

**UNT**  
**COLLEGE OF ENGINEERING**  
**DESIGN DAY**  
**Friday, April 26, 2013**

University of North Texas  
Discovery Park

## Senior Design

All seniors in Electrical Engineering, Mechanical and Energy Engineering, Materials Science and Engineering, Computer Engineering and Engineering Technology culminate their undergraduate engineering education with a two-semester capstone, senior design project. The senior design course provides students with hands-on experience at solving 'real world' problems while working in a team environment. Students learn important concepts such as project planning, designing, scheduling and working as a cohesive group to accomplish an objective. Many of the senior design projects in our college are sponsored by industry.

Senior design is a unique opportunity for companies, organizations and individual entities to partner and interact with students from our college, resulting in a win-win situation for both, our students and industry partners. The capstone course enables students to gain design experience, use innovative approaches and methodologies to solve engineering problems. In addition to providing invaluable practical technical experiences, the capstone course at UNT College of Engineering enables students to hone their communication skills by requiring them to make poster presentations and oral presentations before an audience of their peers, experts from industry and faculty. This is done on Design Day, an event that occurs in the last Friday of April every year.

# Program

*Discovery Park Auditorium, B155*

1. Welcome Address 9:00 – 9:15 am
2. Poster presentation and project presentation in  
Discovery Park Foyer 9:30 am – 11:30 am

**3. Project Presentations: 1:00 pm – 5 pm**

- |  |      |          |
|--|------|----------|
| A) Computer Engineering                | B155 | (1pm)    |
| B) Information Technology              | B155 | (2:30pm) |
| C) Electrical Engineering              | B242 | (1pm)    |
| D) Mechanical and Energy Engineering   | D201 | (12pm)   |
| E) Electrical Engineering Technology   | B190 | (1-2pm)  |
| F) Mechanical Engineering Technology   | B185 | (1pm)    |
| G) Construction Engineering Technology | B192 | (1pm)    |
| H) Materials Science and Engineering   | D202 | (1-3pm)  |

## **Mechanical and Energy Engineering**

### **Team #1: Copper Filtration System sponsored by Encore Wire Corporation**

#### Team Members:

Derek Biggs  
Jeffrey McKee  
Fernando Gamez  
Chandler Smith  
Siegmar Horsch

#### Executive Summary:

Cu Filtration team is assigned the task by Encore Wire Corp. to replace the current fine particulate filtration system used in their wire drawing process. To determine the baseline for established goals a control testing apparatus will be designed and constructed to replicate the current filtration system which uses paper as the filtration medium. The team will design and fabricate a working replacement filtration module that will improve the efficiency of copper particulate removal and eliminate the use of a paper filtration medium. The highlight of the task is designing an original filtration module that is inherently self-cleaning and functions at or above the current removal rate of copper fines. The team has approached this task by accomplishing finite element analysis modeling and simulation of fine particulate in a fluid, as well as completing the design of two unique solutions for filtering modules. Upon completion and successful demonstration Encore Wire plans to implement a full-scale version of the team's fine particulate removal apparatus within their system.

### **Team #2: Rotor Gearbox Housing Re-Design sponsored by Bell Helicopter**

#### Team Members:

Carey Cross  
Chris Stallings  
David Reilly  
Matthew Zaks  
Chris Richardson

#### Executive Summary:

The aerospace industry often uses castings in the manufacture of large, complex parts. Compared to traditional manufacturing methods, castings offer advantages such as simplified construction, isotropic material properties, and the ability to produce intricate internal and external features. Engineers have long noted key disadvantages of castings including the high cost of tooling (i.e., not ideal for low volume production rates of rotorcraft industry, or for adaptability to future modifications), warping, repeatability issues, difficulty maintaining tolerances, post-manufacturing/processing required, difficult quality inspection (e.g., wall thicknesses, complex features, foreign object and debris), fatigue life knockdown factors, poor surface finish (i.e., high stresses), power density (i.e., unnecessary weight in certain areas, according to Finite Element Analysis), and expensive scrap rate when a casting error is discovered after subsequent machining/assembly operations have been performed. Bell Helicopter has offered the team the opportunity to address these problems on a tail rotor gearbox (TRGB) housing made of cast

magnesium. The team was tasked with selecting an alternative manufacturing method for this part and executing the necessary redesign, analysis, testing, and demonstration. The team chose to manufacture the part using electron beam melting (EBM) with Grade 5 titanium. This manufacturing method and material combination puts forward improved mechanical properties (i.e., creep resistant and high yield strength), superior process control, low setup costs, and significantly reduced production lead times. EBM manufacturing also allows for greater design freedom which the team will use to find creative ways remove excess material. The design will be tested with ANSYS simulations and laboratory experiments.

