the guitar! The Triumphant helps those with little to no hand/finger mobility to be able to play the trumpet by using foot pedals. This project has been busy prototyping as well this quarter to ensure the user is capable of playing the trumpet with ease! We are excited to see where each team takes these projects next quarter!



**TRIUMPHANT TEAM MEMBERS:**

Syndey Dedrick*
Lauren Tran
Daniel Reed
Monserrat Trujillo
Esther Chou

**FUITAR TEAM MEMBERS:**

Elliot Tanovan*
Ethan Fischer
Elias Saliba
Sabine Heid

*indicates Team Lead

# FORMAL DESIGN PROJECTS

**2022-2023**

## HAND FOR MAGGIE

### PROBLEM STATEMENT AND PROGRESS:

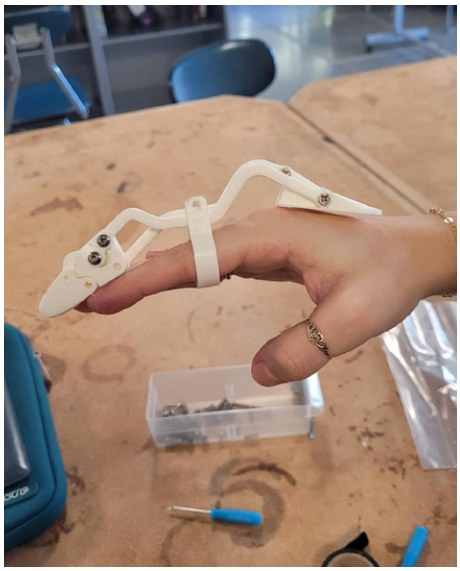
Maggie is a 3rd-year Biomedical Engineering student at Cal Poly who needs a prosthetic hand to help her grab and lift heavy objects. She wants to be able to turn door knobs and lift weights in the gym.

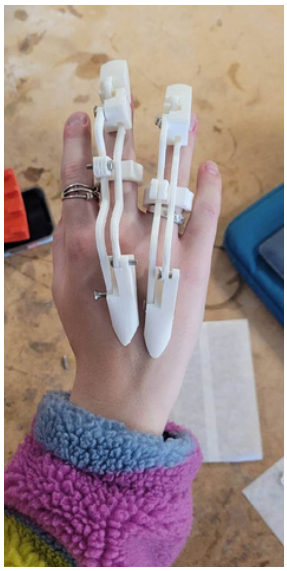
During the winter quarter, the team completed a preliminary SolidWorks CAD model and converted it into a functional prototype using additive manufacturing. The prototype includes two separate assemblies of the finger joint and wrist plate. The model uses a linkage system to transfer wrist motion into finger flexion. One challenge the team has faced and overcome is designing around complex geometries of Maggie's residual limbs and incorporating those complex geometries into their CAD files. Some next steps for the team are completing iterations for a perfect custom fit, completing FEA on the CAD model, and manufacturing the final product with more durable materials such as aluminum and carbon fiber.

### TEAM MEMBERS:

Rachel Rowe*
Aidan Geurts
Jeffrey Wisoff
Natalie Adamson
Ruth Abigail Rodriguez
Skylar Rose
Maggie Collier

*indicates Team Lead





# FORMAL DESIGN PROJECTS

**2022-2023**

## PORTABLE LIFT FOR ALEX

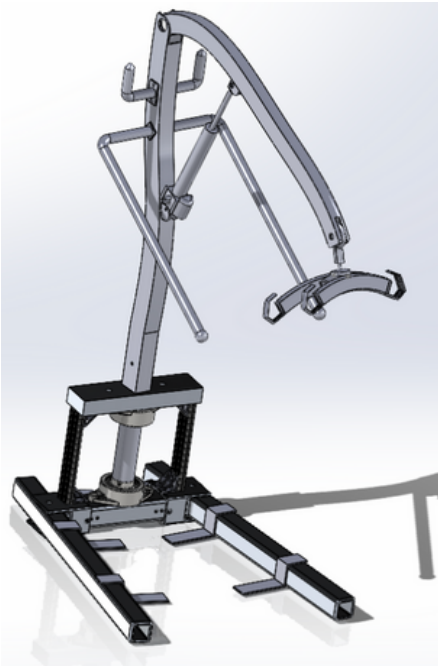
### PROBLEM STATEMENT AND PROGRESS:

Alex is a handicapped 5th-year Aerospace Engineering student who needs a portable lift to help him get to and from his wheelchair. The device must be able to fit on a plane to allow Alex to use the lift when he travels to visit his family in Hong Kong and elsewhere. This project has been ongoing since 2019 and has had three project leaders. One challenge the team has been facing is making the design small and light to be able to fit on a plane while also keeping the lift functional and durable. The current team had to revise the previous design to combine a preexisting lift with some of the design elements established by previous teams. This allowed the design to be lighter than previous versions while also being able to rotate 180 degrees so that Alex can easily get to and from his wheelchair. The next steps for the project are the assembly of the main lift, the design of the instruction manual, and the creation of a portable travel case for the lift.

### TEAM MEMBERS:

Brooke Ellis*
Christie Altamura
Col Cook
Elliott Tanovan
Anna Smith
Lina Boukhateb

*indicates Team Lead



# FORMAL DESIGN PROJECTS

**2022-2023**

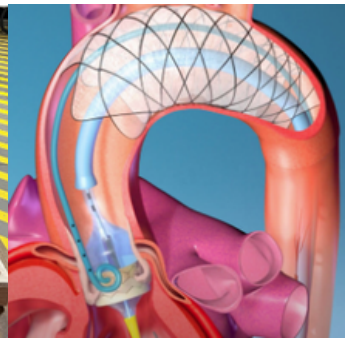
## ENCOMPASS - F2 IN-VITRO STENT FATIGUE TESTING

### PROBLEM STATEMENT AND PROGRESS:

Braided structures, and stents, are used in the medical device industry for stroke treatment. Based on the specific treatment and location - stents can be used in arterial, venous vasculatures, neurovascular, cardiovascular, and peripheral anatomical structures. The FDA requires stent durability and fatigue testing and recommends that you “test the durability of your stent to the equivalent of ten years of real-time use under pulsatile flow and physiologic loading that simulates blood pressure conditions in the human body.” Over the course of this last quarter, the group has been tirelessly working to ensure that their pump will be able to help EnCompass with their stent testing. They are looking into making a more in depth prototype and final product this coming quarter which will be encouraging to see in the coming weeks! They are looking forward to purchasing materials that will withstand the amount of cycles required for the stents durability!

### TEAM MEMBERS:

Zander Sadorra*
Erica Singh
Katie Kellum
Maliha Hossain
Will Stauffer
Emily Mendyke
Heather Erickson
Kyu Rhee Han



*indicates Team Lead

# FORMAL DESIGN PROJECTS

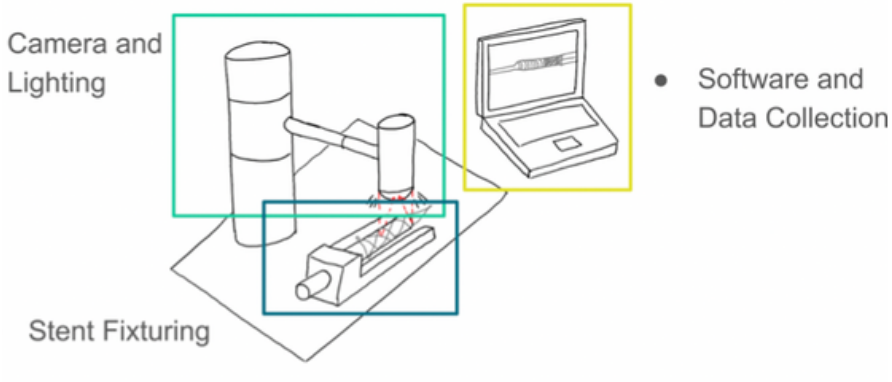
**2022-2023**

## ENCOMPASS - STENT WELD INSPECTION

Throughout this year EMPOWER students have been hard at work. One of these students is Akanksha Maddi, a fourth-year Mechanical Engineering major with a concentration in Mechatronics. Akansha and the rest of the team are developing an optical inspection system to help the company, Encompass, document the welds that are on their stents. EMPOWER students are aiming to aid Encompass in helping them improve their inspection process. Prior to this project, the inspection process was done manually. Encompass asked EMPOWER students to provide them with a system that is going to be used to test the durability of 4mm and 6 mm stents after undergoing 380 million cycles. EMPOWER students worked to research and build a strong enough pump for this task. The team is currently working on finalizing the fixed prototype. In the next few weeks they are planning on adjusting the light fixture and optimizing the light modes. The project is planned to be completed in April/May. The showcase for the project will be shortly after. We can't wait to see the rest of the project unfold!

