Student Conference Day Presentations
Senior Design Projects
May 08, 2020

SJSU SAN JOSÉ STATE UNIVERSITY

Department of Mechanical Engineering

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Session 1: 8:30 AM – 12:00 PM,

Advisor: Prof. Raymond Yee

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2B	9:00 – 9:25	**Robotics & Intelligent Machine**	Tung Chi Chan Nicolai Stiefei (MfgE) Ryan Oquendo (BME)	Jabil
2C	9:30 – 9:55	**Total Knee Replacement Insert Test Device**	Rachel Lee Angel Fajardo Macias Julio Medina Evelio Perez	Dr. R. Yee (ME Dept)
2D	10:00 – 10:25	**Collapsible Cup Design for Coffee/Tea**	Rachel Bui Daniel Fuentes Hugh Pham Adrian Valdez	Jason Blum
2E	10:30 – 10:55	**Testing Apparatus Instructional Aid for Finite Element Classes**	James McLaughlin Dylan Schmartz	Dr. E. Chan (ME Dept)
2F	11:00 – 11:25	**Piezo Characterization**	Henry Lum Rabia Shaheen (BME) Julie Lo (BME)	Jabil
2G	11:30 – 11:55	**Hyperlens - Metamaterials**	Christopher Miley Steffi Anaya (BME) Julia Son-Bell (BME)	Jabil

Session 2: 9:30 AM – 12:00 PM,

Advisor: Prof. Burford Furman

Project ID	Time	Project Title	Team Members	Sponsor
3A	9:30 – 9:55	**Spartan Superway – Wayside Power**	Aryamitra Bake Waylon Chan Reynaldo Jahja Alex Ng Shane Sharp	Swenson Builder, INIST
3B	10:00 – 10:25	**Spartan Superway – Power Module**	Steven Goh Joe Lau Eric Near	Swenson Builder, INIST
3C	10:30 – 10:55	**Spartan Superway – Small-Scale Model**	Julio de Pereda Banda Asmaa Darwish Shane Fatehi Justin Ghieuw Lissette Romero	Swenson Builder, INIST
3D	11:00 – 11:25	**Spartan Superway – Half-Scale Model**	Keanu Heggem Pinqian Lin Brandon Scully Greg White	Swenson Builder, INIST
3E	11:30 – 11:55	**Spartan Superway – 11 m Track**	Ninebra Babazadehsaralan Jonathan Lagasca Neeraj Lal	Swenson Builder, INIST

Session 3: 9:30 PM – 12:00 PM,

Advisor: Prof. Winncy Du

Project ID	Time	Project Title	Team Members	Sponsor
4A	9:30 – 9:55	**Simulation and Control of SCARA Robot using ROS**	Andres Cuenca (Team Lead) Per Fornaeus David Yu Bryant Wu Natalia Gutierrez Jing Zhao	
4B	10:00 – 10:25	**Modular Heavy Lift Drone**	Nathan Tom (Team Lead) Aaron Jadushlever Noel De la Fuente	CoE for UAV Research Center, Therma Corporation
4C	10:30 – 10:55	**Modular Tiny Green House**	Tim Nguyen (Team Lead) Ashleigh Ballas Xitlali Marquez James Nguyen	
4D	11:00 – 11:25	**Lockheed Martin Diode Forming Process**	Joseph Robles (Team Lead) Juan Cortez Steven Grace Kaije Hoi Andy Wong	Lockheed Martin
4E	11:30 – 11:55	**Automated Solar Array Hinge Mounting Unit for Testing and Installation (ORION)**	Jared Zygarewicz (Team Lead) Antonio Gonzalez Lesslie Verduzco Luis Aguilar Nicholas Dubuk Zach Knesek	Lockheed Martin

Session 4: 1:00 PM – 3:00PM,

Advisor: Prof. Raghu Agarwal

Project ID	Time	Project Title	Team Members	Sponsor
1A	1:00 – 1:25	**Formula SAE Cooling System**	Clarens Caine Van Chrisopher Arzadon Dan Foster Daniel Gu Colin Kwan	
1B	1:30 – 1:55	**SAE Baja**	Alamri, Fahad Barreto Blanco, Rafael Esterly, Daniel David Ge, Joseph Grilli, Guliano Ho, Charles Johnson, Jeremy Y Paap, Alexander	SJSU Baja Club
1C	2:00 – 2:25	**Solar Assisted Wind Turbine**	Ambur,Davis Maximillan Cervantes,Monica Renee Khasgiwala,Rohan Liron, Adams Shinn,Lauren Elizabeth Tran,Brian Minh Anh Weisman,Charles Daniel	Dr. B. Krishan
1D	2:30 – 2:55	**Formula SAE Drive Train**	Cruz,Andrew Jordan Blackburn,Mathew Keang Nojima,Takafumi Silva, Nathan Torres Gonzalez,Emilio Stryker Jr,William Flint	

Session 5: 1:30 PM – 5:30 PM,
Advisor: Prof. Vimal Viswanathan

Project ID	Time	Project Title	Team Members	Sponsor
5A	1:30 - 1:55 PM	**Design & Simulation of a Drive System for the Hyperloop Pod**	Evan Tuliglowski Justin Lee Marco Trinidad	Spartan Hyperloop
5B	2:00 – 2:25	**Design of a Braking System for the Hyperloop Pod**	Mawuto Attiogbe Jordan Chou Yone Lee	Spartan Hyperloop
5C	2:30 – 2:55	**Design & Simulation of a Suspension for the Hyperloop Pod**	Jameson Au Daniel Mah Matt Burger Christopher Day	Spartan Hyperloop
5D	3:00 – 3:25	**Design of a Lateral Stability System for the Spartan Hyperloop Pod**	Mark Domingo Robert Skinner Seyed Ghetmiri Mustafa Ihsan	Spartan Hyperloop
5E	3:30 – 3:55	**Design of a Battery Mounting System for the Spartan Hyperloop Pod**	Waleed Khasru Wesley Lin Kyle Young	Spartan Hyperloop
5F	4:00 – 4:25	**Design and Simulation of an Aerodynamic Aeroshell for the Hyperloop Pod**	Alexander Henderson Eric Luong Bryan Tran David Vaiz	Spartan Hyperloop
5G	4:30 – 4:55	**Design and Optimization of the Core Chassis for the Spartan Hyperloop Pod**	Lalit Amulani Igor Tymoshytskyi Carlos Zarate	Spartan Hyperloop
5H	5:00 – 5:25	**Design and Optimization of the Tip, Tail and Side Panels of the Chassis for the Spartan Hyperloop Pod**	Ricardo Nakane Bao Nguyen Giovanni Pereira Quan Pham	Spartan Hyperloop

Session 6: 1:30 PM – 4:30 PM,

Advisor: Prof. James Mokri

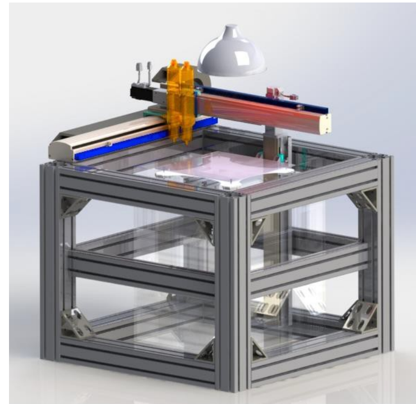
Project ID	Time	Project Title	Team Members	Sponsor
6A	1:30 - 1:55 PM	**Lexus Hybrid Battery Removal Apparatus**	Rylan Ruelli Redza Dzafri Allen Hernandez Brandon Jansen Laura Skarr Carlos Trigueros	Stevens Creek Lexus
6B	2:00 – 2:25	**Automated Sandbag Opening System for the BaggerBot**	Jacob Keller Casey Anderson, Travis Crain, Alfonso De La Rosa, Anthony Garcia, Ziheng Lin, Guojun Peng	Golden Gate Mechanical, Santa Clara
6C	2:30 – 2:55	**Autonomous Lawnmower**	Ankish Priet Eric Naputi Christopher Gulland Adrian Panuco Kaiming Cai	SJSU, Gardenland, Campbell
6D	3:00 – 3:25	**REV Pack - Repurposed Electric Vehicle Battery Pack**	Michael Johansen Chris Yee, Greg Zuniga, Cory Thich, Paul Pham, Austin Stein	Chroma ATE, Inc. Carl Salas (Salas O’Brien Engineers, Inc.) Dr. Fred Barez (SJSU)
6E	3:30 – 3:55	**Automotive Work Platform**	Shimpei Koike Nicholas Nguyen Raul Sanchez Kaikea Sonoda Brian Torres	SJSU, Independence High School, Lexus Dealership
6F	4:00 – 4:25	**Modular Structural System for Solar Panel Installation**	Nathan Cassens Newton Dang Rusiru Gunawardena Alvin Phan Arlen Williams	Kevin Cameron, Hareon Solar, Sim’s Metal, Western Roofing

Session 7: 1:00 PM – 2:30 PM,

Advisor: Prof. Syed Zaidi

Project ID	Time	Project Title	Team Members	Sponsor
7A	1:00 – 1:25	**High Power LED Passive Cooling Techniques**	Antone Silva Theodore Maruyama Steven Nguyen Erik Duque	IntelliScience and Hastest Solutions
7B	1:30 – 1:55	**Robotics Trash Recycler**	Bryan Hackett Lior Raskin Moshe Rienhart Diego Rivera, Tyler Zamencik	Students self-funding and IntelliScience
7C	2:00 – 2:25	**Energy Analysis of Water-Cooled Photovoltaics and Waste Heat Water**	Brian Carrozza Ngoc Chau Alan Huang Jeff Ko Lucas Lim	Students self-funding and IntelliScience

Additive Manufacturing of Advanced Ceramic Material



Student Team Members:
Marcus Freitas (Team Lead)
Brendon Huor, Victor Rodriguez,
Daniel Schultze, Alex Thieu

Faculty Advisor: Dr. Raymond Yee and Dr. Amir Armani

Project Scope and Objectives:
Design and build an improved prototype for the additive manufacturing of advanced ceramic material based on research and specifications provided by Dr. Amir Armani's patented CODE method
(Ceramic On-Demand Extrusion.)