### **Team #3: Solwind self-powered portable refrigerator**

#### Team members:

Patrick Branson  
Tony Rivera  
Khan Pouch  
Farhan Dohde  
Petru Sarbu

#### Executive Summary:

This team is to design and build a lightweight, portable, iceless cooler powered by built in solar panels and a collapsible wind turbine. The cooler will have a container capacity of 50 quarts. It will be refrigerated using a 30-Watt thermoelectric assembly that will sustain cooler contents at up to 50 degrees Fahrenheit below ambient temperature. The cooler will incorporate a USB port for charging various hand held portable electronics. The cooler will be powered by two sources, a solar panel which flips out from the top of the cooler to face the sun, and an novel collapsing vertical axis wind turbine designed to be stored in a small flat cavity inside the top of the cooler and deploys from storage position with one fluid motion from the user for maximum portability and ease of use. Both the solar panel and the wind turbine will be capable of powering the cooling system independently to maximize their effectiveness in the absence of either of the power sources. For the event of complete loss of suitable wind and solar conditions, the cooler will incorporate a back-up battery as well as a 12-volt power cord that will allow the user to power the cooler with their car.

### **Team #4: Formula SAE Design Competition**

#### Team Members:

Fergus Reid  
Rayner Wilmot  
Mustafa Ismail

#### Executive Summary:

For the first time at UNT, a group of students are undertaking the challenge that is designing and building a 600cc, single-seater, Formula SAE car. For the senior design project this year, the FSAE team will be concentrating on three areas of the car: the driver cell and interface, fuel storage and delivery, and the cooling system. The Formula team aims to have a finished car by mid-April, to allow for testing before competing in Nebraska in June. The main aim is to complete all events, with an eye on the "Rookie Team of the Year" award.

## **Team #5: Rapid Ascent Miniature Unmanned Aerial Vehicle (RAM-UAV)**

### Team Members:

Ethan McMillan  
Kyle Kayfus  
Wesley Golden

### Executive Summary:

The RAM-UAV team's goal is to design and build a prototype Miniature Unmanned Aerial Vehicle (MUAV) with capabilities currently unavailable in today's designs. It is to consist of a compact and portable folding wing UAV platform that is capable of rapid ascent to reach operational altitude via a rocket motor assisted launch. In doing so, the Rapid Ascent Miniature Unmanned Aerial Vehicle (RAM-UAV) will alleviate two constraints of current UAV's in its classification. Firstly, the RAM-UAV eliminates spatial limitations that current systems require in order to launch. An example of this is an open area to act as a launch point that is devoid of obstructions such as trees and buildings and at the same time requires launch into the prevailing wind direction for system stability. Secondly, the RAM-UAV virtually eradicates the traceability that current systems possess upon launch. With the use of a rocket based launch system, the RAM UAV is virtually untraceable by ground observers during launch, as it can reach operational altitude in a matter of seconds without the risk of being targeted compared to the minutes of exposure that current systems employ. By outfitting the system with a first person heads up display (HUD), the RAM-UAV will be useful for surveillance in both the military and civilian sectors, and, with a payload option, could prove of further use in a variety of rolls. Designed to be portable, lightweight, and affordable, the RAM-UAV will revolutionize the close support role of the MUAV.

## **Team #6: Biodiesel Team sponsored by Frito-Lay**

### Team Members:

David Ayo  
Mark Castaneda  
Samantha Daugherty  
Nabin Maharjan  
Javier Ramos  
Kush Shrestha  
Ramona von Niederhausern

### Executive Summary:

Biodiesel fuel is created through a process of converting an organic waste product into usable diesel fuel. For the purpose of our project, we will be using waste vegetable oil from the Frito Lay R&D plant in Plano, TX. Our design will be an automated control system with minimal human input and an average batch capacity of 20 gallons. The biodiesel that is produced will be used onsite by the Frito Lay R&D plant to fuel various pieces of equipment. Frito Lay, a subsidiary of PepsiCo, will be funding the project entirely.

### **Team #7: Blade Inspection Device sponsored by CTI**

#### **Team Members:**

Matt Hart  
Josh Goldstrom  
Jeffrey Hamilton  
Randy Whitehead

#### **Executive Summary:**

The Blade Inspection Device (BID) increases the speed, efficiency, and effectiveness of the current non-destructive inspection of composite helicopter main rotor blades at Composite Technology, Inc. (CTI). The BID detects sub-surface damage by utilizing accelerometers and LabVIEW software to generate frequency responses from localized impacts, and analyzes the data against acceptable frequency profiles. The BID presents many business and engineering advancements that include: providing a searchable database, marking damaged areas of the rotor blade, increasing inspection precision, and automating a fully manual process. In order to design the BID, team members use their knowledge in design of experiments, system controls, electrical circuits, programming, material selection, and mechanical design.

### **Team #8: Reactor Cooling sponsored by Comanche Peak**

#### **Team Members:**

Herbert A. Jones III  
Matthew Gray  
Tim Hickle  
Christie Falwell  
Pete White

#### **Executive Summary:**

In the wake of the Fukushima nuclear disaster in Japan, the United States Nuclear Regulatory Commission (NRC) has determined that all U.S. nuclear power plants have a disaster condition emergency cooling system. Such a system must exceed design-basis criteria and function under the assumption of external AC power loss. The current design at Comanche Peak depends on two diesel generators for an emergency power supply. The disaster scenario for Comanche Peak involves a category 5 tornado that completely takes the switch yard offline, resulting in loss of power to the cooling pumps and reactor core pressurizing systems. The NRC mandates that a method of reactor cooling be in place should the generators fail. In order to maintain safe operating conditions, the situation demands an auxiliary system comprised of a combination of temperature and pressure control. Our task is to conduct a feasibility study and design such a system based on the findings. The results will be presented to Comanche Peak officials for verification and approval, serving as a preliminary design in the process toward meeting new NRC guidelines.

