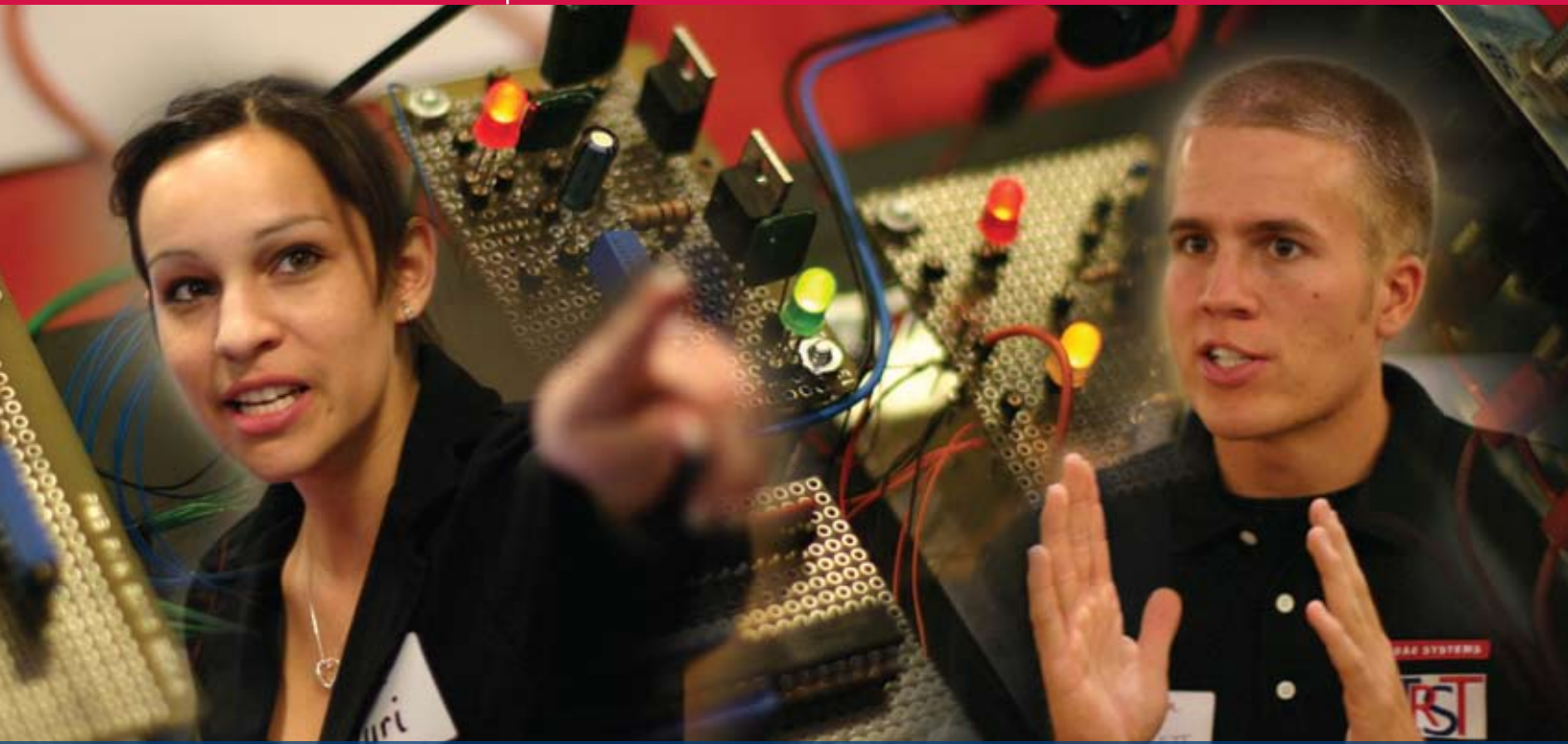
THE UNIVERSITY OF ARIZONA | College of Engineering



ENGINEERING DESIGN DAY

May 5, 2009

azengineering

ENGINEERING DESIGN DAY 2009

Sponsored by Lockheed Martin, BAE Systems and The University of Arizona

SPONSORING A DESIGN PROJECT

Consider a design or manufacturing project of about 1,000 hours in scope that can be accomplished during an academic year (August-May). Contact the appropriate program by end of June to develop the project, contract, and payment as appropriate.

