Spring 2018

Engineering

SENIOR DESIGN PROJECTS

St. Mary's University
School of Science,
Engineering and Technology

San Antonio, TX

WWW.STMARYTX.EDU

APICS San Antonio Chapter

The Engineering Department of St. Mary's University would like to thank the San Antonio Chapter of APICS for sponsoring this event.

ST. MARY'S UNIVERSITY

Table of Contents

Welcome.....3
Designing Innovation.....4
2018 Class.....5
Friday, April 27 Agenda.....6
Saturday, April 28 Agenda.....8
Dr. Ozan Award.....10
Judges.....11
Friday Projects.....12
Saturday Projects.....16
Sponsors.....21-22

APICS San Antonio Chapter

ST. MARY'S UNIVERSITY

Welcome

We welcome you to the 2018 Engineering Senior Design Presentations. Today is a special day, as it marks the culmination of a nine-month capstone experience for all graduating St. Mary´s University Engineering seniors. Advised by engineering professors and industrial supervisors, senior project students applied their knowledge and skills towards designing solutions to relevant problems.

A word of gratitude to all who participated in the 2017-18 Senior Design Project experience: the graduating seniors, their classmates, their family and friends, the Engineering faculty and staff, Dr. Gopal Easwaran (Department Chair), Dr. Winston Erevelles (Dean, School of Science, Engineering and Technology), St. Mary's STRIVE Center-Career Services, St. Mary's International Student and Scholar Services, and especially, the senior project sponsors.

Project Supervisors

Ozgur Aktunc, Ph.D.
Vahid Emamian, Ph.D.
Rafael Moras, Ph.D., P.E.
Juan Ocampo, Ph.D.

APICS San Antonio Chapter

Designing Innovation

The Engineering Senior Design Projects are the capstone of the St. Mary's University Engineering program. Each year, graduating seniors present their projects to professionals from industry, faculty, family, friends and peers. The Senior Design Project is a comprehensive effort: the students must apply their educational experience to identify, plan and design a practical solution to a real-world issue. Their work is evaluated by the Engineering faculty and an external panel from industry.

The goal of the Senior Design Projects is to encourage interdisciplinary teamwork among students through the individual application of the concepts, skills, and knowledge acquired in the classroom.

APICS San Antonio Chapter

2018 Class

Presenting the 2018 Senior Design Class

3 Computer Engineering
11 Electrical Engineering
1 Engineering Management
2 Engineering Science
15 Industrial Engineering
10 Mechanical Engineering
4 Software Engineering

46 Engineers

APICS San Antonio Chapter

Friday, April 27

Master of Ceremonies
Roxana Cruz Santory and Roberto Rodriguez

Faculty Supervisors: Ozgur Aktunc, Ph. D., Vahid Emamian, Ph.D. and Rafael Moras, Ph.D., P.E.

12:30 PM	**Opening Remarks**	
12:35 PM	**Invocation**	The Rev. Richard Villa, S.M. Chaplain, School of Science, Engineering and Technology
12:40 PM	**Texas Society of Professional Engineers**	Brian LaFoy, P.E., ENV SP
12:50 PM	**APICS South Central Texas**	Pat Tarver
1:00 PM	**Driver Scheduling System Development** Labatt Food Service	Alex Artola Ruiz (IE) Roxana Cruz Santory (IE)
1:20 PM	**Implementation of Lean Six-Sigma Based Productivity Improvements** San Antonio Food Bank	Rosa Antunez (IE) Valeria R. Garza (IE) Jesus Hernandez (SE) Andrea L. Magaña (IE) Natália Victor (IE)
1:40 PM	**Optimization of Logistics** Meals on Wheels San Antonio	Ali Alamer (IE) Fayez Alfayez (IE) Loiy Alherz (IE) Jawad Alramis (IE) Julian De La Rosa (SE) Eric Galy (EM)
2:00 PM	**Break/Introduce Judges**	