### **Team #9: Spent Fuel Pool Cooling sponsored by Comanche Peak**

#### **Team Members:**

Kyle Gilliam  
Jonathan Maslyk  
Alejandro Moncada  
Ross Russell

Team Spent Fuel Pool is working with Luminant and Comanche Peak Nuclear Power Plant in response to a new directive set up by the Nuclear Regulatory Commission (NRC) to develop a mobile flexible response plan to deal with a natural disaster. The team is tasked with cooling the spent fuel pool (SFP). The specific disaster the team is designing for is an EF5 tornado which takes out the electrical switch yard at the power plant and the backup generators fail to start. In the event of a total loss of power this three phase design will come in to play.

- Phase 1- Monitor the level and temperature of the SFP
- Phase 2- Makeup the water evaporating from the SFP
- Phase 3- Actively cool the SFP

### **Team #10: Solar Powered Steam Generator**

#### **Team Members:**

James Nix  
Michael Fierro  
Karl Hunter  
Andrew Hernandez

#### **Executive Summary:**

The Green Eagle Energy Group is developing a device that will supply users with electrical power using proven technologies that support sustainable energy. The device will have a practical design that is modeled after the Rankine cycle, which is the cycle describing modern day steam power generation. The highlights of the design are the utilization of solar evacuated tubes and parabolic troughs. The group's members will apply numerous engineering concepts and fundamentals to perform an engineering analysis to optimize the device.

## **Engineering Technology**

### **Electrical Engineering Technology**

## **Team #1: C & M Charger**

### Team Members:

Christel Herlin Djaha Fodja  
Mustafa Almahel

### Executive Summary:

C&M Charger constructed a solar-based battery charger for heavy-duty lead acid batteries such as commonly used in cars, tractors, lawn mowers, garage door openers etc. The charger operates exclusively on solar power and can charge concurrently up to 3 batteries of different sizes and capacities. It uses a sequencing technique that polls each battery to determine whether it needs charging or not. An inexpensive microcontroller implements all the checking and control functions, while a stand-alone analog-to-digital converter handles all necessary conversions. A light emitting diode attached to each charging terminal indicates the status of each battery. The standby power is of the order of a few mW making the charger ideal for continuous operation over extended periods of time. In addition to batteries, the power from the charger is sufficient for the operation of small appliances such as laptops. The overall cost of the solar sequencer is approximately \$200 but the majority of the cost is due to the solar panel. The electronic circuitry costs less than \$50.

## **Team #2: Robo-Ensemble**

### Team Members:

Robert DeSoto  
Michael Schneider

### Executive Summary:

Line of Sight Module for Quad Copters. This project is a continuation of a previous Master's Thesis work at UNT which utilized a quad copter, camera module, and open source computer vision software (OpenCV) to enable an autonomous aerial vehicle track a specified pattern. As with many aerial vehicles, modules are added and removed to alter functionality. This project will give the quad copter an additional functional module. The Line of Sight Module will allow the quad copter to align itself between a base station and a roving unit using specified GPS and signal strength algorithms. The GPS algorithm will first center the quad copter between the base station and roving unit. Then, the signal strength algorithm will be used to compensate for signal strength differences if one of the units has a significant reduction in transmission power. After the vehicle has achieved and locked into an optimal position, it will begin bidirectional transmission of data between the base station, quad copter, and the roving unit. The Line of Sight Module will be easily added and removed to accommodate mission criteria. Applications include search and rescue operations, forward troop communications, long range improvised explosive device (IED) and mine detection, long range identify friend or foe (IFF) recognition, and oceanic exploration.

## **Construction Engineering Technology**

## **Team #1: American Construction and Redesign**

### **Team Members:**

Brad Tatum  
Brian Douglas  
Nick Darani  
Yasir Abdelrazig  
Jesse Montgomery

### **Executive Summary:**

Due to the new Apogee Stadium and future development, a demand for a safe and efficient pedestrian crosswalk over I-35 E at North Texas was needed. Our project objective is to redesign certain aspects of a future bridge linking the University of North Texas to the stadium side of the highway. The original design was a steel truss bridge that spans approximately 380 feet and maintain a minimum height of 27'9" over I-35. The team at ACR Contracting has taken steps to improve the aesthetics and design of the bridge. Our team has 3 primary objectives that will help us to provide proper project delivery:

1. Improve lighting, canopy and other aspects of the bridge
2. Make the bridge more environmentally efficient
3. Create a 3-D model
4. Estimate, schedule, and manage the construction of the bridge

## **Team #2: Eagle Ridge Construction**

### **Team Members:**

John Seidenberg  
David Keane  
Tom Robertson  
Ash Day  
Jason Bruner

### **Executive Summary:**

The empty plot of land we are using is 3.42 acres and is located in Garland, Texas off of South Country Club Road. The land is surrounded by residential subdivisions, but is zoned commercial. It is our duty to design something for that spot that would attract the surrounding population and be aesthetically pleasing to the eyes of the community.