Interdisciplinary Engineering Design Program	Martha Ostheimer	ostheime@email.arizona.edu	520 621-9921
Aerospace Engineering	Sergey Shkarayev	svs@email.arizona.edu	520 626-4470
Agricultural & Biosystems Engineering	Donald Slack	slackd@email.arizona.edu	520 621-1607
Chemical & Environmental Engineering	Paul Blowers	blowers@engr.arizona.edu	520 626-5319
Civil Engineering	Juan Valdes	jvaldes@u.arizona.edu	520 621-6564

SPONSORING DESIGN DAY EVENTS OR AWARDS

We are interested in soliciting sponsorships for Design Day 2010. We are looking for support for the costs of the event and for individual company-sponsored awards. Please contact Martha Ostheimer (520 621-9921) for additional information.

THE UNIVERSITY OF ARIZONA
College of Engineering

College of Engineering
Office of the Dean
Civil Engineering Building #72

P. O. Box 210072
Tucson, AZ 85721-0072
(520) 621-6594
FAX: (520) 621-2232

May 5, 2009

Dear Participants of the 7th Annual Engineering Design Day:

I would like to welcome each of you to the 7th Annual Engineering Design Day. This event is a wonderful opportunity to demonstrate the broad array of design work going on here in the College of Engineering to a community including students, faculty, industrial partners, alumni, local K-12 students, family members, and community members.

This event comes about with the hard work of students and faculty, and importantly, with the generous support and partnership with many, many individuals and organizations. Projects are mentored by faculty and industrial mentors, both providing significant input and guidance to student teams. Projects are sponsored by companies, grants, ingenuity, and faculty, providing funds for students to realize their designs. This year, the Design Day event has been sponsored by Lockheed Martin, BAE Systems and the College of Engineering.

Please stop, look, and talk with the students about their projects. Give them a chance to show you their stuff and make a point to ask questions. Remember, they've spent a lot of time on their projects this year and would like nothing better than to help you see what it's all about. Finally, sample the range of possibility of the engineering disciplines, as seen through the diversity of design solutions reached. Above all, enjoy!