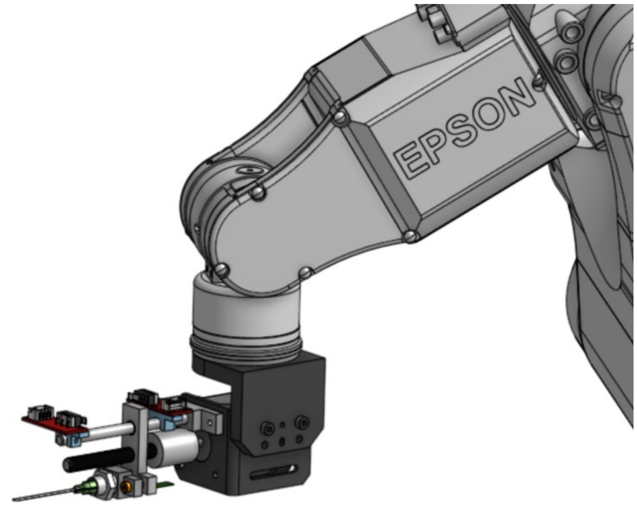
1. Select off-the-shelf components that meet research requirements and design specifications.
    a. Multi axis motion system
        i. Repeatability of 10 micron
        ii. Speed of >100 mm/s
        iii. Stroke of at least 305mm (12 in.)
    b. Radiative heating system
        i. 350 W lamp
        ii. Dry layers in approximately 2 minutes
    c. Extrusion systems and controls
        i. Flow rate of at least 0.198 ml/min
    d. Oil bath system
    e. Slicing software and extrusion firmware
2. Design a sturdy frame assembly to minimize deflection and print inaccuracies of the motion system and print head to only a few microns.
3. Simulations of components and subsystems including thermal analysis, deflection, and stress analysis.
4. (Postponed) Perform physical tests to calibrate extrusion and motion system integration

Project Results:

1. Successfully designed and selected components for a ceramic printing system.
2. Successfully conducted FEA simulations and necessary calculations for thermal, deflection and stress.
3. Physical assembly, testing and extrusion calibration will need to be conducted.

Sponsors:
SJSU, Dr. Amir Armani, Applied Materials

Automated Phlebotomy Machine



Student Team Members:
Tung Chi Chan
Ryan Oqendo
Nicolai Stiefel

Faculty Advisor: Prof. Raymond Yee

Prof. Folarin Erogbogbo
Prof. Alessandro Bellofiore
Prof. Pouya Ostovari

Project Scope and Objectives:
Design and build a needle driving device with machine learning capability on a 6-DoF robotic arm to automate medical procedure such as phlebotomy.

1. Design a machine learning module that could identify medial cubital veins from pictures taken from an near-infrared camera among different people.
2. Design and build a needle driving device that moves the needle forward while constantly monitoring inserting force.
3. Design an ideal controlled route with the 6-DoF robotic arm from EPSON.
4. Combine the individual systems above to a fully functioning robotic that meets the following specifications:
    a. Capable of identifying veins with at least 90% accuracy.
    b. Capable of puncturing veins with less than 0.5mm positional error.
    c. Capable of function fully automatically without
    d. Capable of being disassembled, transported, and controlled easily with one individual.
    e. Small and light enough to sit on an office desk.

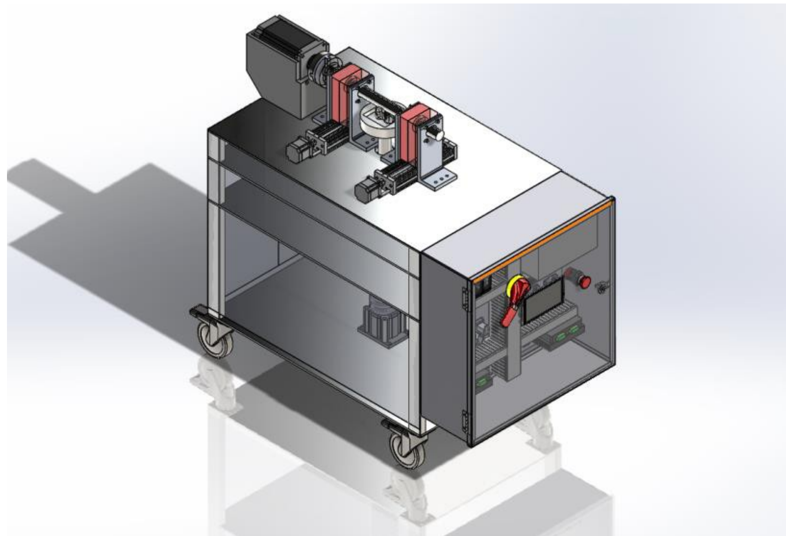
Project Results:
1. Successfully designed and tested the machine learning module.
2. Successfully designed the needle driving device.
3. Successfully learned and designed the moving route of the robotic arm.

Sponsors:
Jabil, SJSU.

Total Knee Replacement Tester

Student Team Members:
Rachel Lee
Angel F. Macias
Julio C. Medina
Evelio J. Perez

Faculty Advisor: Dr. Raymond Yee



Project Scope and Objectives:

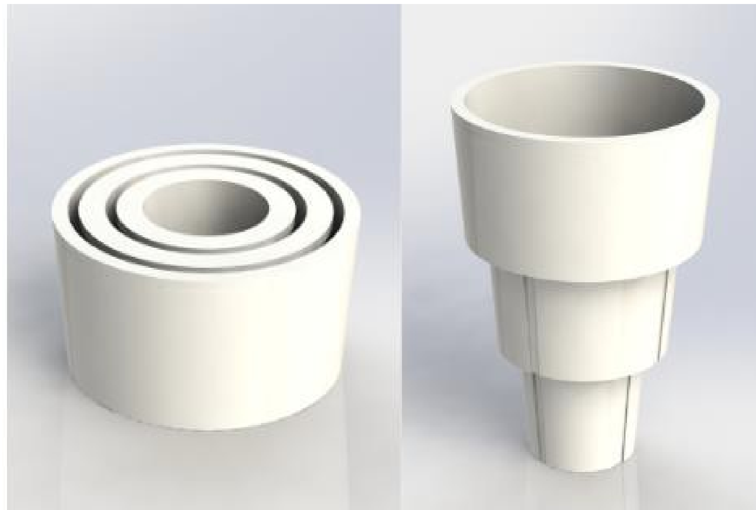
Design and create a test plan to replicate the wear of a polyethylene insert used in Total Knee Replacement Surgeries and to gather data to analyze the wear of the insert over time.

1. Design a device according to the ISO 14243
    1. Capable of mounting and enclosing the insert
    2. Capable of replicating the environment of the knee in terms of temperature and lubrication
    3. Capable of simulating the knee gait cycle through the same applied forces, torques, and rotations
2. Design a device safe to use, minimizing vibrations and noise
3. Design a control system for load control and tracking the number of cycles
4. Form a test plan to make observations and gather data on insert wear rate

Project Results:

1. Successfully minimized noise and vibrations
2. Successfully designed a complete control system
3. Successfully designed a device that meets the design specifications detailed in the ISO 14243
4. Successfully designed a device that is safe to use based on FEA analysis
5. Successfully formed test plan to gather observations and data

Collapsible Cup



Student Team Members:

Rachel Bui

Daniel Fuentes

Hugh Pham (Team Lead)

Adrian Valdez

Faculty Advisor: Dr. Raymond Yee

Project Scope and Objectives:

Design and produce a cup model that promotes sustainability and easy access for a consumer

1. Design and build a cup that meets the following specifications:
    1. Capable of containing at least 12 oz fluid
    2. Capable of holding the fluid's original temperature within 20 degrees C range for two hours.
    3. Capable of being compacted and expanded for a mobile design
    4. Satisfies health standards and regulations for consumption usage.
2. Perform a thermodynamic study to verify the thermal capabilities of the cup design

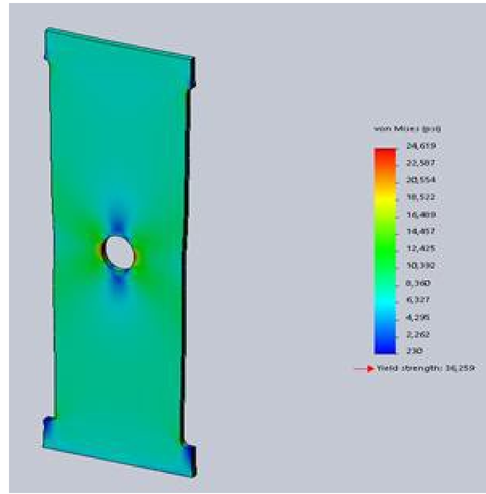
Project Results:

1. Successfully designed the cup compression and expansion mechanism.
2. Successfully designed a thermal insulative cup layer.
3. Successfully confirmed the cup's containment of fluid.
4. Successfully analyzed the cup's thermal and mechanical performance via simulation analysis to confirm its efficiency.

Sponsors:

Jason A. Blum, John Adkins, Scott Hart, Elise Kiland

Finite Element Analysis Teaching Aid: Apparatus with Empirical Data



Student Team Members:
James McLaughlin (Team Lead)
Dylan Schmatz

Faculty Advisor: Dr. Raymond Yee

Project Scope and Objectives:

Design and build a Load Testing Apparatus as an experimental platform. We will use the platform to study the relationship between specimen geometry and stress concentration. The apparatus will provide students with empirical data to supplement course material. It will function as an instructional aid for ME160/ME273 Finite Element Analysis courses.

1. Design tensile test specimens which:
    a. include regions of stress concentration to study
    b. must be equipped with sensory equipment to collect strain data
    c. can be easily fabricated
    d. are reusable and deform elastically without permanently yielding
2. Develop tensile testing apparatus which is capable of deforming specimens
3. Design and assemble data acquisition system to measure specimen deformation at areas of interest and calculation of local stress
4. Work with the support of industry professionals
5. Publish testing results in a manner which is useful to ME160/ME273 course instructors

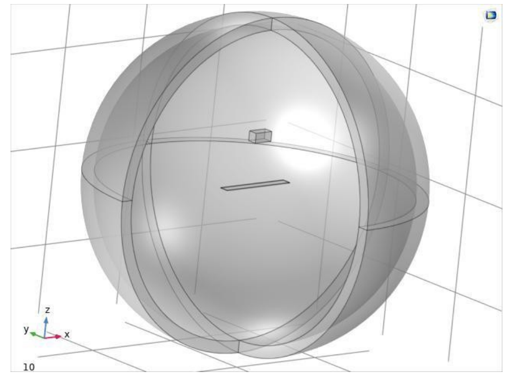
Project Results:

1. Conceptualized testing apparatus and testing regime
2. Worked with sponsor to manufacture apparatus hardware
3. With the aid of faculty, developed a plan to use department equipment to satisfy tensile test requirements
4. Developed computerized simulation to verify initial design intent
5. Published results of the experiment and design simulations

Sponsors:

The Dutra Group
Mechanical Engineering Department at SJSU

Piezo Characterization: Thin Film PVDF



Student Team Members:
Henry Lum Rabia
Shaheen Julie Lo

Faculty Advisor: Dr. Raymond Yee
Jabil Advisor: Corey Smith

Project Scope and Objectives:
Create and experimentally test a Multiphysics Simulation Model of a thin Polyvinylidene Fluoride Film in COMSOL Multiphysics to simulate the Flexural Modulus of the film.