### TEAM MEMBERS:

Akanksha Maddi*
Allie McAuliffe
Adam Gish
Annie Larson
Pouya Behdinan
Sydney Dedrick
Josh Gottschalk
Natsumi Shudo




*indicates Team Lead

# FORMAL DESIGN PROJECTS

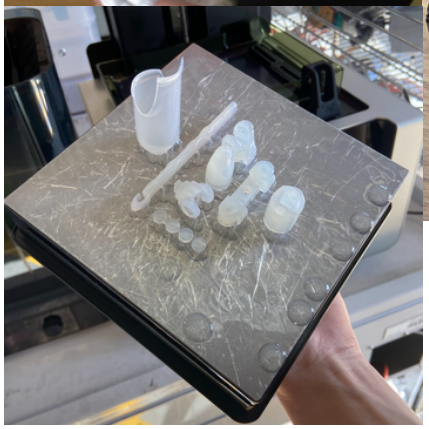
**2022-2023**

## HAND FOR BETH

### PROBLEM STATEMENT AND PROGRESS:

After facing sepsis in 2016 and losing parts of each of her limbs, Beth Parrish wants a device that will give her left hand the basic dexterity and strength required to hold objects like clothing, a dish, or a piece of fruit. Such a device could also provide Beth with the ability to type on a keyboard.

The team has been working tirelessly this quarter to ensure that the hand will be able to be given to Beth at the end of the year! They have been working with a wide variety of 3-D printing materials this quarter and have come up with a solid design that should enable Beth to do many of the tasks she wants to do! Additionally, the team has a fully working finger that works extremely well!



### TEAM MEMBERS:

Michael Grandi*
Kelsea Clays
Lucas Rambo
Jamey Farin
Samantha Gonzales
Jessica Schmok

*indicates Team Lead

# FORMAL DESIGN PROJECTS

**2022-2023**

## EDWARDS - VARIABLE SYSTEM MEASUREMENT

### PROBLEM STATEMENT AND PROGRESS:

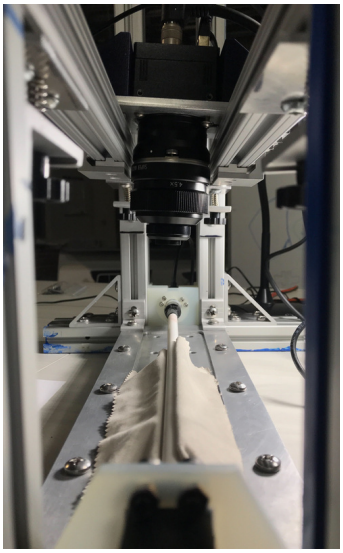
The team goal is to design a variable visual inspection system to characterize coating defects on a dilator component used in TAVR procedures.

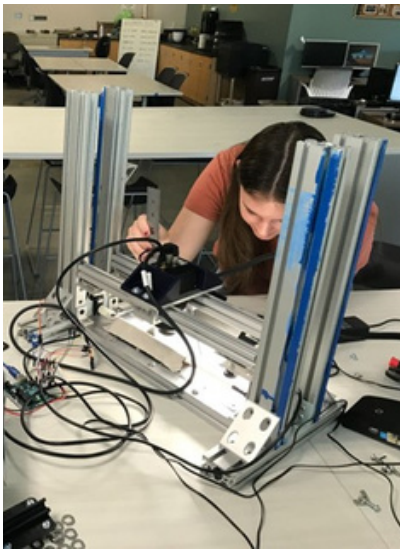
During the winter quarter, the team developed a functioning prototype that can load a dilator onto a mandrel and take magnified photos of the component surface. The fixture uses a computer-controlled 2-axis system to control the rotation of the mandrel as well as the position of the camera to take photos with less variability than manual inspection. The software for the prototype includes visual detection based on a trained algorithm to differentiate dilator coating from defects. One challenge was parts' tolerance for assembly which they overcame with rapid prototyping iterations for fixture parts. Next steps are getting better images for image processing through higher quality components and automating photo cycles for even less variability.