Eagle Ridge Construction has decided to build Country Club Markets, a 2 story market center, on this 3.42 acre plot of land that can hold roughly 6 to 10 units that can be leased out to small businesses. The Country Club Markets will be a quick-stop shopping plaza that caters to the community's daily needs. The Country Club Markets serve as convenience for residential communities and relatively inexpensive retail space for the start-up of small businesses. The participating retail businesses that we have in mind that Country Club Markets could offer may include: small restaurants, a mail shipping center, a coffee shop, a cell phone provider store, a small grocery store, a neighborhood pharmacy, a dry cleaner, a local bank, a

hair salon, or a video rental store. The construction of the Country Club Markets will provide the people of the surrounding neighborhoods a convenient place to get some of their day to day errands accomplished.

### **Team #3: Belle Consultant Group**

#### **Team Members:**

Maribel Goodrum

#### **Executive Summary:**

Due to the increased growth as well as projected growth of the city of Prosper, Belle Consultant Group has teamed up with Highland Homes to provide avenues of efficiency during the construction process of Phase 4 at Whitley Place. This part of the project will include improvements in scheduling, technical support, construction management, communication, sustainability and accounting. BCG will also be working with developers and designers in the second part of the project to maximize attraction to buyers in a future land acquisition taking place in Prosper over the next year. This endeavor will include modifications on lot and street placement.

### **Team #4: Eagle Engineering**

#### **Team Members:**

Jay Fox

Ethan Spencer

Kris Khastehdel

Nick Tang

Ricardo Cantu

#### **Executive Summary:**

On January 26th 2012 the main building of the Selwyn College Preparatory School was burned to the ground due to an electrical fire. The building housed several classrooms and acted as the administration building as well. Selwyn School is in immediate need for a new building that will provide students with a safe and modern place to learn, and to serve as the location of the administration department. The school has approved 1.5 million dollars to fund the building of the structure. The school board has given Eagle Engineering full license to design the building and prepare the construction plan. Our design is a two story 18,000 square feet building that will consist of 10-12 classrooms, 4-6 administrative offices, and 4 bathrooms. The building will be fully equipped with modern technology to provide the rooms with fire safety, internet access, and classroom safety. With the future in mind, we will also strive to make the building as self-sustaining as possible. The project completion time will be 8 months.

### **Team #5: Viridis Partnership**

### Team Members:

Vini Deraj  
Jonathan Gallaway  
David Olsen  
Hayden Richardson  
Nathan Wood

### Executive Summary:

The City of Denton, in Partnership with the Denton Animal Shelter Foundation is beginning construction on a new animal care and adoption center to replace the old facility. The city of Denton has more than doubled in population since the construction of the original animal shelter creating a need for a larger and upgraded facility. The Facility consists of a 15,200 square foot building located on a 4.25 acres lot off of Highway 77. The City of Denton has enlisted the help of Viridis Partnership to perform value engineering on the proposed project and to provide suggestions for modifications that can reduce build-cost as well as meet the criteria to obtain a LEED silver certification.

## **Mechanical Engineering Technology**

### **Team #1: SAE Formula 1 Chassis and Drivetrain**

#### Team Members:

Aaron Watkins  
Lea Graham  
Steven Lagow  
Ryan Haag  
Jonathan Gallo

#### Executive Summary:

The Society of Automotive Engineers (SAE) offers a collegiate competition involving a smaller version of Formula Racing. The competition limits engine size to 600cc and mandates a size specific restrictor plate installed within the intake manifold. The University of North Texas Chapter of SAE is participating in the competition held in Lincoln, Nebraska where universities from around the globe will gather and go head-to-head in a multitude of events that test the overall design of their car. This Senior Design Project covers the Chassis and Drivetrain portion of the car. The project includes the design process, rigidity analysis, and the final proposal of this year's frame and drivetrain for use in the 2013 June competition. The drivetrain portion of the project starts at the drive chain coming off of the output shaft of the transmission extends to the rear differential and out to each drive hub. The chassis portion covers the frame with respect to SAE Guidelines, and the mounting of all other components (e.g., brakes, wheels, etc.) involved in the creation of Mean Green's 2013 First SAE Formula Race Car.