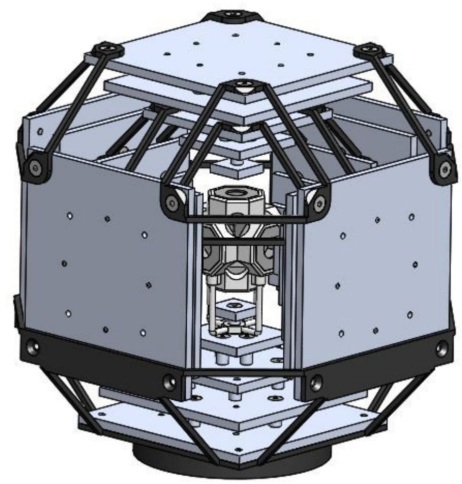
1. Perform literature review on the current literature studies on PVDF and select a supplier to source the thin-films (to experimentally measure its bending modulus).
2. Create a Multiphysics Simulation Model of the PVDF film using relevant properties (from supplier's data sheet) to simulate the Flexural Modulus of the film for the following dimensions:
    a. 1 cm (width) x 8 cm (length) x 0.050 cm (height)
    b. 1 cm (width) x 8 cm (length) x 0.020 cm (height)
    c. 1 cm (width) x 8 cm (length) x 0.012 cm (height)
    d. 1 cm (width) x 8 cm (length) x 0.010 cm (height)
3. Simulate the films as cantilever beams with one side fixed and an uniformly distributed acoustic load will be applied onto one side of the films.
4. Perform experiment at Jabil's facilities to measure the Flexural Modulus of the films.
    a. A Klippel MPM Measurement Device will be used to take measurements.

Project Results:

1. Successfully performed literature review & purchasing of thin-films and equipment for measurements.
2. Successfully created a Multiphysics Simulation Model of the PVDF films with varying height dimensions.
3. Simulation is currently in progress.
4. Unable to experimentally verify results from simulation on Jabil's facilities.

Sponsors:
Jabil Circuits Inc.

Metamaterial Sound Damping Project
(Acoustic Hyperlens /Jabil Scholars)



Student Team Members:
Christopher Miley (ME)
Steffi Anaya (BME)
Julia Son-Bell (BME)

Faculty Advisor: Dr. Raymond Yee

Project Scope and Objectives:
Create a 3D metamaterial noise reduction device that implements the metamaterial geometry from last year's SJSU team (2018-2019), such that a minimum attenuation of 10 decibels (dB) in Sound Pressure Levels
(SPL) is achieved.

1. Build acoustic simulation model in COMSOL Multiphysics in order to optimize geometry based on dB output.
2. Build support structure for speaker array and metamaterial geometry.
   a. Must be less than the size of a basketball.
   b. Upper and lower sections must separate for testing purposes.
   c. Must be easily moved by 1 person
3. Preform a stress analysis on structure to ensure proper support with minimum cross section.
   a. 0.118-inch cross section
4. Preform frequency analysis to ensure that that test frequencies do no match natural frequency of structure.
   a. Test frequency range 2kHz-9kHz

Project Results:
1. Successfully built COMSOL simulation model
   a. Optimized given variables to create optimal geometry
2. Designed optimized geometry support and simulated stress and frequency analysis
3. Fabricated geometry and assembled upper section of model verifying stress analysis
4. Fabricated speaker array and preformed baseline test on Near Field Scanner

Sponsors:
Jabil

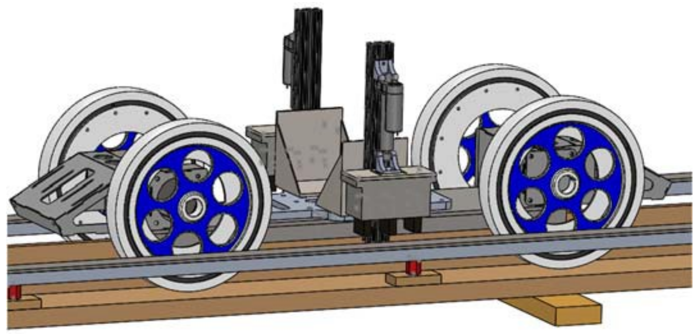
SPARTAN Superway - Wayside Power and Distribution System

Student Team Members:

Alex Ng *(Team Lead)*

Reynaldo Jahja *(Design)*

Shane Sharp *(Design/Fabrication)*
Waylon Chan *(Electrical)* Aryamitra Bake *(Electrical)*



Faculty Advisor:
Professor Burford Furman

Industry Advisor:
Ron Swenson

Project Scope and Objectives:
Design and build a full-scale third rail power system prototype to distribute power to a moving 'bogie'.

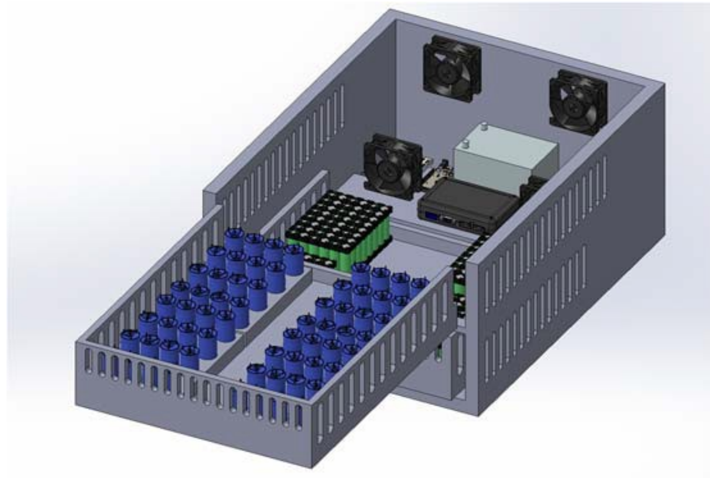
1. Design and build a conductive and durable third rail that will distribute power to the bogie.
2. Design and build a conductor shoe that slides along the third rail and transfers power to a power module.
3. Design and build a conductor shoe mechanism that will move the conductor shoe onto the third rail and apply adequate contact pressure between the third rail and conductor shoe.
4. Deliver a mechanically and electrically safe system that will prevent individuals from injury including:
    1. Proper electrical grounding
    2. Proper insulators
    3. Third rail shielding
5. Design a system to display and monitor current and voltage input from rail and output from conductor shoe.

Project Results:

1. Successfully designed and built the third rail system with insulators.
2. Successfully designed the conductor shoe.
3. Successfully designed an adjustable conductor shoe mechanism.
4. Successfully designed an electrical monitoring system.

Sponsors:
SPARTAN Superway, SJSU, Swenson Builders

SPARTAN Superway - Power Module



Student Team Members:
Steven Goh
Joe Lau
Eric Near

Faculty Advisor: Prof. Burford Furman

Industry Advisor: Ron Swenson

Project Scope and Objectives:

Design a power module capable of accelerating a 1500 kg bogie at 2.45 m/s^2 up to a cruise speed of 30 mph.

1. Simulate an electrical system that would safely transmit power from conductor rails to onboard motors.
2. Simulate a hybrid power module that incorporates the use of supercapacitors and lithium-ion batteries.
3. Design and build a switching mechanism to switch between two power sources.
4. Design a Printed Circuit Board (PCB) to minimize wiring in the system.
5. Simulate a cooling system for the power module battery and supercapacitor packs.

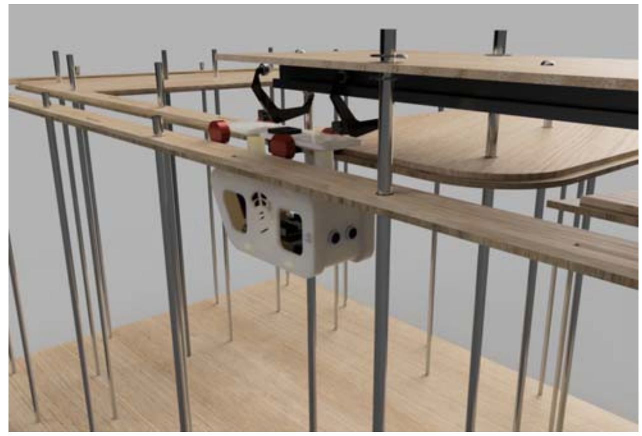
Project Results:

1. Successfully built and demonstrated a switching mechanism between supercapacitors and lithium-ion batteries using an industrial grade relay.
2. Successfully designed a housing to hold all required components securely.
3. Successfully designed a PCB to handle 50 Amps to the supercapacitor pack.
4. Successfully simulated an electrical diagram to demonstrate power delivery from rails to the motor.

Sponsors:

San Jose State University, INIST, Swenson Builder

SPARTAN Superway - Small Scale Model



Student Team Members:

Asmaa Darwish, Lissette Romero,
Julio de Pereda Banda,
Shane Fatehi, Justin Ghieuw

Faculty Advisor: Dr. Burford Furman

Industry Advisor: Ron Swenson

Project Scope and Objectives:
The small scale team is divided into three sub-teams, each with its own specific objectives.

1. Guideway
   a. Fabricate a guideway using laser-cut rails to improve the accuracy of manufacturing.
   b. Design interchangeable rails to allow for reassembly if needed.
   c. Redesign the y-junction, assembly, and overall track to allow the bogie to run smoothly throughout it.
2. Bogie
   a. Develop a new switching mechanism to ensure that there is no risk of falling off at the y-junction.
   b. Design a pod design that allows for easy access to the electronic component.
3. Controls
   a. Have multiple pods that can simultaneously traverse across the guideway.
   b. The pods/bogies will utilize ultrasonic sensors for an anti-collision system.
   c. Develop an app that allows the user to control the bogies from their mobile device.
   d. Each pod will travel to their desired locations by searching for specific barcodes.

Project Results:
1. The guideway team successfully designed a functional and interchangeable track with a working y-junction.
2. The bogie team successfully designed a swiveling mechanism that allows for smooth movement throughout turns.
3. The guideway and bogie team successfully designed a y-junction and y-switch that allows for the bogie to not fall between the gaps
4. The controls team successfully designed an anti-collision system and a complete Arduino control system that connects to a user friendly iOS app.

Sponsors:
Ron Swenson, Swenson Builder, INIST

SPARTAN Superway - Half-Scale Bogie and Controls System

Student Team Members:

Greg White (Project Lead)
Brandon Scully

Keanu Heggem
Pinqian Lin

Faculty Advisor(s): Dr. Burford Furman, Ron Swenson

Project Scope and Objectives:

Design and build a half-scale prototype of the bogie mechanism and controls system for the Spartan Superway transportation system.