Sincerely,

Jeffrey B. Goldberg
Dean, College of Engineering

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Engineering Design Day 2009

ENGINEERING DESIGN DAY EVENT SCHEDULE

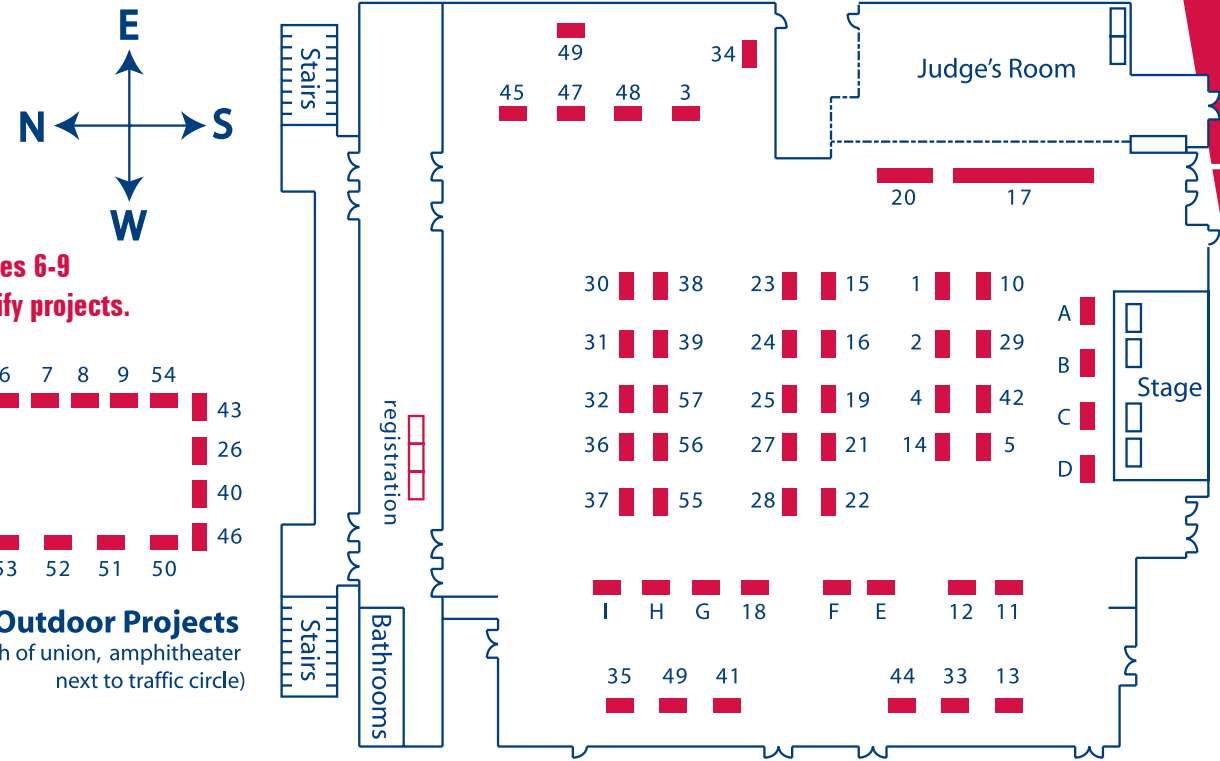
May 5, 2009

10:00am - 3:00pm	**Design Day Demos** — Student Union Ballroom and Amphitheater on north side of Student Union *
1:20pm - 3:00pm	**Judging of Design Day Demos to finalize awards**
3:00pm - 4:00pm	**Judges' Meeting** — Santa Rita Room
3:30pm - 4:00pm	**Comment cards delivered to each team by judges** — Student Union Ballroom
4:00pm - 4:30pm	**Awards Ceremony** — Student Union Ballroom
4:30pm - 6:30pm	**Free Barbeque** — Student Union Ballroom

**Large projects can be found at the amphitheater on the north side of the building.*

EVENT MAP

Engineering Design Day 2009



See pages 6-9 to identify projects.

Outdoor Projects

(North of union, amphitheater next to traffic circle)

MAP KEY

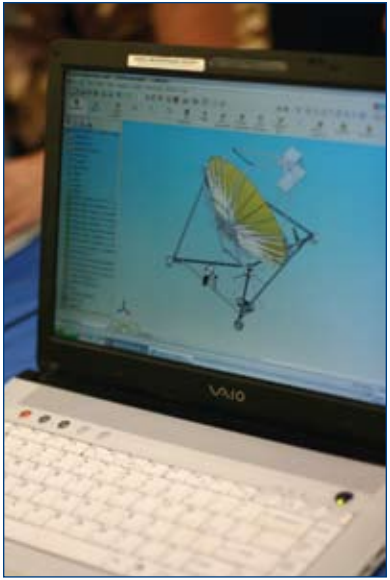
See map on page 5 to locate project tables

INTERDISCIPLINARY ENGINEERING DESIGN PROGRAM

1 A Telemetry System Prototype
2 A Multiscale Biaxial Opto-Mechanical Device
3 ASCEND! Student Satellite Space Imaging Payload
4 Adiabatic Cell using Low Reagent Volumes
6 Alternative Motorboat Propulsion System Development – Glen Canyon
7 Alternative Motorboat Propulsion System Development – Glen Canyon
8-9 Alternative Motorboat Propulsion System Development – Grand Canyon
10 Apache Missile Blast Deflector
11 Biological Signal Interface Board
12 Brain Wave Activity Alarm
13 Colonoscope De-looping Tool
14 Command and Control (1/3) Unmanned Ground Vehicle
15 Command and Control (2/3) Unmanned Aerial Vehicle
16 Cooperative Unmanned Vehicle Planning II
18 Design and Control of Concentrated Solar Cooking System at a Few kW Level
19 Digital Auto-Collimator
21 Full Spectrum Imaging System
22 Gravity Aligned Collimator
23 High Resolution 3D Optical Mobile Inspection System

MAP KEY (cont.)