## **Team #2: Portable Maintenance Platform**

### Team Members:

Jeffrey Gittle  
Alex Pham  
Colby Thomas

### Executive Summary:

PMP designed and developed a helicopter maintenance platform which could be transported by helicopter. It is deliverable to locations which may not have the necessary equipment already available on site. Current maintenance platforms are welded or bolted together, and either too physically big to transport or requires special tools and multiple people to assemble. The PMP solution consists of four main specifications:

- 1) Transportable inside the cabin of a helicopter
- 2) Able to be assembled on site by 1 person, without tools, in a timely manner
- 3) Stable enough to support multiple technicians and tools at multiple elevations
- 4) Provides useful accessories, such as a toolbox, handrails, and a light for night maintenance

Each joint was engineered to provide the most convenience in assembling the platforms, and a technician will be able to assemble the stand on his/her own. The platform also has wheels for easy mobility, and two separate elevations, thus providing the technician with the most possibilities for potential use.

## **Team #3: SAE Formula 1 Suspension**

### Team Members:

Ramis Al Ramis  
Michael Cardone  
Matthew Ellis  
Eric Green  
Jason Hoff

### Executive Summary:

The Mean Green Racing Suspension team designs and manufactures the suspension for a formula style race car to compete in an event such as, "Formula SAE", sponsored by the Society of Automotive Engineers in Lincoln, Nebraska. The suspension system consists of the shocks, A-Arms, uprights, bell cranks, spindles, anti-roll bars, hubs, steering, and braking system. All parts are custom to specific applications dictated by desired suspension kinematics and calculated cornering, braking, and steering forces. The key to designing a good suspension is to have minimal compliance which comes from parts

other than the main suspension components. These parts consist of everything the suspension is connected to including any fasteners, fittings, and joints. The suspension of a race car is designed to obtain the most grip out of a tire as possible at the highest lateral and longitudinal accelerations as possible. This is done by studying tire data to determine the maximum lateral force at different camber settings which are dictated by the kinematics of the suspension links.

#### **Team #4: Shifter Kart**

##### Team Members:

Justin Lunger  
Ronald Marsh  
Ken Miyagi  
Steven Sinclair

##### Executive Summary:

Shifter Kart racing has been increasing through the years. The need for competitive and economical frames is paramount. The SK Team has taken it upon itself to create an adjustable frame to fit the needs of different tracks and different riders. By having an adjustable frame, the shifter kart will be able to adjust the wheel base to change the length of the kart. The longer the wheel base, the more stable the kart will be at higher speeds. The shorter the wheel base, the quicker transition will be on corners. Also, the SK team will be adjusting the pedals for different rider heights. With these adjustable features, the SK team believes that this frame will have a competitive advantage over standard frames.

#### **Team #5: Mechanical Human Lifting System**

##### Team Members:

Salman Al-Raimi  
Josh Caldwell  
Rylan Cox  
Mohamed Elmonoufy  
Adriano Ferreira

##### Executive Summary:

A professional acquaintance approached the group with a project idea to help a local special needs camp, Camp Summit in Argyle, Texas. The camp was in need of a system to lift campers, with a variety of mental and physical handicaps, up to a zip line cable at the top of an existing standing tower. The camp currently uses a system of pulleys to raise the camper up to the base of the zip line. From there, the camper was led up to the top of the tower before being released to enjoy the zip line. This process is time consuming and

physically demanding. The Mechanical Human Lifting System (MHLS) was designed to relieve the camp of these stresses. The goal of the project was to design a lift with a power operated winch attached to a freestanding support. The winch lifts the campers to the top of the tower where they are attached to the zip line. The system is designed to be completely isolated from the pre-standing tower or zip line course for liability reasons. A high degree of safety is included in all calculations and designs to ensure the camper's safety.

### **Team #6: Frito Lay Improvement Project**

#### Team Members:

Edwin Chavez

Darin Cooper

David Gorman

Jacob McNeley

Joseph Swearingen

#### Executive Summary:

Frito Lay Inc. approached Advanced Impeller solutions in regards to improving the performance of their existing impeller paddle component. A measurement tool for improvement analysis is the reduction of scrap material produced by the existing slicer system. The main objective of the F.L.I.P. team was to vary the design of the impeller paddle while keeping the system assembly the same. Conditions that the F.L.I.P. team will consider are material composition, torque produced, angle variance, and impeller paddle protrusions. The team has the ability to use the Frito Lay Inc. R&D facility and the University of North Texas' machining lab to perform tests necessary to compile data acquired, and build the prototypes.

## **Computer Science and Engineering**

### **Team #1: Cuning Technologies**

#### Team Members:

Tahla Ali  
Daniel Derusha  
Michael Jabillo  
Rajee Jones  
Adam Nottingham  
Robert Tidwell

Executive Summary:

The TruID system is a product intended to assist users with authentication to internet services. This system seeks to provide the authentication service in way that removes the user from the process of normal password creation and maintenance by doing these things for them. It is intended that this will be a much more secure way to access internet services. The device will also have multiple levels of security including fingerprint authentication and a pin, making the users credentials as secure as possible.

**Team #2: The Outliers**

Team Members:

James Buchanan  
Benedict Chukwuma  
Jesse Hendricks  
Christie Johnson  
Robert Linehart  
Eric Schlueter

Executive Summary:

Mimir is a combination of technologies. The first part is a brain-computer interface (BCI) produced by Emotiv. This BCI uses electroencephalography (EEG) to read brain waves. The software reads these brain wave patterns and allows developers to map them to functions. The second piece of hardware included in Mimir is the head tracker. This device tracks the direction the user is looking in.