Agenda

2:20 PM	**Dr. Ozan Award**	Bahman Rezaie, Ph.D.
2:40 PM	**TCU Ventures and Values Competition** Guardian Angel and The Harvey Najim Center for Business Innovation and Social Responsibility	Hudson McAshan (SE) Kiernan Akers (ES)
3:00 PM	**Lean/Six-Sigma Implementation** Bimbo Bakeries USA of San Antonio	Abdulmajeed Alghamdi (IE) Ahmed Al Okran (IE) Mohammed Basarwan (IE) Roberto Rodriguez (SE)
3:20 PM	**SMDL - Autonomous Framework** St. Mary's Drone Lab (SMDL)	David C. Culbreth (CE) Carlos I. Vasquez (CE) Brennen G. Horton (EE)
3:40 PM	**Creation of the Electronics Prototyping Laboratory** School of Science, Engineering and Technology	Sultan A. Mabrouk (EE)
4:00 PM	**Closing Remarks**	

EM: *Engineering Management*
IE: *Industrial Engineering*
EE: *Electrical Engineering*
ES: *Engineering Science*
SE: *Software Engineering*
CE: *Computer Engineering*

Saturday, April 28

Master of Ceremonies
Roxana Cruz Santory and Roberto Rodriguez

Faculty Supervisors: Vahid Emamian, Ph.D. and Juan Ocampo, Ph.D.

9:00 AM	**Opening Remarks**	
9:05 AM	**Invocation**	The Rev. Richard Villa, S.M. Chaplain, School of Science, Engineering and Technology
9:10 AM	**Wheelchair Design** Jim and Donna Moore Dan and Theresa Hong	Paola C. Diaz-Portela (ES) Courtney D. Ramirez (ME) Kristen N. Salazar (ME)
9:30 AM	**Cluster System for High Performance Computing** School of Science, Engineering and Technology	Sedrick Yudo (CE) Andrew J. Carrum (EE) Richard Mialkowski (EE) Evan A. Villarreal (EE)
9:50 AM	**Electromagnetic Linear Accelerator for Space Launch** Robots Everywhere, Matteo Borri	David E. Dell'Osso (EE) Hassan Almotairi (EE) Diego Rascon (EE)
10:10 AM	**Drone Painting System Design** School of Science, Engineering And Technology	Elena J. Botello (EE) Juan J. Ramirez (EE) Bijan A. Aminian (ME) Norberto Montanez (ME)

Agenda

10:30 AM	**Break/Introduce Judges**	
10:50 AM	**Dust Mitigation System Design** RO&A	Mario C. Cancel (ME) Aaron T. Nava (ME)
11:10 AM	**Friedrich Testing Wall Design** Friedrich Air Conditioning Company	Camille Constantine (ME) Karla V. Martin Patino (ME)
11:30 AM	**Quantifying the Visual Effects of Distortion of Electromagnetic Waves as They Pass Through Optical Filters** Engility Corp.	Rachel J. Singleton (EE)
11:50 AM	**Piezoelectric Energy** CPS Energy and School of Science, Engineering and Technology	Jose E. Torres (ME) Michael P. Olson (ME)
12:10 PM	**Closing Remarks**	

EE: *Electrical Engineering* **CE:** *Computer Engineering*
ME: *Mechanical Engineering* **ES:** *Engineering Science*

Dr. Ozan Student of the Year Award

The Student of the Year Award is named after Turgut Ozan, Ph.D., who founded the St. Mary's Engineering Department in 1960. Dr. Ozan, always a perfectionist in his work and in his life, established the longstanding tradition of high standards that is epitomized today by the Engineering Senior Design Projects. The Dr. Turgut Ozan Student of the Year awardees are chosen by the Engineering faculty on the basis of their academic performance and service to the department.

The Turgut Ozan Endowed Scholarship in Engineering is named after the Department's revered founder.

Judges

A word of gratitude for your invaluable support!

On behalf of the faculty and students of the Department of Engineering at St. Mary's University, we thank all of the judges who took time out of their day to observe and judge the 2018 Senior Design Presentations. Your commitment to the Engineering students is unparalleled, and we sincerely appreciate your time and effort.

It is an honor to have the best in the industry review the work of the 2018 graduates. Without the dedication of the panel of judges from industry, the Senior Design Presentations would not be as significant. The faculty, staff and students of the Engineering Department deeply value your input. Again, we thank you.