### TEAM MEMBERS:

Jadon Bradford**
Jack Foxcroft**
Daniel Kim
Ethan Hemmerlin
Izabella Parga
Brandon Nguyen
Paige Read

**indicates co-Team Lead





# FORMAL DESIGN PROJECTS

**2022-2023**

## SPASM ALGORITHM FOR TAMAR

### PROBLEM STATEMENT AND PROGRESS:

Tamar was born with quadriplegic cerebral palsy which causes neurological complications resulting in him having muscle spasms and seizures. The goal of this project is to construct a Machine Learning model that can recognize these muscle spasms and/or seizures by training it with EEG data.

The team has acquired an EEG headset, and have set up the method of of data collection using the Muse 2 EEG headset and a supporting app, MindMonitor. They are currently in the data collection stage, where they are learning how to process the data and properly feed it to the Machine Learning Model to train the algorithm for Tamar.

### TEAM MEMBERS:

Noah Nguyen*
Grace Romero
Asa Levine

*indicates Team Lead

# FORMAL DESIGN PROJECTS

**2022-2023**

## DOLPHIN BIOPSY TOOL

### PROBLEM STATEMENT AND PROGRESS:

The Dolphin Skin Biopsy team is a new project this quarter. The team is collaborating with the National Marine Mammal Foundation (NMMF) to create a skin biopsy tool for use in field research on dolphins. No suitable biopsy tool for this application currently exists, as standard veterinary biopsy tools are not thick enough for a dolphin's blubber. The team is also attempting to create a more sustainable version of the biopsy too; since tools must be sterile before use, they are typically thrown out after a single use.

Over the past few weeks, the team has been working diligently to develop a comprehensive design that improves the current standard of research tools. They have completed extensive research on the current tools available on the market, and have created an initial design. After presenting their design to NMMF, the team is now focused on creating a proof-of-concept to test their idea. Their next steps will be to create plans for manufacturing and scale-up of their biopsy tool design's production to meet the needs of the research team on their upcoming summer expeditions. Soon, the team will be traveling to San Diego to work with the dolphins in person.

### TEAM MEMBERS:

Kieran Cunningham*
David Liao
David Nyberg
Ben McConnell

*indicates Team Lead

# FORMAL DESIGN PROJECTS

**2022-2023**

## SKATEBOARD FOR CARLO

### PROBLEM STATEMENT AND PROGRESS:

As a new addition to the list of projects this quarter, this is one of the most exciting projects! This project is aimed to create an electric skateboard that has mounts to support a wheelchair for a Cal Poly student named Carlo that is wheelchair bound. This project aims to help diminish the amount of total travel time that is needed to get to and from campus!

This quarter they have been busy ordering and 3-D printing the the brackets for the board so that Carlo is capable of getting on and off the board they will be designing with ease! Additionally, the skateboard will be able to brake when needed and they have been donated the desired board from LACROIX. We appreciate the donations to enable Carlo a smooth travels to and from school! We are excited to see the final product at the end of Spring Quarter!

### TEAM MEMBERS:

Jaden Rausenberger*
Carlo Ruggiero
Trace Bell

*indicates Team Lead

# LOOKING FORWARD

We are looking forward to Spring Quarter 2023, as we have many workshops and information sessions planned. If you would like to attend our meetings this upcoming quarter, they will be in the TECHE Lab from 6:10 to 7 pm every Tuesday night. Finally, our Formal Design Project teams are preparing for their final manufacturing of the year which will improve many people's lives as a result! We are excited to see where the rest of the year takes us!

Thank you for taking the opportunity to learn more about EMPOWER. If you would like more information about what we do, how to get involved, or past projects, please check out our website https://www.cpempower.com/ or email us at cpempowerops@gmail.com.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