**Team #3: Team Sharp**

Team Members:

Raul Ascencio  
Charles Jovanovich  
Sushil Neupane  
Elizabeth Payson

Executive Summary:

The Automatic drive system is a self-driven and self-operated vehicles that can carry new visitors to their destination without any hassle in short amount of time. It will be designed with the embedded computer, which obeys the visitor's instruction. It will be designed so simple that it can be operated without any hassle and extreme safety. Hopefully Vehicle will save our time in finding the places and departments inside the building of Discovery Park.

**Team #4: Team Red**

Team Members:

Ryan Aldridge  
Kayleigh Bush  
Kyle Miller  
Tommy Nguyen

Executive Summary:

Team Red is to design or extend a prototype home entertainment system that can encode and store television broadcasts on-the-fly for future playback on devices such as a television, home PC, or smart-phone as well as play files from a PC or smart-phone on a TV.

**Team #5: Cumulus Four**

Team Members:

Payton Climer  
Westley Huebner  
Curtis Myers  
Kevin Ray

Executive Summary:

CloudOne needs a modular intranet portal that will allow us to present to our customers their monthly usages and billing for their environments. The Key areas are Jazz monitoring/Billing, FlexLTML monitoring/Billing, (both areas here we are looking for Peak concurrent usage), VPC (Virtual Private Cloud) Details, and Helpdesk.

**Team #6: GetIT**

Team Members:

Zachary Banes  
James Freeman  
Wesley Nyamangwanda  
Timothy Page

Executive Summary:

LifeNet Community Behavioral Healthcare is an out-patient mental health clinic that provides services to indigent and homeless individuals and families. LifeNet is comprised of 3 divisions, Clinical Services, Supported Employment, and Permanent Supportive Housing. LifeNet needs a website for its housing department that not only promotes the department but also serves as a portal for homeless people to sign up for housing, submit contact info to LifeNet staff and get self-help.

### **Team #7: Life Tech**

#### Team Members:

Christopher Brown  
Kenneth Leddy  
Christopher Lord  
Ian Walton  
Byron West

#### Executive Summary:

The Project to be completed by “Life Tech” this year will be primarily focused on design and implementation of a Mobile Application that will allow a parent or primary user to set a “Chore” list that a child or second user would have to complete in order to gain tokens to access applications or gain internet access on their mobile smart phones.

### **Team #8: Redeye Consultants**

#### Team Members:

Anousone Bousanouvong  
Christopher Daughtrey  
Christopher Herrera  
Jonathan Mesa  
Alfredo Villagomez

#### Executive Summary:

Redeye Consultants will be creating an ecommerce website for Alan Blanquicet, a business owner who wants to extend his personalized clothing services to an online audience. This website will allow him to reach a greater number of clients while managing his current sales and business. It will also streamline his sales and finances into an easy to use and manage format.

### **Team #9: Tru Identity**

#### Team Members:

Patrick Cryer  
William Evans

James Glenn  
Mark Hurtado  
James Mills  
Jose Salazar

Executive Summary:

To design a solution for mobile devices, that allows a user to log into websites from their mobile device using only one unique and creative authentication method without remembering passwords and usernames.

**Electrical Engineering**

**Team #1: RF Bridge De-Ice System**

Team Members:

Joel Copley  
Robert Parker  
Eric Cooklin

### Executive Summary:

Ice and Snow cause 1.4 million traffic accidents annually in the U.S. Development of a low cost bridge de-icing system would go along way to eliminating these accidents. This system currently in development, over time will cost less and reduce the environmental impact of current methods. Additionally, the system is automatic and requires little to no routine maintenance. We are proposing the development of a bridge and overpass de-ice control system without damage to existing bridges. A growing need for a solution lingers as the number of ice and snow related traffic accidents increases annually. A de-icing control system would reduce the total annual traffic accidents nationwide, which directly results in lives saved. In addition, this system will reduce the structural and environmental damage caused by freeze cracking and chemical de-icing solvents.

### **Team #2: Somatosensory (Haptic Perception) Communications**

#### Team Members:

Chelsea Wellmeier

Nabila Salma

#### Executive Summary:

Haptic sense means kinetic sense (force, motion) or tactile sense (tact, touch). This project addresses only tactile feedback system. In microgravity, it is uncomfortable for the intra-vehicular crew to rely on audio warnings wearing ear buds, in some cases they also have to wear hearing protection to reduce machinery noise. This type of situation calls for a new approach on communication. With haptic communication a sense of touch or tapping can pass on spacecraft situation awareness information without audio announcement. Haptic communication has been accomplished by tactile actuators to create a sensation of tapping, but in that case actuator needs to move quick enough to pass on a message effectively in a short amount of time. A sense of vibration instead can be quick enough to convey the message in a code providing the location and the type of the situation. Since sending an elaborated coded message using haptic technology will require learning of cryptic language like Morse code, our approach to the problem was to add LED lights to represent location and haptic sense to represent situation. For example if there are eight areas in the spacecraft, each light will represent the area been affected and the number of buzz or vibration the device creates will represent the code of a particular situation (like 1-air pollution, 2-radiation alert etc.). These sensors and light will be controlled by Arduino board and lily pad which will turn them off and on according to the command sent. Zigbee will be used to establish wireless communication between these components and the lily pad along with receiving zigbee will be sewed into clothing by conductive threading to make it easily wearable. We will also attempt to make a haptic response system by the crew that will ensure the message been received by a motion or pressure sensor.