Friday Projects

Driver Scheduling System Development for Labatt Food Service

Abstract: To facilitate the transportation manager's duty of assigning drivers to a scheduled set of routes, we created a queuing algorithm to assign routes to drivers while balancing pay and increasing the amount of rest between shifts. The newly created free-time constraints consider the number of miles, dispatch time, and route length, and safety. This algorithm is the basis of a software package for the transportation managers to use to automate the assignment of drivers. We designed the software by writing descriptions of what the user can do (called "stories"). The goal was for the software to allow the transportation managers to have a visualization of driver's pay and safety metrics of the route sets. We designed the software to permit the transportation managers to adjust the route schedule to meet the safety constraints without drastically affecting the drivers' paycheck or rest time. The software would allow the managers to apply the necessary changes in real time to meet driver criteria and improve drivers' pay and safety.

Team: Alex Artola Ruiz (IE) and Roxana Cruz Santory (IE)
Sponsor: Labatt Food Service

Implementation of Lean Six-Sigma Based Productivity Improvements for San Antonio Food Bank

Abstract: This senior design project was conducted at the San Antonio Food Bank (SAFB). The goal was to improve the effectiveness of the warehouse operations. The end-to-end process for product movement consisted of three sub-processes: receiving inbound product shipments, storing the products, and selecting products for outbound orders. Based on our observations, we identified three main challenges to address within the warehouse: inventory receiving efficiency, warehouse navigation, and inventory software training. We observed the public-facing side of the warehouse operations during the volunteer donation sorting sessions and decided to address challenges in the dry goods sorting process. The problems were diverse, but when viewed from the context of the overall product movement process, each one contributed to reduced productivity in the warehouse.

Team: Rosa Antunez (IE), Valeria R. Garza (IE), Jesus Hernandez (SE), Andrea L. Magaña (IE), Natália Victor (IE)
Sponsor: San Antonio Food Bank

Friday Continued

Optimization of Logistics for Meals on Wheels

Abstract: Through careful analysis and data collection, we found solutions to some of the logistics problems found at Meals on Wheels San Antonio. We conducted a route analysis to find better routes for meal deliveries. We developed an application that can be used to track meal pickups and confirmation of the correct meals. By conducting observational research and utilizing data provided by the management, we analyzed the growth of the client base and the best locations for the company to serve. The software application would be used to ensure that no meals are wasted and everything involving meal pickup takes place without issues.

Team: Ali Alamer (IE), Fayez Alfayez (IE), Loiy Alherz (IE), Jawad Alramis (IE), Julian De La Rosa (SE), and Eric Galy (EM)
Sponsor: Meals on Wheels San Antonio

TCU Ventures and Values Competition for Guardian Angel

Abstract: In the United States we have a serious issue of children being left behind in unattended vehicles, and suffering from life-threatening situations. On average, thirty-nine young children die every year because of extreme heat related maladies occurring inside of vehicles. In order to address this major problem, our team designed the Guardian Angel. The Guardian Angel is a smart baby seat cushion that is capable of detecting the presence of a child in a car seat, measuring the ambient car temperature, and alerting users of whether a child is in a dangerous situation. In April, 2018, the authors won the $2500 Marjorie and James Sly Award for Innovation at the Ventures and Values Competition at TCU with this project.

Team: Hudson McAshan (SE) and Kiernan Akers (ES)
Sponsor: Guardian Angel and The Harvey Najim Center for Business Innovation and Social Responsibility

Lean Six-Sigma Implementation for Bimbo Bakeries USA of San Antonio

Abstract: To better satisfy the needs of Bimbo Bakeries USA and its San Antonio bakery location, a thorough investigation of the manufacturing process was conducted to understand operations of creating bread and bread products. Because bread and its components are perishables, the timeframe to deliver quality product is very small. From the investigations conducted, we concluded that it was imperative to improve operations at the bakery to prevent waste. Through the implementation of Six Sigma principles, a simulation model was made outlining the specific sections of the bakery that needed improvement. The result of these investigations and simulation was a set of standard operating procedures (SoP) that included improvements to be followed by the bakery.

Friday Continued

To coordinate this endeavor and store the data that we gathered, a web-based, prototype project management software was developed born from the project management software present at the bakery. This software allowed storage of material pertinent to the project and facilitated communications between the team members.