1. Perform dynamic analysis on the bogie mechanism as progress from last year's team
2. Improve the design and performance of the switching mechanism
   1. Prototype a new switch arm which clamps onto the track firmly
   2. Redesign a functioning prototype code for the switching mechanism to switch successfully at the Y-junctions
3. Improve and design a compact, organized and easily accessible control systems compartment for the bogie mechanism
4. Diagnose the hardware and wiring connection errors in the controls system.
5. Build and program a wireless controller to enable mounting of the control box while maintaining safe manual control of the system.

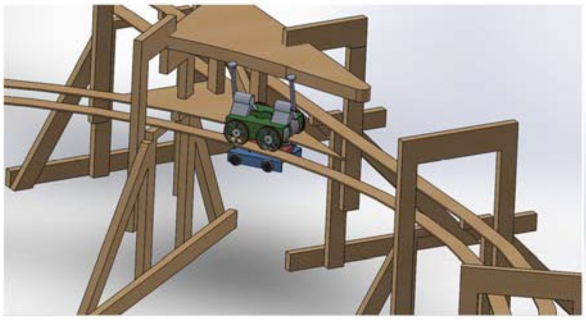
Project Results:

1. Successfully prototyped a new switch arm for the bogie assembly using PLA filament.
2. Successfully designed a functional code for the switching mechanism of the bogie.
3. Successfully prototyped a functioning code for the controller.
4. Successfully performed maintenance analysis and re-fabrication on the bogie mechanism.
5. Successfully designed a CAD simulation of our project which is relevant to our project scope and objectives, including an ideal track design.
6. Successfully redesigned the control box and performed various simulations.
7. Successfully diagnosed the hardware errors in the controls system and rectified the issues with the wiring connections.

Sponsors:

Swenson Builder, INIST

SPARTAN Superway - 11 Meter Scaled Track Model

Student Team Members:

Jonathan Lagasca
Neeraj Lal
Ninebra Babazadehsaralan

Faculty Advisor: Professor Burford Furman

Project Scope and Objectives:

Design and build a scale model track for future senior project teams to test their bogie designs on

1. Have a "Y-junction" implemented where the bogie will be able to contact the track at all times
2. Be made out of exclusively wood for the project to be made easily elsewhere
3. Design the track to meet the following specifications
    1. Support a bogie speed of 6.7 m/s
    2. Deflection of less than 10mm for the track
    3. Minimum FOS (Factor of Safety) of 1.5
    4. At least 3 ft off ground
    5. Withstand centripetal and normal forces projected by the bogie

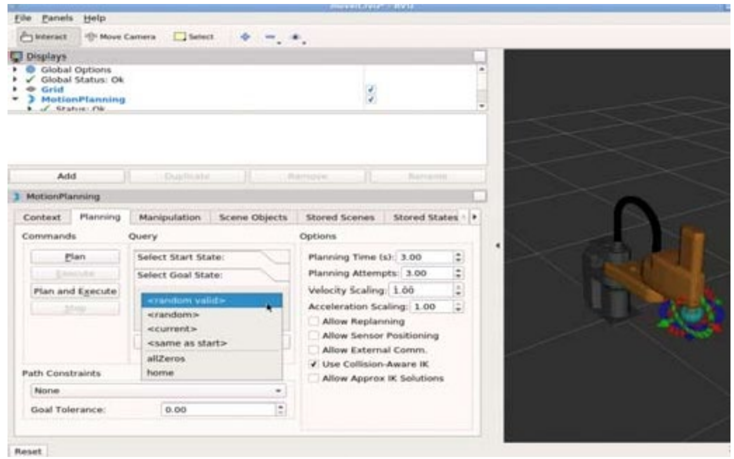
Project Results:

1. Successfully implemented "Y-junction".
2. Successfully created out of the minimum types of materials possible.
3. Successfully designed and built a scale model track that meets (or exceeds) all of the design specifications.

Sponsors:

SJSU, Central Machine Shop, Ron Swenson, Spartan Superway, Swenson Builder, INIST

Simulation and Control of SCARA Robot using ROS



Student Members:

Andres Cuenca (Team Lead)
Per Fornaeus
David Yu
Bryant Wu
Natalia Gutierrez
Jing Zhao

Faculty Advisor: Dr. Winncy Du

Industry Advisor: Nolan Chan

Project Scope and Objectives:

Design and build an open-source robotics platform that covers applying a robotic model to a ROS simulation program and control system based on ROS; providing an additional learning experience to students taking ME 192 (Robotics and Manufacturing System).

- Define the workspace of an industrial robot
- Define the dimensions of a robotic model of RRPR
- Less than 2 feet in length when the robot is fully extended
- Less than 20 pounds in weight
- Derive the forward, inverse kinematics and inverse dynamics equations for the RRPR robot
- Design a simulation and control system using ROS to implement the inverse kinematics
- Establish the interface of an Arduino controller with the ROS environment
- Design a DC motor control system network and provide a method to control the linkages of the RRPR robot
- Derive controller system for each DC motor to obtain the desired position
- Obtain data from DC motor quadrature encoders

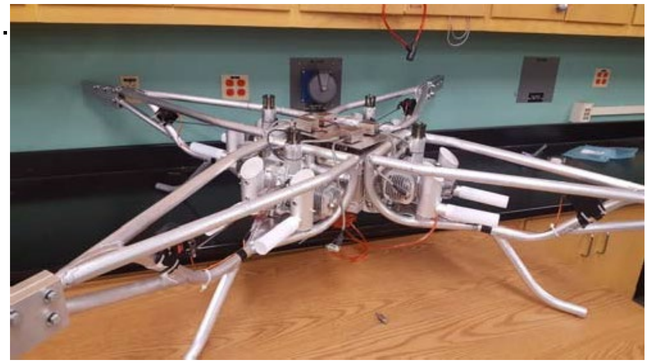
Project Results:

- Successfully designed and modeled RRPR SCARA robot on SolidWorks CAD software that meets all of the design specifications
- Successfully derived forward, inverse kinematics and inverse dynamics calculation for RRPR robot
- Successfully designed the simulation of the RRPR SCARA robot and Adept SCARA robot and a complete control system based on ROS
- Successfully compiled a PID Control System on Arduino code to have the DC motor shaft rotate to the desired angular position relative to time. Arduino prints time, angular position, and velocity
- Successfully analyzed step response on Matlab for each DC Motor and met design criteria

Modular Heavy Lift Drone

Student Team Members:
Nathan Tom (Team Lead)
Noel De La Fuente

Aaron Jadushlever



Faculty Advisor: Dr. Winncy Du

Project Scope and Objectives:

Design and create a drone to help first aid responders during emergencies.

1) The drone must be able to carry a 50 lb payload.
2) Flight time should be at least one hour.
3) Design will be modular to allow easy repairability or changes in configuration.
4) Implement a control system to operate the drone remotely and perform some automatic actions.
5) Remote controlled starting system and emergency shut off.
6) Minimize downtime between flights.

Project Results:

1) Determined and acquired optimal starter assembly for motors
2) Implemented safety control features into design
3) Performed simulation of flight dynamics with varying flight conditions
4) Interfaced transmitter and receiver with flight controller

Sponsors:

College of Engineering for the UAV Research Center

Therma Corporation

Modular Green Tiny (MGT) House

Student Team Members:
Tim Nguyen (Team Lead)
Ashleigh Ballas
Xitlali Galmez-Marquez
James Nguyen

Faculty Advisor:
Dr. Winncy Du

Project Scope and Objectives:
Design and build a prototype for a sustainable and modular tiny house aimed at offering a low-cost option for low-income residents.

- Design a housing prototype that satisfies local building codes.
- Install plumbing and wiring aspects that emphasize affordability and portability.
- Design a modular house that is easily built and dismantled for mobility.
- Implement smart outlets and switches to monitor energy consumption.

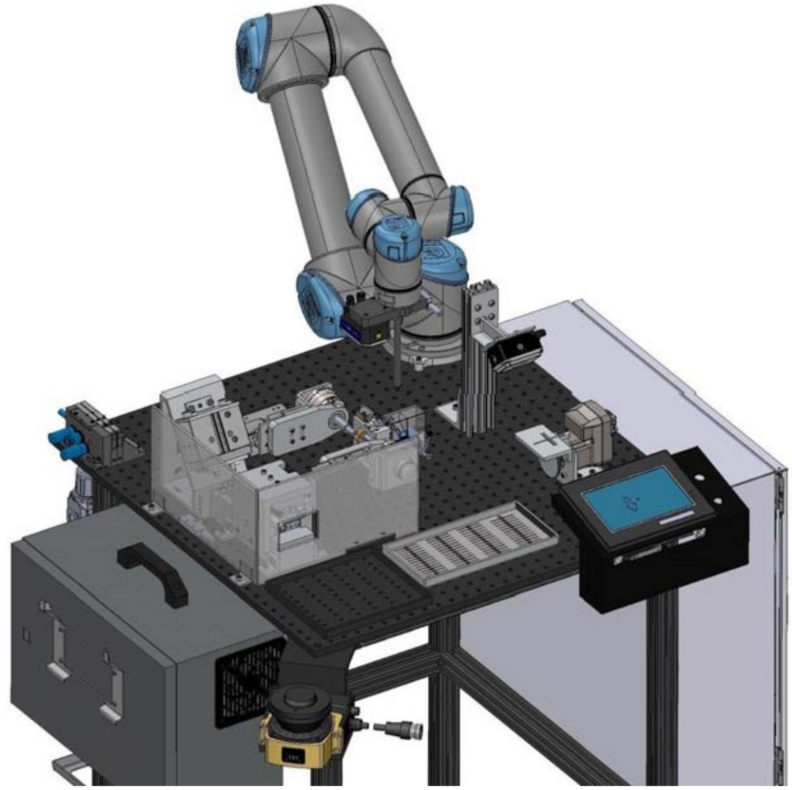
Project Results:

- Updated previous years design to satisfy local building codes
- Began to modify the prototype to meet updated design
- Modeled plumbing and water supply aspects using CAD software
- Designed the electrical layout
- Performed load calculations for HVAC aspects

Sponsors:

Christos Ballas and Dr. Winncy Du

Lockheed Martin Automated Robotic Diode Preparation Process



Student Team Members:
Joseph Robles (Team Leader)
Andy Wong
Juan Cortez
Steven Grace
Kaije Hoi

Faculty Advisor:
Dr. Winncy Du
Industry Advisors:
Chris Walther, Controls Engineer, Lockheed Martin
Tim Petro, Controls Engineer, Lockheed Martin

Project Scope and Objectives:
Design an automated process for high-precision cleaning, cutting, and bending of diode leads for proper mounting to the solar array circuit board.