See map on page 5 to locate project tables



INTERDISCIPLINARY ENGINEERING DESIGN PROGRAM (cont.)

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25 Insert Installation Automation System
26 Irrigation Flowstream Energy Extraction and Storage Via Turbine
27 Laser Sentry
28 Leave-behind Remote Sensor
29 Measuring Thrust Recovering Valve Performance
30 Mechatronic Medical Device Deployment System
31 Mobile Security-Surveillance Unit
32 Multi-Zone Wireless Environmental Monitor
33 PedOne – Pediatric Electronic Medical Records
35 Photovoltaic Energy System for Remote Power Applications
37 Rapid Capture, Analysis, and Storage of Images of Integrated Circuits for Defect Detection and Data Analysis
39 Remote Imaging System Acquisition (RISA)
40 Robot for Internal Strengthening of Pipes with Braided Carbon Fabric
41 Robot for Internal Wrapping of Pipes with Carbon Fabric
43 Scaled Model Wind Turbine with Active Flow Control Technology
44 Solar Decathlon – Adaptive Building Envelopes
45 Soldier Position Reporting System (SPURS)
46 Stabilized Helicopter Landing Platform

MAP KEY (cont.)

See map on page 5 to locate project tables

INTERDISCIPLINARY ENGINEERING DESIGN PROGRAM (cont.)

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54 UA Baja Rear Suspension
55 UVC Purifiers
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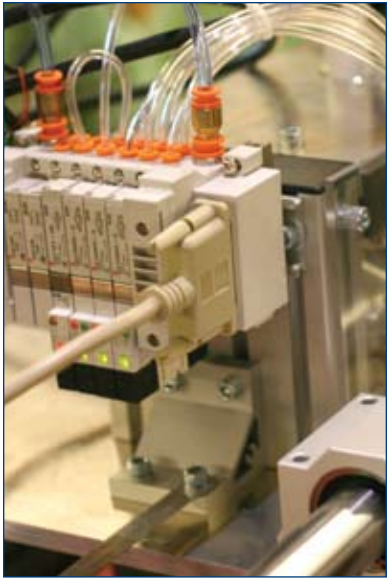
MAP KEY (cont.)

See map on page 5 to locate project tables



AGRICULTURAL AND BIOSYSTEMS ENGINEERING

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36 Portable Gluten Biosensor

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A Chilled Water System
B Dual Phase Extraction
C Hydrofluoroether (HFE) Plant
D HydroxyEthylHydrazine (HEH) Plant
E Regasification Plant
F Reverse Osmosis (RO)
G Syngas Production
H Waste Water Treatment Facility
I Yellow Grease Biodiesel

AWARDS
Engineering Design Day 2009

LOCKHEED MARTIN AND BAE SYSTEMS BEST OVERALL DESIGN AWARD ($1,500) AND RUNNER UP ($1,000)

While several designs may meet the judging criteria, this award should be given to the design that does so the most effectively. The project that receives this award excels in many ways. The design is well thought out and its implementation is of high quality. It accomplished all key design requirements. The design is supported by rigorous analysis and/or testing as appropriate. Its poster and presentation are easy to understand and professional looking.

VENTANA INNOVATION IN ENGINEERING AWARD ($1,000)

Innovation can include the novel use of existing components or the creation of entirely new components to meet customer requirements. The most innovative design will not only be a creative solution to a problem, it will be an effective solution that is well implemented.