Team: Abdulmajeed Alghamdi (IE), Ahmed Al Okran (IE), Mohammed Basarwan (IE), and Roberto Rodriguez (SE)
Sponsor: Bimbo Bakeries USA of San Antonio

St. Mary's Drone Lab – Autonomous Framework

Abstract: The St. Mary's Drone Lab (SMDL) program was started as a foundation upon which future students could build senior design projects or graduate theses that involved a drone as part of their project. It is not feasible or efficient for every student drone project to build a drone from the ground up before beginning work on their desired improvements. Even if they did have a pre-built drone they would lack the resources needed to both code and directly utilize sensors to control it. At the start of this project, this program had produced a quad-copter that could be remote controlled by an expert user. The SMDL Autonomous Framework (SMDL-AF) project expands upon the pre-existing SMDL design through the implementation of network-based flight controls. This newly established data-link layer will allow live control adjustments and transmission of sensory data between a quadcopter and a remote computer. Through a basic mission control program, users will be able to log data, run computer analysis, and send instructions to a drone from a simple GUI. Concurrent to this project, a number of hardware modifications were made to the drone, so SMDL-AF also developed a streamlined method for stabilizing a drone. This process included determining a mathematical model of the system, calculating parameters for a Proportional-Integral-Derivative (PID) controller, and heuristically tuning these parameters to improve in-flight stability.

Team: David C. Culbreth (CE), Brennen G. Horton (EE), Carlos I. Vasquez (CE)
Sponsor: St. Mary's Drone Lab - Dr. Bahman Rezaie

Friday Continued

Creation of the Electronics Prototyping Laboratory

Abstract: This project is a part of ongoing improvement to the laboratories in the Engineering Department to enable students in building their own Printed Circuit Boards (PCBs) after designing and testing specific circuitry. Currently, students have to outsource their design in case they want to build a prototype. This laboratory will allow students to design and produce their own electronics circuits board in-house. This laboratory will be used in the Advanced Electronics Design course/lab and the future Senior Design Project sequence among others.

Team: Sultan Mabrouk (EE)
Sponsor: St. Mary's University Department of Engineering, Dr. Bahman Rezaie

Saturday Projects

Wheelchair Design

Abstract: Our senior design team had the opportunity of designing a wheelchair for a double-amputee, Lance Corporal Jim Moore. LCpl Moore is a former Marine and Purple Heart recipient. He also attended law school at St. Mary's University and went on to become Chief of Prosthetics of the Audie Murphy VA Hospital. During this project our team worked closely with LCpl Moore's daughter, Theresa Hong and the rest of the Moore-Hong family to design and create a wheelchair that fits LCpl Moore's needs. The objective of this project was to design and fabricate a lifting table that will lower six to nine inches from the ground-- the lifting table then would attach to wheelchair frames which will create a fully functioning wheelchair. This will allow the user to be able to reach items lower on the ground and allow the user to be more independent when getting on and off the chair-- there is not a wheelchair on the market that performs this specific function.

In conclusion, this project was a very rewarding learning experience that allowed the team to apply what they have learned in the classroom. It was an honor to help a family and a veteran that has fought for our country. Further work includes correspondence with the Moore-Hong family to continue to redesign our prototype, and to later convert the mechanical wheelchair to an electrical mechanism. With this design, our team and sponsors will be able to help more double amputees and handicap people around the country, and eventually around the world.

Team: Paola C. Diaz-Portela (ES), Courtney D. Ramirez (ME) and Kristen N. Salazar (ME)
Sponsor: Jim and Donna Moore, Dan and Theresa Hong

Saturday Continued

Cluster System for High Performance Computing

Abstract: The main objective of this project is to develop a cluster system specifically designed for use in performing computations modeling molecular, atomic, and nuclear scale systems, while keeping the cluster as portable and power efficient as possible. Specifically, we will solve the eigenvalue-eigenvector problem (EEP) of very large sparse or dense matrices. In the system, we will have a simple circuit keeping track of master to slave communication. If time allows, we would like to design an uninterruptible power supply for the cluster, so that if the cluster were to lose power, information and work process up to that point can be saved. Portability will be achieved with use of a power regulator to keep the system powered with or without an outlet supply. A battery will eventually be installed to power the whole system, such that the cluster system could be transported and used without connection to an outlet. One of our main goals will be to determine if a cluster system can be developed that obtains sufficient results, but requires a small budget and is relatively easy to maintain.