1. Reduce technician work time and potential health risks.
2. Design all fixtures, pneumatic actuators, and sensors to integrate with a UR5Robot and a Programmable Logic Controller (PLC).
3. Assemble the prototype, including electrical wiring, cabling, pneumatic routing, and safety protocols.
4. Test the diode preparation process to ensure it meets all Lockheed Martin specifications and make any alterations if necessary.

Project Results:
1. Designed scalable indexing, cleaning, cutting, and forming modules.
2. Achieved 90% of the prototype assembly.
3. Completed electrical wiring to connect all modules to the plc hardware.
4. Completed pneumatic wiring to connect all actuators to the main manifold.
5. Finished test code for the manufacturing process and modules.

Sponsor:
Lockheed Martin Space

Automated Solar Array Hinge Mounting Unit for Testing and Installation (ORION)

Student Team Members:
Jared Zygarewicz (Team Lead)
Antonio Gonzalez
Lesslie Verduzco
Luis Aguilar
Nicholas Dubuk
Zach Knesek

Faculty Advisor: Winncy Du

Industry Advisor: Truong Nguyen, Lockhhed Martin Staff

Project Scope and Objectives:

Design and assemble an automated system to close, test, consisting of two mounting geometries.

- Reduce damaging the cam by bending or fracture
- Reduce damage to the pin lead that locks the hinge position in space
- Avoid risk of worker injury
- Assemble a working system using a Programmable Logic Controller (PLC)
- Use sensor feedback to simultaneously test hinge, reduce testing iterations, and hold the closed position for mounting preparation.

Project Specifications:

- Close the hinge by placing a 1/4-inch square head key onto a motor arm, and provide a torque of 46.54lb-in.
- Rotation speed is limited to one degree per second.
- Compatible with both mounting geometries.
- Complete system must be mounted in 3'x3' optical breadboard
- Hinge and the system interface will not damage the hinge itself.
- Automated and touchscreen interface required
- One person operated system
- Sensor feedback
- Torque measurement feedback

Project Results:

- Successfully designed the hinge locking system, motor mounting housing, and actuator assist.
- Ordered all pneumatics, main motor, PLC, and supporting components.
- Fully assembled system mounting table
- Created flowchart of commands and system pneumatic and wire schematics
- Began wire assembly.

Sponsors:
Lockheed Martin Space

Formula SAE Race Car Cooling System

Student Team Members:

Clarens Caine (Team Lead) Van
Chrisopher Arzadon Dan
Foster

Daniel Gu
Colin Kwan

Faculty Advisor: Dr. Raghu Agarwal

Project Scope and Objectives:

Design the engine cooling system for SJSU's
Formula SAE competition race car.

1. Derive the heat transfer equations and measure and analyze previous system data to inform component selection decisions.
2. Improve car's overall competition performance by:
   a. Reducing system weight compared to previous iteration
   b. Improving reliability and serviceability
3. Improve integration with other related car subsystems.
4. Meet or exceed the following design specifications:
   a. 11 lb. maximum system weight
   b. Maximum engine temperature of 220 F in 100F ambient air temperature
   c. Coolant must be water without additives as dictated by competition rules
   d. System must not leak even when tilted 45 degrees
   e. Must function without failure for entire 30 minute endurance run

Project Results:

1. Successfully derived heat transfer equations and utilized them to inform design changes.
2. Successfully reduced overall system weight.
3. Successfully worked with other subsystem designers and improved system integration.

Sponsors:

SPAL Automotive USA, Pankey's Radiator Repair, Mishimoto, Brown & Miller Racing Solutions (BMRS), Primus Racing Parts

SAE Baja, Four Wheel Drive Vehicle

Student Team Members:
Joseph Ge (Team Lead)
Rafael Barreto

Guliano Grilli
Fahad Alamri

Charles Ho
Jeremy Johnson
Alexander Paap
Daniel Esterly

Faculty Advisor: Dr. Raghu Agarwal

Project Scope and Objectives:
Design, build, and race a four-wheel-drive off-road vehicle for the 2020 Baja SAE Arizona competition.

1. Establish top-level vehicle performance requirements based on previous generation competition vehicles
    a. Design a part-time, mechanically auto-engaging four-wheel-drive powertrain layout
    b. Develop kinematic skeleton for desired vehicle dynamic characteristics
    c. Integrate all powertrain, suspension, and ergonomic points by designing a new chromoly space-frame
2. Validate all components
    a. Develop load cases using researched and historic data
    b. Perform Finite Element Analysis (FEA) on all components, studying failure modes and effects
3. Manufacture all components
    a. Create 3D model and 2D drawings for manufacturing
    b. Performing tolerance analysis
    c. Welding, machining, and assembling vehicle
        i. Creating manufacturing jigs where necessary
4. Test and Race
    a. Develop test plan to validate all systems before competition
    b. Finish top 20 at SAE Baja Arizona

Project Results:

1. Vehicle performance targets established
2. All components designed and validated with developed load cases
3. Prototype manufacturing in progress.

Sponsors:

ANSYS, Briggs & Stratton, Borgs Gear Specialties, Campbell Metals, CRCdj, Don Beall Foundation, Guayaki, Jon Lockwood, Mass Precision, Micro Mechanics, Pacific Heat Treat Co, Peanuts Cafe, Polaris, Royal Brass, SAE, SJSU Associated Students, SJSU College of Engineering, SKF Bearings, Solidworks, and VR3 Engineering

Hybrid Renewable Power Generation and Storage System

Student Team Members:
Monica Cervantes (Team Leader)
Rohan Khasgiwala
Charles Weisman
Adam Liron
Lauren Shinn
Davis Ambur
Brian Tran

Faculty Advisor: Dr. Agarwal

Project Scope and Objectives:
Improving the efficiency of wind turbines through the assistance of solar energy. Application is powering a bus stop sign along the road that needs power without connecting it to the grid.

1. Power needs:
    - 200 Watthour/day
    - Storage: 1.5KWH
2. Design a system capable of providing continuous source of power:
    - Vertical axis wind turbine
    - Solar panel
    - Wind speed detector
    - Logic
    - Battery and charging circuit
3. Obtain energy from the wind turbine to charge the battery. Solar panel will power the motor to turn the turbine when not enough wind is present.

Project Results:
1. Successfully designed and built a functional prototype that meets all the design specifications
2. Prove or disprove the concept of using a combined system of a wind turbine aided by a solar panel to increase wind turbine efficiency.

Sponsors:
San Jose State University - Department of Engineering
Baldev Krishan Ph.D.

Formula SAE Drive-Train System

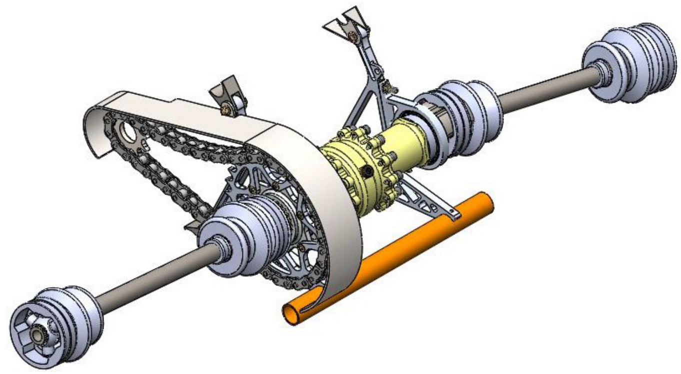
Team Members:
Andrew Cruz
Nathan Silva

Emilio Torres

William Stryker
Matthew Blackburn
Takafumi Nojima

Faculty Advisor:

Dr. Raghu Agarwal



Project Scope:

Design, build and evaluate the performance of a custom chain-driven limited-slip twin rear-axle and carrier assembly for the 12th iteration of San Jose State's Formula SAE combustion vehicle.

Reliable and competitive vehicle performance

Objectives:

Comprehensive, multi-scenario load case based on understood tire behavior and expected vehicle dynamics

Pursue optimized sprocket and carrier bracket topology based on load case developed

Carrier: Adjustable chain-tensioning system, system weight 10% less than SR11; Rotating FOS: 1.15; Translational FoS: 1.25, <10 minutes to achieve chain tension

Gearing: Integrate gear ratios with suspension goals to ensure maximum acceleration at the limit of the tires; 70 mph in fourth gear at 12,500 engine RPM

Project Results: Design and Simulation

Platform exists for future system manufacture and validation testing

Successfully created a drivetrain force-calculator to substantiate the system load case under dynamic load

Successfully integrated outboard tripod housing into vehicle wheel hubs for mass reduction **Successfully** designed carrier bracketry; reduced weight by 31%; maintained static and fatigue factors of safety

Successfully integrated a chain-tensioning system with the carrier brackets by means of shimmable flanges

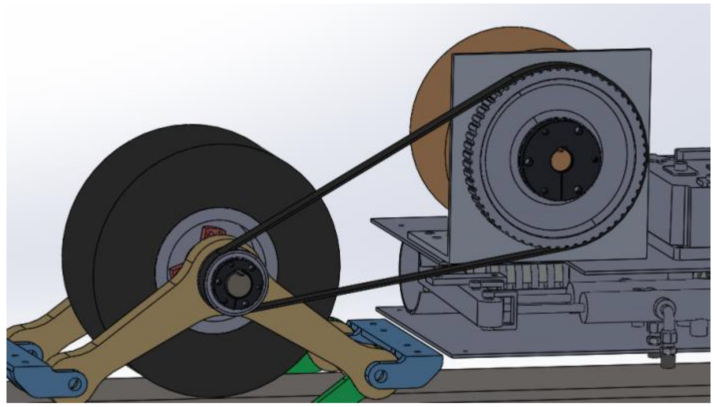
Successfully integrated transmission/drive ratios to achieve a peak wheel torque-per-gear of #; This gear train will reach 70 mph in fourth gear at 12,500 engine RPM

Sponsors: Heinzen, SJSU Central Machine Shop, Mass Precision Machining, A1-Jays Machining, Jabil, Drexler, SKF Bearings, TaylorRace, Pegasus AutoRacing

Design & Simulation of a Drive System for the Hyperloop Pod

Student Team Members:

Evan Tuliglowski (Team Lead)
Marco Trinidad
Justin Lee



Faculty Advisor: Dr. Vimal Viswanathan

Project Scope and Objectives:
Design a propulsion system that will drive the Hyperloop pod.