Our project idea separates in two different paths (expected outputs):

- 1) A body-worn somatosensory communication system with wireless link to the spacecraft.
- 2) An optional crew response to the haptic transmission.

The main purpose of this design is to allow the intra-vehicular crew to enjoy the freedom of floating around the spacecraft without headsets or wires attached to the, . This design would allow the crew to move freely with fewer constraints, while still providing them with the necessary warning indications.

### **Team #3**

#### Team Members:

Dustin Doubet  
Gerardo Garcia  
Kenneth Rommel

#### Executive Summary:

Our group has chosen a project that identifies with problems that active VTUAVs (Vertical Takeoff Unmanned Aerial Vehicles) currently embody. We are intending to solve a problem(s) that associate with weight, EEI (Electronic Electromagnetic Interference), vehicle power control and Environmental Monitoring (EM). We are planning to deploy an EM system that monitors the interior of the aircraft- specifically inside the Faraday Cage, which is the main source of protection for electronic equipment. We are primarily planning on establishing a system that allows wireless communication and control to and from the sensors around the aircraft with the equipment inside the Faraday Cage (FC), while not compromising the FC's ability to block electromagnetic interference. Our ideas will employ wireless communication and control, which differs greatly from today's established communication and control methods within UAVs. Currently communication and control is established with different types of wired systems and protocols, which require bundles of wire and over-braid protection. Due to the ever increasing size of UAVs (such as full size helicopters) there is a need to monitor more sensors, which intern requires more cables and power. Our ideas will allow sensors, systems and power cables (FC and others) to be analyzed and controlled using less wire and over-braid, which ultimately saves wire cost, power, weight and fuel on the aircraft.

### **Team #4: Laser Link Audio Communication System**

#### Team Members:

Sean Brooks  
Forrest Holub

#### Executive Summary:

The team will be designing a multi-channel laser link that will transfer audio wirelessly. Our project will consist of a 3.5mm headphone jack, pre amp, transmitter circuit, receiver circuit, speaker system, and a 9V

battery. Today there are many uses for laser systems, but currently there is nothing in the market place with a stereo quality laser link that has the capability of powering multiple speakers. If our project is successful we could upgrade our lasers and photodiodes to something more advanced and make it more dynamic in its send and receive capabilities along with increasing the quality of the transmitted sound.

### **Team #5: Proposal for a High Efficiency Radio Frequency Power Amplifier Using the Envelope Tracking Technique for 4G LTE Systems**

Team Members:

Mitch Grabner

Eric De Santiago

Hesam Mohamedianfard

Executive Summary:

This paper proposes the implementation of an envelope tracking (ET) radio frequency power amplifier (RFPA). Specifically, for mobile user equipment implementing a fourth generation (4G) cellular network like 3GPP long term evolution (LTE). Today's mobile devices are becoming increasingly power hungry with multi-core processors and high density LCD displays making energy consumption in other hardware areas even more of a concern. In addition, the new 4G networks employ sophisticated modulation and multiple access techniques like orthogonal frequency division multiple access (OFDMA) that increase the peak-to-average power ratio (PAPR) and introduces a non-constant envelope signal, making efficient power amplifier design challenging compared to old GSM networks. In GSM networks ultra efficient switching class D or linear class AB RFPAs could be used since the amplitude is constant. When these types of amplifiers are used in 4G systems severe distortion is introduced with signal clipping. To remedy this current amplifiers employ "backing off" the power of the class AB RFPAs until the distortion is at a minimum since linearity is proportional to the square of output power, however, this significantly reduces the efficiency. Two main designs have been introduced in the last few years that allow dynamic control of the RFPAs power supply to allow optimal linearity as well as efficiencies closer to those found in GSM systems, one is ET and the other is envelope elimination and restoration (EER). These two concepts differ in the main RFPA being used, ET uses a linear class amplifier while EER uses a switching class. Our envelope tracking amplifier will track the average input voltage by using a comparator and step up or down the input power with an amplifier to the RFPA to provide optimal output characteristics.