Team: Sedrick Yudo (CE), Andrew J. Carrum (EE), Evan A. Villarreal (EE), Richard Mialkowski (EE)
Sponsor: School of Science Engineering and Technology, Dr. Richard Lombardini

Electromagnetic Linear Accelerator for Space Launch

Abstract: Launching a 1-lb payload to Earth's orbit using solid fuel costs on average $10,000, and the launching process can be dangerous. A crack in the solid fuel may lead to an explosion. This type of fuel is single-use only, which represents a considerable loss compared to techniques that use electromagnetic energy. We applied the concepts learned in class with external research to build a device that launches an object using an electromagnetic propulsion also known as the Lorentz Force. This project is critical because it can be applied to launch a multitude of objects into space. The value behind this project is that it is much more reliable, safer and has a lower cost per launch. This project is an alternate solution to current space launch methods. Being that this project requires rather large potentials and currents, unique problems arise such as finding instruments to get proper measurements. We must also consider the mechanical stress experienced by the accelerator. The key problem to overcome is figuring out how to deliver a maximum amount of power in the shortest amount of time. Our solution to this problem is using a capacitor bank and minimizing impedances adequately.

Team: Hassan Almotairi (EE), Diego Rascon (EE), David (Ethan) Dell'Osso (EE)
Sponsor: Robots Everywhere, Matteo Borri

Saturday Continued

Drone Painting System Design

Abstract: This project is to show the proof of concept for a drone capable of painting walls and not the windows. We will use a hexacopter with a 960-mm diameter with 5008-340kv motors which produces a thrust of about 3.15 kg per motor (6 motors). The mechanical system consists of a mount that supports the battery and the sprayer. The positions of the sprayer and the battery are adjustable to maintain the stability of the hexacopter. The mount also includes a solenoid which will activate the paint sprayer to paint the wall. The electrical part involves a system capable of recognizing where the windows are so the sprayer can deactivate so no paint will get on the windows. Electrical equipment includes Raspberry Pi(s), camera, wiring, etc. The Raspberry Pi and camera are the brain of the operation; when the camera detects the edge of the wall, it deactivates the solenoid and stops the paint gun from spraying. The Raspberry Pi is also responsible for flight control, making the hexacopter an autonomous system where there is no human interaction with the system painting the wall. This system can improve safety significantly by minimizing human intervention in the dangerous task of painting high walls. It can also save money by reducing expensive human labor. This design has potential beyond just painting; future students could also use the hexacopter for their senior design to handle other tasks that could be dangerous or uncomfortable for humans to do.

Team: Elena J. Botello (EE), Juan J. Ramirez (EE), Bijan A. Aminian (ME), and Norberto Montanez (ME)
Sponsor: St. Mary's University School of Science, Engineering and Technology

Dust Mitigation System Design

Abstract: Sand and concrete are two of the most important materials that are in high demand due to the role they play in the construction of anything that seems imaginable, from the concrete base to the concrete pillars that help support the structures that exist today. Before any concrete or sand is used at a job site, it must first be purchased from material distributors from terminals that are located across the nation. At these terminals, material is delivered via rail car and is then transferred to material trucks that will take that same material to where it is needed for further construction. There are many places in a terminal that can be severely hazardous due to the amount of dust that is formed when the material is moved. The project involves various areas of mechanical engineering which include material science, mechanical design and fluid mechanics. The material science focuses on the size of the particles and how each material behaves differently.

Saturday Continued

The mechanical design of the project is to assure that the prototype is able to withstand the high pressure over long periods of time without failure. Fluid mechanics is the most important aspect of the project due to the various principles that will play a part in the system such as the Venturi principle.The project for a Dry Fog system was developed to design and manufacture a compact dry fog emitting unit that will help provide suppression of high volumes of dust during the processing and transportation of highly fluidized materials. Today there are similar fogging systems that are installed into working facilities in order to suppress the high volumes of dust that is created when processing and moving sand from one location to another, whether it be from a rail car to conveyor, or silo to material truck. Unfortunately, the instillation of the equipment can range from hundreds to thousands of dollars in manufacturing and installation fees. The unit is to be compact, mobile, cost efficient, and fully functional to help provide a safe and secure work environment.