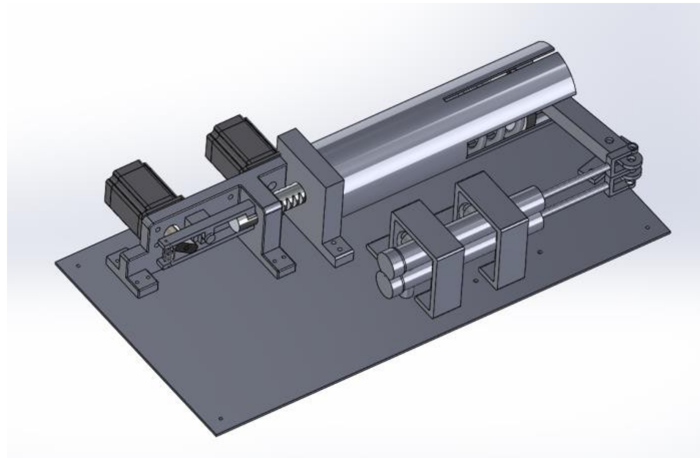
1. Derive equations that will determine the proper pulley sizes to reach our speed goal of 100 mph.
2. Design a pulley system that will sufficiently transfer power and speed to the wheel.
3. Calculate and determine the forces that will act on this system and update design to withstand those forces.
4. Simulate the system to confirm calculations and determine speed the pulley system will provide.

Project Results:

1. Successfully determined the pulley sizes.
2. Successfully designed pulley system.
3. Successfully determined the forces on the system.
4. Successfully simulated the system.

Sponsor:
Spartan Hyperloop Club

Design of a Braking System for the Hyperloop Pod



Student Team Members: Mawuto Attiogbe (Team Lead), Jordan Chou, Yone Lee

Faculty Advisor: Vimal Kumar Cherickal Viswanathan

Project Scope and Objectives:

Design and build the braking system of the Spartan Hyperloop team pod for the next SpaceX competition

1. Design a full-functional braking system that meets the specification given by the Hyperloop team.
2. Design a Hydraulic braking system that would be connected to four Calipers, which would clamp to the I-beam and bring the pod to a full stop.
3. Perform initial kinematic calculations to showcase the proof of concept of the design
4. Program Stepper motors that would control the prime and deployed state of the braking mechanism.
5. Perform simulation study to determine the performance of the designed braking system.

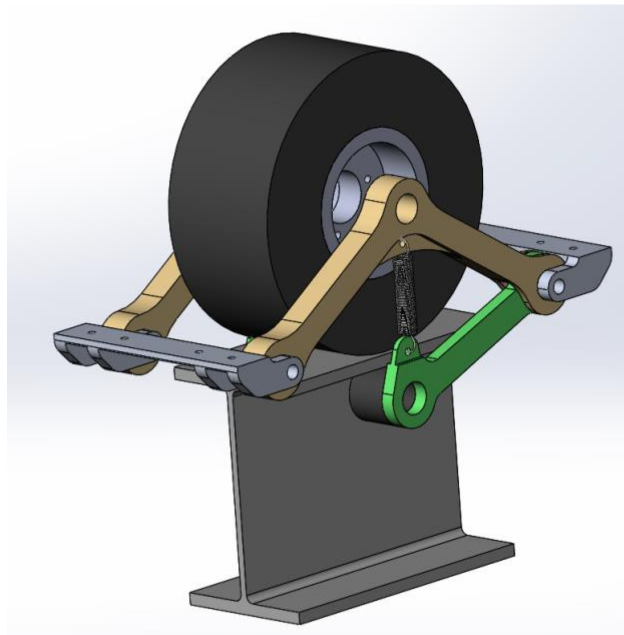
Project Results:

1. Successfully performed required calculations and simulations to prove reliability of design
2. Successfully identified calipers on the market that works with the design and meets the requirements of the competition
3. Successfully designed a full-functional braking system
4. Successfully designed system that meets all design specifications given by the Hyperloop team.

Sponsors:

Spartan Hyperloop Club

Design & Simulation of a Suspension for the Hyperloop Pod



Student Team Members:
Jameson Au
Daniel Mah
Matt Burgers
Chris Day

Faculty Advisor: Dr. Vimal Viswanathan

Project Scope and Objectives:

To design a stability suspension system for a hyperloop pod, so that it may mitigate vibrations on the pod.

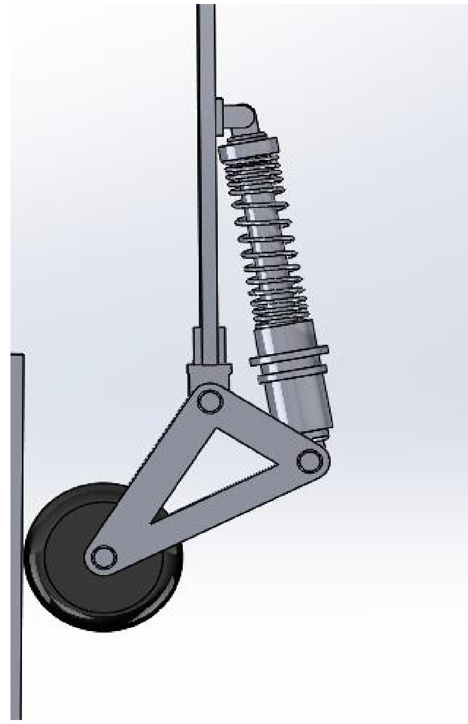
1) Derive kinematic, static, and vibration equations for the A-Arm and Lever Arm
2) Calculate for minimum spring tension needed and bearing size/type
3) Perform an Ansys Simulation, SolidWorks Simulation, and SolidWorks Motion Study
4) Design and build a stability suspension system that meets following specifications:
    a) Capable of supporting the forces exerted by a 200 pound pod
    b) Capable of maintaining a spring deflection of 0.5 inches or less
    c) Bearing selection allows pod to travel at desired speed

Project Results:

1) Successfully performed kinematic, static, and vibration calculations on A-Arm and Lever Arm
2) Completed SolidWorks assembly of the entire system
3) Successfully ran simulation results and motion study
4) Successfully designed a stability suspension system that meets (or exceeds) the design specifications

Sponsors: Spartan Hyperloop Club

Design of a Lateral Stability System for the Spartan Hyperloop Pod

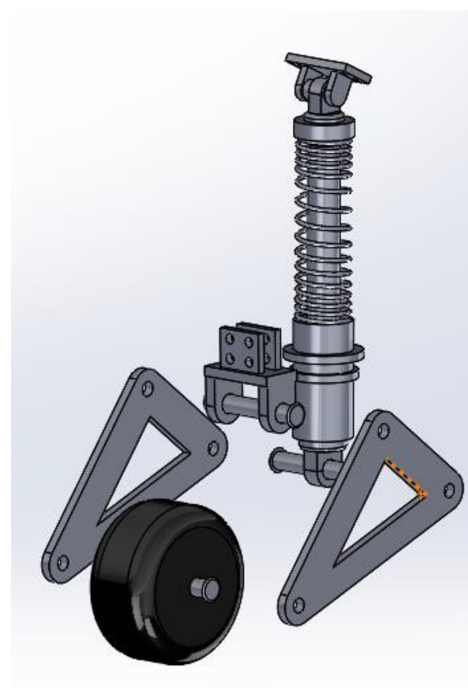


Student Team Members:
Mark Domingo (Team Lead)
Mehdi Ghetmiri
Mustafa Ihsan
Robert Skinner

Faculty Advisor: Dr. Vimal Viswanathan

Project Scope and Objectives:
Design and build a lateral stability system for the Spartan Hyperloop pod.

1. Conduct research on existing lateral stability technology
2. Create model design using SolidWorks
3. Analyze triangular member to minimize mass while maintaining a Factor of Safety of 2.
4. Calculate spring constant and damping ratio to achieve vibration mitigation.
5. Conduct computer-aided stress and motion analysis on the system.
6. Prototype pod sized model.

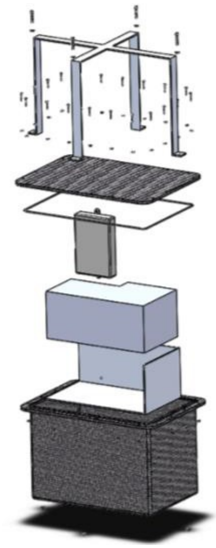


Project Results:

1. Successfully designed the lateral stability system.
2. Successfully derived static load management analysis for all components in the design.
3. Successfully completed dynamic vibration analysis.
4. Successfully establish optimal design of spring system.
5. Partially complete prototyped model that meets all design specifications.

Sponsors:
Spartan Hyperloop Club

Design of a Battery Mounting System for the Spartan Hyperloop Pod



Student Team Members:
Waleed Khasru (Team Lead)
Wesley Lin
Kyle Young

Faculty Advisor: Dr. Vimal Viswanathan

Project Scope and Objectives:
Design two hermetically sealed battery enclosures for the Spartan Hyperloop V Pod.

1. Utilize computer-aided design to provide a visual representation of two separate enclosures according to the dimensions of the primary and secondary battery packs.
2. Perform ANSYS pressure simulations and manual calculations to test viability of all components (screws, washers, nuts, brackets, lids, O-rings, pack frames, bases).
3. Troubleshoot and outline fabrication methodology to meet the following specifications:
    a. Capable of enclosing all electronic components within (battery packs, battery management system, connectors)
    b. Capable of maintaining 1 atm internally in near vacuum conditions
    c. Secured to the pod chassis with sufficient fasteners and mounting structures
    d. Capable of allowing battery packs to work properly in all conditions, including during high speed testing
4. Finalize a detailed report with simulation results, a bill of materials, and product sources to aid the subsequent team.

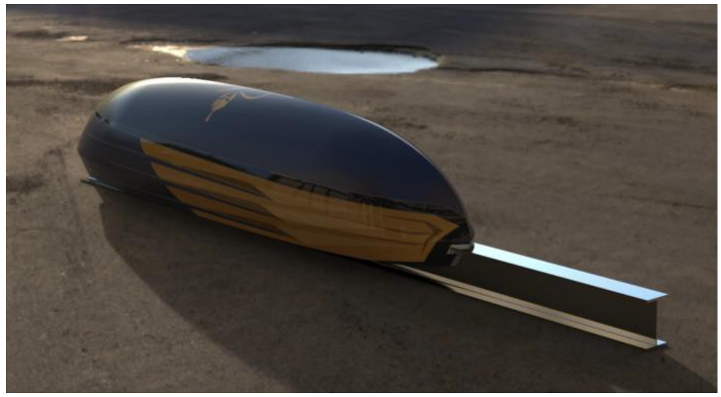
Project Results:
1. Successfully used CAD to draw out a detailed representation of the designs.
2. Successfully performed simulations and calculations to ensure the success of all components.
3. Successfully designed two battery enclosures meeting the given design specifications.
4. Successfully sourced all required materials and completed a detailed report of the project.