RAYTHEON BEST ENGINEERING ANALYSIS AWARD ($750)

This award recognizes the team with the strongest strategy, implementation and documentation of analyses supporting their design. Analyses vary from project to project, but may include market research and analysis, analysis of prior solutions to the design problem posed, trade studies that justify the final design that was selected from among alternatives considered, system modeling to demonstrate that the final design is sound

and should perform as desired, analysis of potential reasons for failure and a mitigation plan, and economic or other analysis of the benefits of the final design in its intended application. Criteria for judging will include the completeness of the project analysis based on the above categories, thoroughness of the analyses, application of sound engineering principles and practice, a demonstrated understanding by team members of any tools or models used, reasonableness of all assumptions, and the quality of the documentation of the analyses.

TECHNICAL DOCUMENTATION CONSULTANTS OF ARIZONA
BEST DESIGN DOCUMENTATION AWARD ($750)

Successful implementation of any innovative design requires that all members of the design and production team communicate effectively. Design intent must be communicated from the design activity to the rest of the team using design documentation with a clear map for others to reproduce the design based on documentation only. The mechanical portion of the design will be evaluated on the use of drawings with geometric dimensioning and tolerancing, solids models, illustrations, presentations, etc. that can be used to manufacture and inspect design hardware; software and other systems will be evaluated on the use of documentation that clearly and fully describes the system.

RINCON RESEARCH BEST PRESENTATION AWARD ($750)

This award reflects the quality of the overall verbal and poster presentations. Verbal presentations should be well structured to efficiently provide the overall problem being solved and specifics of how the team accomplished their design. Answers to questions should be direct and demonstrate mastery of the project. Presenters should be clear and loud, making good eye contact with the judging pod. The poster board should be visually interesting, and graphically well organized to independently tell the story of the project to outsiders.

AWARDS
Engineering Design Day 2009

TEXAS INSTRUMENTS ANALOG DESIGN CONTEST AWARDS (1ST PRIZE: $1,500 — 2ND PRIZE: $500)

Regardless of whether a design project is sponsored, who is sponsoring it, or what you choose to design, there are often analog integrated circuits required. Teams using 3 or more TI analog ICs in their design entered the TI Analog Design Contest. Projects are judged on originality of design, quality of design, creativity of design, level of engineering analysis, and a written description of how each TI analog chip benefited the design. More information on the contest and complete rules are at www.ti.com/analoguniversityprogram

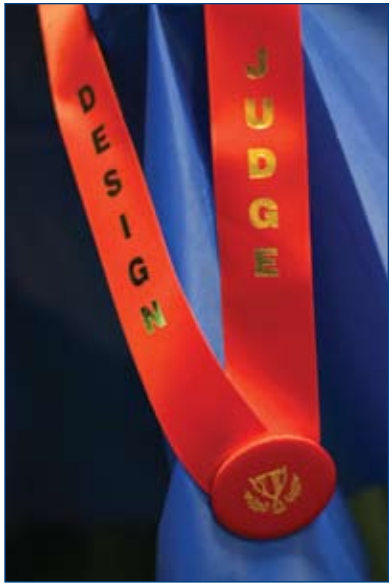
HONEYWELL TEAM LEADERSHIP AWARDS (2 INDIVIDUALS: $250)

The purpose of this award is to recognize those students that best exemplify teamwork skills, including the ability to work cooperatively with others to produce high quality work, take initiative, support and respect fellow team member's opinions, give and receive feedback, effectively demonstrate effective leadership and keep their team focused, and elevate the work of their fellow team members. These awardees are nominated by their team-mates.

PADT BEST USE OF PROTOTYPING AWARD ($750)

This award recognizes the team that best used prototyping in their project. This award will go to the team that best used a physical prototype model in their project to understand and study the fit, form and/or function of the device or system they designed. Teams will be judged on the appropriateness of the prototyping technology used, how effectively they used prototyping to improve their design, and how effectively they communicated the use of prototyping in their study. Prototypes can be made using rapid fabrication technology, traditional manufacturing or be hand built.