### **Team #6: High Noise Environment Microphone Array**

Team Members:

Eric Pruett

Charles Drotar

Marigona Bokshi

Executive Summary:

Noise reduction in a certain ambient, like a spacecraft or habitat location, is becoming very crucial in order to create an ease for communication without being tied to constraints of wearing microphones or

microphone headsets. Clear and reliable voice communication is extremely essential especially for astronauts collaborating together in space in order to accomplish effective flight missions. The widely varying working conditions and the special design of an astronaut's space suit (space cap) not only form an acoustic ambient for capturing and transmitting speech communication, but also provide an intrusive way of communication between the astronauts. Because of these constraints, it is highly necessary to use another method for voice communication and speech recognition between the crew members in the spacecraft. By substituting the communication methodology described above with a proposed microphone array, we take out the constraint of the astronaut being strictly tied to a headset and provide the ability for the crew members to speak freely into remotely-located microphones inside the spacecraft. We also apply different features to our microphone array in order to differentiate between sources when multiple people are inside the aircraft and also between voice commands.

## **Materials Science and Engineering**

### **Title: Development of low friction polymeric coatings for 600 V metal wires**

Student: Austin Richards

We characterize extant and novel formulations of electrical wire coating materials based on nylons. The materials are for coating commercial grade 600 V copper wire and are evaluated in terms of thermophysical properties, tensile behavior, static and dynamic friction values and also wear rates from pin-on-disk tribometry. We study several preparations—containing various additives—obtained by twin-screw mixing followed by pelletizing and then compression molding. Some of our preparations provide lower friction values as well as lower wear rates than the standard commercial nylon compositions.

### **Title: Tape Casting of Zirconia for Ballistic Body Protection**

Student: Cameron Lemons

In an attempt to recreate a tape cast from an article taken out of the “Bulletin of Materials Science” journal titled “Dispersion and rheological studies of Y-PSZ tap casting slurry”, tape casts made from yttria and hafnia stabilized zirconia were produced.

### **Title: Oxidation in several titanium alloys**

Student: David Brice

The operating temperature of titanium alloys is limited due to the affinity that titanium has for oxygen. The ingress of oxygen into titanium will change the fraction of phases, microstructure, and resulting properties. Currently, there is no agreed upon method of rapidly determining oxygen ingress in titanium sheet. This project presents the preliminary results on 7 different titanium alloys subjected to oxidation conditions. Further, the project aims to describe various approaches of oxygen ingress and present initial results related to rates of oxidation and mechanism of formation.

### **Title: Economical, direct reduction of $\text{SiCl}_4$ in liquid Na**

Student: Alyn M. Gray

The importance of pure silicon in modern day semiconductors and devices has become increasingly essential. In this work, it was assessed if the Armstrong process for creating small diameter and highly pure titanium powder could be applied to direct reduction of silicon tetrachloride in liquid sodium. Economically designing a laboratory scale reactor with glassware and frit in an inert atmosphere was used to engineer a vigorous redox reaction between constituents at 310° C. Structural investigations using various microscopic techniques of the product from the reduced silicon tetrachloride in liquid sodium were also reported.

## **Fabrication of Porous Titanium and Incorporation of Magnesium**

Student: Juah Song

Due to its lesser mechanical properties than bulk titanium, porous titanium-based implants can alleviate stress shielding effects between an implant and surrounding natural bone. Armstrong powder may provide an alternative means to producing titanium bone implants if consolidated into a porous structure. Additionally, if magnesium can be incorporated throughout the porous titanium matrix, biocompatibility may be improved. The key instrument used to investigate powder consolidation is a spark plasma sintering (SPS) furnace. For incorporation of magnesium, two methods are explored: electrodeposition and the melting of magnesium upon a sintering puck of Armstrong powder.

## **Understanding the reaction mechanism between zirconia and carbon monoxide under varying partial pressure ratios of CO and CO<sub>2</sub>**

Student: Ian Jones

Zirconium carbide (ZrC) is an important ultra-high temperature ceramic because of its refractory properties and high melting point. It is commonly synthesized via carbothermal reduction of zirconia at temperatures of 1657°C and above according to following reaction,



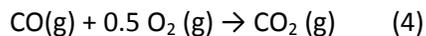
Literature suggests that ZrO<sub>2</sub> to ZrC conversion is mediated by CO species rather than by carbon. On the contrary, experiments conducted by Sondhi et. al. (2013) showed that both carbon and CO play a key role in driving ZrC formation.

Two reactions are possible between ZrO<sub>2</sub> and CO to form ZrC as given by (2) and (3). ΔG values for these reactions at ambient pressures are positive for a broad range of temperature.



Solid gas reactions are known to be dependent on not just temperatures, but also on gas partial pressures. A predominance diagram was constructed using FactSage software to understand the influence of partial pressure of CO on these reactions. Interestingly some partial pressures of CO were found where ZrC can form even at ambient pressures.

Thus the aim of this project is to understand the complete mechanism behind ZrC formation from ZrO<sub>2</sub> and conduct high temperature experiments under varying partial pressures CO<sub>2</sub>. Since experiments are done in a graphite furnace thus to control the reaction conditions posed by (4), CO/CO<sub>2</sub> gas mixtures would be used.



## **Developing ZnO as a potential replacement for the ITO**

Student: James Gould

ITO is commonly used in a wide variety of different electronic applications, as it is transparent, conductive, and has a high work function. However, indium is an expensive, rare earth element. The goal of this project is to develop ZnO as a potential replacement for the ITO.