Sponsors:
Spartan Hyperloop Club, San Jose State University, Technology Marketing Inc.

Design and Simulation of an Aerodynamic Aeroshell for the Hyperloop Pod

Student Team Members:
David Vaiz (Team Lead)
Alexander Henderson
Eric Luong
Bryan Tran

Faculty Advisor: Dr. Vimal Viswanathan



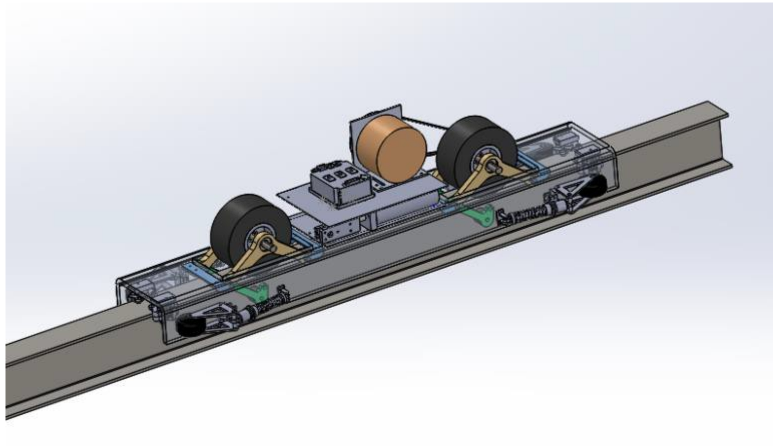
Project Scope and Objectives:
Research and design an improved aeroshell to compete in the Hyperloop competition.

1. Design an aeroshell that can mate/interface to the chassis.
2. Design an aeroshell that meets the following Hyperloop technical specifications:
    a. Fit within the cross-section of the vacuum tube used in competition.
    b. A minimum and maximum pod length of 5 and 24 feet, respectively.
3. Simulate the new design using ANSYS Fluent for drag reduction analysis.

Project Results:
1. Successfully designed an aeroshell that is capable of interfacing with the chassis.
2. Successfully met the Hyperloop technical specifications for the aeroshell.
3. Successfully reduced drag with the new design based on drag reduction analysis.

Sponsors: Spartan Hyperloop

Design and Optimization of the Core Chassis for the Spartan Hyperloop Pod



Student Team Members:
Lalit Amulani
Igor Tymoshytskyi
Carlos Zarate

Faculty Advisor: Dr. Vimal Viswanathan

Project Scope and Objectives:
Design, build and test carbon-fiber core chassis. Select and run simulations for a battery mount.

1. Create detailed CAD of core
2. Select proper carbon fiber material properties
3. Run proper static structural analysis using ANSYS
4. Research and select proper carbon fiber fabrication techniques
5. Create CAD for purchased motor mount
6. Run static structural analysis for the mount to ensure safety
7. Integrate other team components to the core as a master assembly CAD
8. Create carbon-fiber core
9. Integrate other components to physical core

Project Results:

1. Successfully created CAD for core and motor mount
2. Successfully ran simulations for core and motor mount
3. Successfully determined a fabrication technique
4. Successfully created a Master Assembly CAD
5. Not able to fabricate and test carbon-fiber core due to COVID-19 situation

Sponsors:
Spartan Hyperloop Club

Design and Optimization of the Tip, Tail and Side Panels of the Chassis for the Spartan Hyperloop Pod

Student Team Members:

1. Giovanni Pereira
2. Bao Nguyen
3. Ricardo Nakane
4. Quan Pham

Faculty Advisor: Dr. Vimal Viswanathan

Project Scope & Objectives:
Design and simulate the tip, tail and sides of the chassis for the Hyperloop project.

1. Perform research to achieve an aesthetically pleasing and light chassis and that maintains aerodynamic efficiency.
2. Simplistic design that yields a relatively inexpensive and easy manufacturing process.
3. Ease of mounting and dismounting the body structure.
4. Tip and tail frame members serve as supports to the aeroshell chassis, providing a solid structure for housing sub-units such as the battery, suspension, lateral stability, etc. The aerodynamics are also further being supported by the continuity design between the tip & tail chassis and aeroshell.
5. Achieve a factor of safety on 3 on all parts.
6. Create a modular geometry that allows expandability as needed.

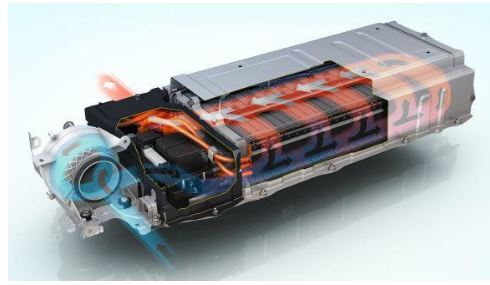
Project Results:

1. Achievable results of 25 lbs load from the aeroshell applied downwards to all surfaces of chassis thickness of 0.125 in without any deformation and within safety factor.
2. Created model geometry that is modular and can be molded in carbon fiber easily through wet lay up or resin unfusin.
3. Established Interfaced with chassis core as well as aeroshell.

Sponsors:

1. Spartan Hyperloop Club

Lexus Hybrid Battery Removal Apparatus



Student Team Members:

Rylan Ruelli (Team Lead)
Redza Dzafri
Allen Hernandez
Brandon Jansen
Laura Skarr
Carlos Trigueros

Faculty Advisor: Prof James Mokri

Project Scope and Objectives:

Design an apparatus capable of assisting an auto technician removing and installing the hybrid battery pack of GS and RX Lexus models and the backseat of the RX model.

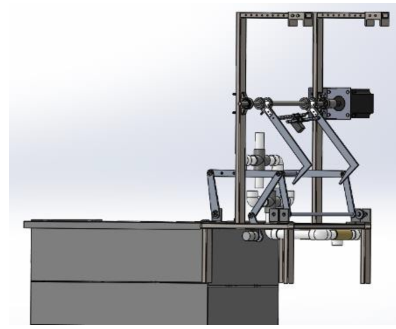
1. Perform geometric, force and stress analysis on the apparatus as well as finite-element analysis methods to verify material selection and hypothetical load conditions
2. Design an electrical-based controls system to power and operate the four-bar mechanism as well as the lifting motion for the battery removal/installation procedure
3. Design an apparatus to exceed the customer's criteria while meeting the following specifications
    a. Single-operator apparatus use as well as optimizing footprint for a minimal area of storage/disassembly. Base dimension - 40''x 60''x 96'' and Height - under 6' when propped up
    b. Optimal material selection to minimize weight but strong enough to exceed load forces
    c. Versatile fork/boom design to be used in the trunk/cargo area of two different vehicles as well as the ability to lift ~ 135 - 195 lbs
    d. Reliable method and ease of power functionality via 120 VAC by use of actuator force

Project Results:

1. Successfully designed the apparatus to collapse and move easily for storage
2. Successfully designed a control system via dual linear actuator and control box for independent actuator control
3. Successfully applied geometric and stress analysis with the use of Solidworks and ANSYS software
4. Successfully designed a four-bar mechanism, base and boom/fork assembly that meets the customer's and design specifications
5. Created a drawing package with full GD&T that contains all parts, assembly drawing, BOM, and recommendations for future improvements

Sponsors: Stevens
Creek Lexus

Automated Sandbag Opening System For the BaggerBot



Student Team Members:

Jacob Keller (Team Lead)
Casey Anderson, Travis Crain,
Alfonso De La Rosa, Anthony Garcia,
Ziheng Lin, Guojun Peng

Faculty Advisor: Prof James Mokri

Project Scope and Objectives:

Improve Previous years design and build a sandbag opening system for the BaggerBot.

1. Create a system that can operate under the parameters:
   a. Operate at a rate of one bag every six seconds (10 bags every minute).
   b. Withstand harsh conditions (rain, snow, freezing temperatures, etc.).
2. Design a system with a frame that is compact and/or collapsible.
3. Design a cassette system to accurately raise the stack of bags and be able to collapse the system to be stored within the BaggerBot unit.
4. Design a rolling system to automatically separate a stack of bags into single pieces efficiently.
5. Design the software and hardware of each mechatronic subsystem (Cassette, Vacuum, Finger, Rolling) to operate the machine.
6. Convert the previous year's system design to be completely automated.
7. Produce an operator's and maintenance manual for the design.

Project Results:

Prior to remotely project contributions:

1. Assembly of the Automated Sandbag Gravel Machine frame including finger system, vacuum system, and 4 bar linkage
2. Successful circuitry set up for the each of the subsystems mentioned above

Remote project contributions:

1. Successfully designed the hardware simulation of the entire system with Unity
   a. Gives real-time operations of the components as machine is in use
   b. Shows 3-D Models of sub-system designs made in SolidWorks and their associated circuit diagrams
   c. Created a solidworks drawing package of the parts with GD&T

Sponsors:

Golden Gate Mechanical, Santa Clara - Tom Burns & Ginger Burns

Autonomous Lawnmower

Student Team Members:

Ankish Priet
Eric Naputi
Christopher Gulland
Adrian Panuco
Kaiming Cai

Faculty Advisor: Prof James Mokri

Project Scope and Objectives:

Design and build a base frame with electric motors and autopilot hardware around an internal combustion engine (ICE) lawnmower. Functionality will include both remote control and an autonomous feature, a Pixhawk 4 autopilot hardware running ArduPilot, to mow a field within a designated area. An RTK capable GPS system is used in conjunction with the autopilot to improve accuracy two orders of magnitude from 1-2 m up to 2 cm.

1. Design and build a frame to hold:
    a. ICE lawnmower with adjustable cutting height
    b. Two powerful electric wheelchair motors
    c. RC and autopilot hardware
    d. 2 full size car batteries to power the vehicle
2. Design a control system that can swap between RC input and autonomy using customizable software.
3. Vehicle Requirements:
    a. Can travel on a 15 degree incline
    b. Must be able to mow a minimum of 1 acre before charge within 90 minutes
    c. Pinpoint location accuracy of < 5 cm
    d. Failsafe mechanism to immediately turn off the ICE and the spinning cutting blade
    e. Obstacle avoidance and waypoint recalibration

Project Results:

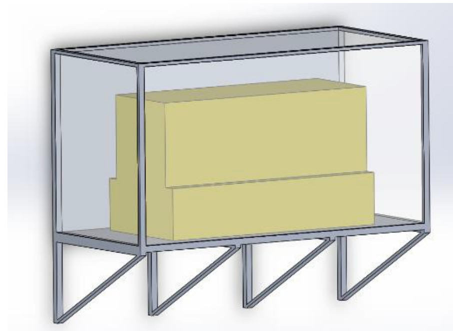
1. Successfully built a frame to hold a lawnmower with height adjustment and be able to hold car batteries with appropriate capacity to mow 1 acre.
2. Successfully established RC user control.
3. Successfully tested the autonomous feature on a small-scale model.