AWARDS
Engineering Design Day 2009



EDMUND OPTICS BEST USE OF OFF THE SHELF COMPONENTS AWARD ($750)

A key aspect of the art of design is being able to design not just a functional product, but one that hits both cost and lead-time requirements. A custom part might easily fit the needs, but costs and lead-time associated with manufacturing it may not meet the goals of the project. This award recognizes a team's ability to incorporate standard components into their design, to reduce costs and lead times. The award will be judged based on the ingenuity involved in finding a solution that avoided the need for custom manufacturing, the amount of components used and the complexity of the design involving the standard components.

FISH OUT OF WATER AWARD ($300)

This award recognizes a student who excelled on a task that was outside of the student's discipline. Included in the written nominations were the name of the nominee, the degree program(s) the student is enrolled in, the task the nominee performed that was outside the student's discipline, and what measures the nominee needed to take to perform the task.

A TELEMETRY SYSTEM PROTOTYPE

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

1

SPONSOR

The University of Arizona

SPONSORING ADVISOR

Dr. Michael Marcellin, ECE Department

PROJECT MENTOR

Clayton Grantham

TEAM MEMBERS

Stephanie Mckeefery
Michelle Ho
Joseph Caglio
Chi Hou Chio
Sandip Uprety
Jae Hyok Goh

PROJECT SUMMARY

The purpose of the project is to build a Telemetry System. Telemetry Systems can be used to remotely transmit and receive data. An example of a Telemetry System is a baby monitor.

Components that are mostly found in these systems include: signal source, data acquisition, data encoding, data modulation, transmit amplifier, transmit antenna, receive antenna, receive amplifier, demodulator (which includes carrier recovery, timing recovery, data decisions), and data decoding. Some of these components have been designed by the students and some purchased by different vendors. This project was flexible in that the students decided on exactly what Telemetry System to build and how to implement it.

This projects "actual" customer is Dr. Marcellin. He required that the students implement a working prototype of a telemetry system that takes data and transmits it from one point to another. This team chose to make this application gear towards firefighters.

The ideal final result for this system is for the sensing unit that will be located on the firefighter to sense temperature, CO, and O2 levels. It will generate alerts at all critical levels and collect information and communicate to the base station. The base station will collect, record, display, and analyze information from the firefighters environment. The base station will locate any fighter in case of an emergency and alert them when critical levels are reached.

A MULTISCALE BIAXIAL OPTOMECHANICAL DEVICE

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

2

SPONSOR

Soft Tissue Biomechanics Laboratory

SPONSORING ADVISOR

Dr. Jonathan P. Vande Geest

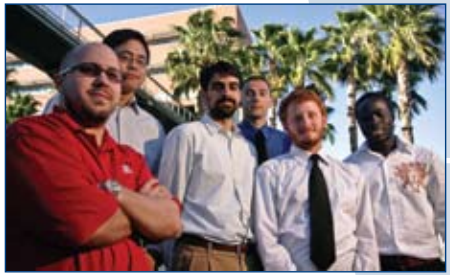
PROJECT MENTOR

Chuck Hassen

TEAM MEMBERS

Hosain Bagheri
Alexandru Dospinoiu
Adoum Mahamat
Jacob Rader
Daniel Wu

PROJECT SUMMARY



In the field of bioengineering, the study of mechanics in soft tissues is integral to the further understanding of how the human body works.

Developments in optical sectioning techniques has provided an excellent mechanism by which matrix proteins organization can be assessed in a non-invasive manner. Combining this information with measurements of both micro and macro mechanical data (stress, strain) will allow the direct assessment of structure-function relationships in soft tissue health and disease.

The purpose of the product is to provide a method of performing biaxial and radial tensile testing to analyze tissue response on a macroscopic and microscopic level. Through the usage of a multi-photon microscope at the BIO5 Institute, the device will have the ability to analyze behavior of collagen and elastin under mechanical strain.