Team: Mario C. Cancel (ME) and Aaron T. Nava (ME)
Sponsor: RO&A

Friedrich Testing Wall Design

Abstract: This project was developed with the purpose of improving the environmental testing chambers used by the Friedrich Air Conditioning Company. These environmental chambers are used to test the quality of all the different air conditioning units produced by Friedrich Air Conditioning Company. This project requires following the ASHREA Standard Method of Testing for Rating Room Air Conditioner and Packaged Terminal Air Conditioner Heating Capacity. This project goes through the design process for this configurable wall made to accommodate all units of every shape and size with accuracy in a safe manner while optimizing the heat transfer between the chambers. This design consists of two different systems that are interchangeable depending on the unit. We described the design processes that were followed and the different stages that each system went through in order to reach its final phase.

Team: Camille Constantine (ME) and Karla V. Martin Patino (ME)
Sponsor: Friedrich Air Conditioning Company

Saturday Continued

Quantifying the Visual Effects of Distortion of Electromagnetic Waves as they Pass through Optical Filters

Abstract: Colored filters are utilized to block or absorb specific wavelengths but allow others to pass through. These filters include night vision goggles, ski goggles, fashion sunglasses and laser eye protection (LEP) both in the laboratory and in the cockpit. Because the filters block some wavelengths they can cause color shifts or color distortion making it hard to discriminate color information in terms of hue. The human visual system works to preserve color recognition by adapting to the filter. This allows them to perceive more colors than pass through the filter. Physical defects incurred during the manufacturing process of these filters can cause optical distortion, or the effect by which a transparent object warps the perception of a visual target.
A graphical user interface (GUI) was developed to quantify and model these kinds of distortion. This GUI will take in measured filter spectral data, bitmap images and the ambient light parameters of interest and through image processing and basic machine learning output a prediction of how a human would view a scene through a given filter and a pass/fail rating on the amount of distortion.

Team: Rachel J. Singleton (EE)
Sponsor: Engility Corporation

Piezoelectric Energy

Abstract: Utilizing the properties of piezoelectric material, our intention is to create a heat sink that mechanically converts heat energy into usable electrical energy. A pressure vessel was used to exploit the dynamic properties of liquid when subjected to increasing temperature. As the vessel heats up, it thermally expands. As the vessel expands, the internal volume should slightly decrease. If the vessel is filled with a non-compressing liquid, the rise in temperature should result in an increase of internal pressure inside the vessel. Also, if the liquid is known to expand when directly exposed to increased temperature, the expanding liquid will be constricted by the internal volume of the pressure vessel. The vessel must be able to withstand this additional pressure increase within the vessel. As the internal pressure inside the vessel increases, the piezoelectric should compress uniformly and emit electricity. A pressure of 2100 psi was achieved which produced a voltage output of 0.159 V.

Team: Jose E. Torres (ME) and Michael P. Olson (ME)
Sponsor: CPS Energy and St. Mary's University School of Science, Engineering and Technology

Sponsors

MEALS on WHEELS AMERICA

TOGETHER, WE CAN DELIVER.

Labatt FOOD SERVICE

ST. MARY'S UNIVERSITY

SCHOOL of SCIENCE, ENGINEERING AND TECHNOLOGY

BIMBO BAKERIES USA

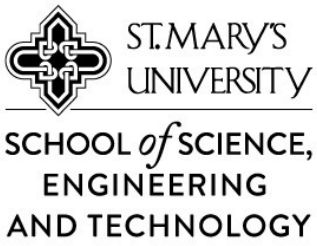
San Antonio FOOD BANK

SERVING SOUTHWEST TEXAS

ST. MARY'S UNIVERSITY | NAJIM CENTER

Sponsors

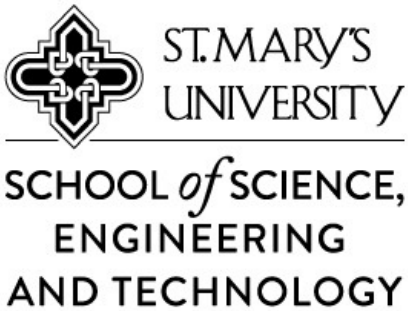
JIM AND DONNA MOORE
DAN AND THERESA HONG



FRIEDRICH
1883

SET Mission

Developing ethical and service-minded scientists, engineers, and technology leaders through experiential learning in a student-centered environment that is committed to success.



One Camino Santa Maria
San Antonio, TX 78228

www.stmarytx.edu/set