Sponsors:

San Jose State University, Gardenland

REV Pack - Repurposed Electric Vehicle Battery Pack

Student Team Members:



Michael Johansen (Team Lead)
Chris Yee - Greg Zuniga - Cory Thich
Paul Pham - Austin Stein

Faculty Advisor: Prof James Mokri

Project Scope and Objectives:

Design, build, test, and compare two battery pack devices made from a repurposed, electric vehicle battery pack and 18650's batteries for use as a backup power source for buildings and other stationary applications.

1. Design and construct a repurposed Chevy Volt battery pack and enclosure.
2. Design and construct an 18650 battery pack with comparable capacity to the Chevy Volt battery pack, utilizing spot welder of own desig.
3. Test and compare the two battery packs on power output, capacity, and reliability.
4. Assess differences in form factors of REV Pack designs (power-to-weight and capacity- to-weight ratios)
5. Assess cooling requirements via testing to justify passive cooling system design or necessitate implementation of active cooling system.
6. Determine battery health and life/cycle expectancy of Chevy Volt module compared to specifications.
7. Assess the environmental benefit and economic cost analysis of reused Chevy Volt battery pack versus 18650 battery pack
8. Ensure energy source can power essential home devices for a minimum of 8 days.

Project Results:

1. Successfully designed and built Chevy Volt and 18650 battery packs and enclosure.
2. Successfully tested both battery packs output, capacity, and health.
3. Continue comparing battery packs power output, capacity, and reliability.
4. Continue assessing environmental benefits and economic cost analysis.

Sponsors:

- Chroma ATE, Inc. Carl Salas (Salas O'Brien Engineers, Inc.) Dr. Fred Barez (SJSU Department of Aviation and Technology**)**

Automotive Work Platform

Student Team Members:
Shimpei Koike
Nicholas Nguyen
Raul Sanchez
Kaikea Sonoda
Brian Torres

Faculty Advisor: Prof James Mokri

Project Scope and Objectives:

Design a work platform that can be used to service large vehicles. As well as work with the students of Independence High School to teach skills like welding and expose the IHS students to the field of engineering.

1. Design a platform, using mechanical engineering design processes, that will make accessing the engine bay of larger vehicles easier for automotive technicians.
2. Design a lifting system, using prototype and FEA simulation analysis tools, that will allow the user the ability to access the roof vehicles (up to 8 feet) by using piston- assisted technology and locking pins.
3. Create a design that is user ergonomic and can comfortably support a technician through a long service session by using memory foam and full torso support.
4. Design a platform that will increase automotive technician efficiency during repairs, which satisfies the following requirements:
    a. Tool storage and holsters for light repair equipment
    b. Lighting capability to aid visibility
    c. Mobility capability that allows the platform to be easily transported across a shop
5. Help promote the pursuit of higher education within the youths at IHS.

Project Results:

1. Successfully generated a platform design that meets safety criteria using FEA models and prototype analysis.
2. Successfully exposed students of Independence High School to ME design processes.
3. Successfully created a technical package that contains:
    a. Technical drawings for parts
    b. Assembly instructions
    c. Proposal for future improvements

Sponsors: SJSU, Independence High School, Lexus Dealership

Modular Structural System for Solar Panel Installation

Student Team Members:
Nathan Cassens
Newton Dang
Rusiru Gunawardena
Alvin Phan
Arlen Williams (Team Lead)

Faculty Advisor: Prof James Mokri

Project Scope and Objectives:
Design, test, and build a solar PV mounting system for pitched roofs which minimizes roof penetrations and potential roof leaks.

1. Perform wind tunnel testing to determine wind force on a model structure scaled down by one-twelfth.
2. Design a pitch adjusting mechanism to fit all roof slopes.
3. Create and package a DIY kit with pre-ordered and prefabricated parts to ease and lower the cost of the installation process.
4. Design and build a full-scale system that meets the following specifications:
    1. Capable of withstanding wind speeds of up to 90 mph.
    2. Capable of adding extra solar panels if needed.
    3. Capable of transmitting power from solar panels to an inverter using support rails.
    4. Capable of being waterproof.

Project Results:

1. Successfully performed wind tunnel testing and determined resulting forces from 90 MPH wind speed using a load cell.
2. Successfully designed a roof pitch adjusting mechanism using a flat plate and slotted bore.
3. Successfully conducted Flow Simulation using SolidWorks and used resulting pressures to analyze stress on the structure at 90 MPH wind loads
4. Successfully designed and built a full-scale prototype.
5. Ordered and pre-fabricated all materials needed for the DIY kit with everything ready to be installed on a roof.

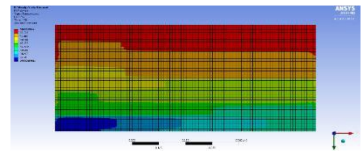
Sponsors:
Kevin Cameron, Hareon Solar, Sim's Metal, Western Roofing Shingle Supplies.

Energy Analysis of Water-Cooled Photovoltaics and Waste Heat Water

Student Members:

Brian Carrozza (Team Lead)
Ngoc Chau

Alan Huang
Jeff Ko
Lucas Lim



Advisor: Dr. Sohail H. Zaidi

Project Scope and Objectives:

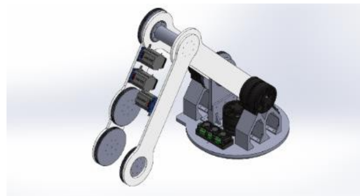
- Theorize, simulate, and implement a method to exchange heat energy from a solar panel to flowing water and analyze the outcome.
- The project aims to obtain optimized performance of the commercially available solar panels and also intend to use the heat extracted from the system for household utilization.
- The critical component of our project is the heat exchanger, referred to as the "evaporator," which interfaces with the back of a large size commercial solar panel.
- The evaporator allows water to directly contact the back of the solar panel. The evaporator design simplifies both the calculations and the simulation. This simplification is achieved by minimizing the interfaces for heat transfer and by keeping the geometry basic.
- The condenser/recirculation system supplies the evaporator with cool water by means of a variable speed pump and an aluminum radiator which is cooled by forced air.
- The system is controlled to keep the temperature of the water output from the evaporator at about 40 degrees C. Temperatures from 32 thermocouples are monitored by two custom, open-source printed circuit boards (PCBs) with surface mount chips (SMCs) in combination with two raspberry pi computers and python programs which record and wirelessly transmit all data.
- A raspberry pi also controls the main power supply, the forced air for the radiator, the pump speed, and records the volumetric flow rate of the recirculating water. A control panel and the test panel are mounted on a 10-degree ground mount which was designed to simulate the common mounting practice for flat-roof, commercial arrays in Santa Clara county.
- Simulations are performed by means of SJSU's super computer with ANSYS utilizing several libraries to yield results for the steady state and transient state scenarios of the panel and evaporator combination. Specific parameters are also set to account for the solar conditions and fair weather conditions due to San Jose State's geographic location.

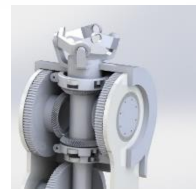
Project Results:

- All components were designed, fabricated, and installed on the solar deck.
- Initial leak evaluation is completed.
- PCB board to operate the system remotely is completed.
- Thermocouples are installed and calibrated for the operations.
- All fixtures required to hold the system are designed and fabricated.
- Troubleshooting of one custom PCB is required before the remote experiment can commence, however, the evaporator is successfully leak free and the recirculation system is fully operational.
- Simulation results appear reasonable and additional computing is required for final results.
- The system is now mounted on the solar deck located at SJSU and experiments will start as soon as the permission is granted.

Robotics Trash Recycler

Student Members
Moshe Rienhart (Team lead)
Bryan Hackett
Lior Raskin
Diego Rivera
Tyler Zamencik





Advisor: Dr. Sohail H. Zaidi

Project Scope and Objectives:

Build an autonomous robot to follow GPS waypoints and pickup bottles or trash in the environment, then depositing them into nearby trashcans.

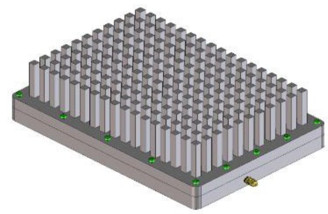
- A 6-DOF arm is developed that will be installed onto a hoverboard automated motor base designed for this project.
- A computer vision algorithm with deep neural networks is being used to determine the optimal grasping position as well as to perfrom obstacle avoidance.
- The soft robotic gripper designed for this application would operate with pneumatics to pickup the refuse and place it into a nearby detected trash can.

Project Results:

- An automated hoverboard base was built and an intel Realsense d435i camera was installed to test navigation for this base.
- A Robot Operating System (ROS) was installed onto the TX2 and Lenovo laptop for running yoloV3 object recognition.
- The robot successfully navigated to waypoints and turned around, using the Realsense camera to navigate the environment.
- We tested the hoverboard drivetrain extensively and designed a PCB for connecting batteries and all the associated sources.
- The robotic arm was designed and was tested with a gearbox to establish the initial joint of the arm.
- Two additional gearboxes were built to test the initial design from the open-torque actuator.
- A ROS node was also developed for using the ODrive with position instead of velocity control. The final assembly and overall testing of the robotic recycler is under progress.

High Power LED Passive Cooling Techniques

Student Members:
Antone Silva (Team lead)
Theodore Maruyama
Steven Nguyen
Erik Duque



Advisor: Dr. Sohail H. Zaidi

Project Scope and Objectives:

To design and build a prototype system that replaces active cooling with passive cooling techniques. More specifically, in this research a heat sink with embedded thermosyphons is designed to make it more compact and efficient for practical applications.

- The device that we designed to solve the cooling problem is a pin fin heat sink with embedded thermosyphons.
- The heat sink is made of aluminum and the working fluid is r-134a.
- The panel that we need to cool gives off 200W of heat and stabilizes at about 50ºC above room temperature.
- This is our temperature goal for the passive cooling techniques.
- The LED panel used in this research reached up to 120 C without any active cooling.

Project Results:

- The first heat sink tested was a classic horizontal fin heat sink. This sink stabilized at about 99ºC above room temperature.
- Thermosyphons were fitted to the side of the sink that stuck up above the system about 2 feet. This system stabilized at 65ºC which is a big improvement but is still 15ºC off of the active cooling method.
- Finally, we have the internally syphoned heat sink simulations that predicts temperatures around 50ºC above room temperature, only being slightly larger than the active cooling method.
- In designing the heat sink, we had to make sure that it would hold the pressures that we will see with the r-134a, this is about 2000kpa and this design is up to the task.