ASCEND! STUDENT SATELLITE SPACE IMAGING PAYLOAD

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

3

SPONSOR

Arizona Space Grant Consortium

SPONSORING ADVISOR

Susan Brew
Mike Borden

PROJECT MENTOR

Chuck Hassen

TEAM MEMBERS

Andrew Scott
Trent Ottoson
Jill Smith
Paul Smith
Mahad Abbasi
Javier Del Hoyo

PROJECT SUMMARY

ASCEND!, a statewide Arizona Space Grant Consortium Workforce Development program, is uniquely designed to involve undergraduate students from across Arizona in the full "design-build-fly-operate-analyze" cycle of a space mission.

Specifically the program goal is for UA, ASU, NAU and ERAU student teams to successfully design and build small payloads for launch from high altitude weather balloons to measure various atmospheric parameters as a function of altitude up to about 100,000 feet and to obtain a series of timed images of the Earth throughout the balloon ascent to characterize surface features, cloud structure and the Earth's curvature. Participation in this program is geared to complement regular classroom learning by offering direct hands-on immersion with the full mission cycle. Few NASA or aerospace industry scientists and engineers ever take a project through the full mission cycle.

The 2008/09 University of Arizona ASCEND! Team has designed a payload that houses an onboard spectrometer. The spectrometer takes solar spectral readings throughout the payload's ascent. The purpose is to monitor the changes in the solar spectrum at varying altitudes to see which wavelengths are allowed to pass through the Earth's atmosphere and which ones are blocked. The analysis of these readings will also provide information about the oxygen levels and the presence of other elements throughout the atmosphere.

Other components of the payload include a lightweight Styrofoam container with foam inserts for insulation and impact protection, a small laptop to provide power supply and data storage for the spectrometer, altimeter and a thermocouple. These components will all work together in collecting spectral readings at varying altitudes while monitoring the internal payload temperature throughout the duration of the flight.

ADIABATIC CELL USING LOW REAGENT VOLUMES

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

4

SPONSOR

Ventana Medical Systems

SPONSORING ADVISOR

Chuck Lemme

PROJECT MENTOR

Bill Richards

TEAM MEMBERS

Tanner Wall
Melissa Bui
Ravneet Chadha
Erica Liebmann

PROJECT SUMMARY

This project, which was sponsored by Ventana Medical Systems, involved designing a closed, independent chamber (also known as a "cell") to help diagnose cancer via IHC tissue staining. Ventana's existing diagnostic instruments consist of multiple open cells that are stained independent of each other. However, the multiple-celled design results in a number of issues that can affect the quality of the stain. These problems include: problems with heat transfer between cells in different stages of staining, excess reagent use due to evaporation, and depletion of the boundary layer between the reagent and tissue. Therefore, the intent of this project was to create an independent, adiabatic cell that could be used for IHC tissue staining while minimizing the amount of staining reagent used.

To solve these problems, the team designed a closed chamber lined with aerogel, and heated by steam. As one of the most effective thermal insulators, aerogel reduced the heat transferred out of the cell. By using steam convection as the mode of heating, not only was evaporation greatly reduced, but the slide was also heated more uniformly and quickly. Lastly, to improve reagent stirring, a fluid aspirator (provided by Ventana) was installed in the system. The aspirator moved axially over the slide to agitate the reagent and consistently replenish the reagent and tissue boundary layer without causing evaporation.

Ultimately, these changes led to a reduced reaction time. The use of steam provided faster and more consistent heating throughout the cell, as well as a decreased rate of evaporation. As a result, we were able to reduce the amount of reagent and buffers that were used in the staining process and the reduced amount of liquids were allowed to react more efficiently with the tissue sample. The end result of our construction allowed for more rapid testing, quicker detection of cancerous tissue.

AERO-ELASTICALLY SCALED MODEL OF THE AMT-200S MOTORGLIDER

Aerospace Engineering

CLASS

AME 422

EVENT TABLE

5

SPONSOR

Air Force Office of Scientific Research

SPONSORING ADVISOR

Dr. Hermann F. Fasel

PROJECT MENTOR

Dr. Hermann F. Fasel

TEAM MEMBERS

Michael A. Balthazar
Mike Bower
Jason Brockbank
Nathan Decker
John Mulroy
Kyle Ritter

PROJECT SUMMARY

This project aims to investigate the feasibility of testing scale-model aircraft as a predictor of full-scale performance. A general aviation motorglider, the AMT 200s 'Super Ximango' was chosen as our candidate aircraft due to its composite construction, large wingspan, and high aspect ratio.

A 1/5th geometric and dynamically scaled model was constructed, while investigations were completed to develop aerodynamic and elastic similarity. An aerodynamically scaled airfoil was developed to exhibit the same performance characteristics as the full-size at the scale-model Reynold's number.

To develop elastic similarity, Finite Element Model's were used to predict performance of a variety of internal structure configurations and wing skin layups. Bending tests were conducted on the full-size wings to investigate its static performance under bending, which was used to set the target structural performance values for the scale-model.

By matching the static structural characteristics and combining it with the aerodynamically scaled airfoil, the same aeroelastic performance should be obtained. Further flight test investigations will focus on validating the construction during steady maneuvers and then attempting to investigate dynamic performance, specifically the phenomena of stall flutter.

ALTERNATIVE MOTORBOAT PROPULSION SYSTEM DEVELOPMENT GLEN CANYON

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

6

SPONSOR

Grand Canyon River Outfitters Association

SPONSORING ADVISOR

Mark Grisham

PROJECT MENTOR

Chuck Lemme

TEAM MEMBERS

Jose E. Cardenas
Leigh McGill
Tom Cleary
James Downing

PROJECT SUMMARY

The Grand Canyon River Outfitters Association (GCROA) is the collection of all the companies with concession contracts to run commercial river trips through the Grand and Glen Canyons. In order to satisfy their new contracts, and be a leader in the green movement, they need to convert their fleet of boats to run on non-fossil fuels. Furthermore, the GCROA wants their boats to run more silently on the downstream trip through the Glen Canyon. To accomplish this, we recommend converting the main motor to run on ethanol for the upstream trip, while the downstream trip will be run using a Minn Kota electric motor. To power this, a silent generator, running on ethanol, will supplement power to the batteries, as batteries alone would be extremely cumbersome.

ALTERNATIVE MOTORBOAT PROPULSION SYSTEM DEVELOPMENT GLEN CANYON

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

7

SPONSOR

Mark Grisham
Grand Canyon River
Outfitters Association

SPONSORING ADVISOR

Mark Grisham

PROJECT MENTOR

Anthony King

TEAM MEMBERS

Eric Brown, Team Lead
Robert Case
Dave Rich
William Kelsey

PROJECT SUMMARY

The Grand Canyon River Outfitter's Association (G.C.R.O.A.) has initiated the development of an alternative motorboat propulsion system for its smooth water pontoon boat touring operations at Glen Canyon, Arizona.

The pontoon boats in use are 22 ft. in length and powered by a single 135 hp Honda four stroke outboard engine. These boats transport 22 passengers and a pilot on scenic downstream trips. The river trip begins at the Glen Canyon dam and lasts no less than 2.5 hours before arriving 15 miles downstream at Lee's Ferry. At this point, the passengers are unloaded and the pilot quickly returns to the Glen Canyon dam in no more than 1 hour's time. G.C.R.O.A. requires the alternative motorboat propulsion system to transport the passengers and pilot downstream at a minimum of 3-5 mph in addition to the speed of the downstream current and yet still maintain enough propulsion power to return the boat and pilot a 15 mile distance back upstream in under 1 hour's time. Additionally, the alternative propulsion system must reduce/eliminate the use of fossil fuels, not exceed the noise level of the current system, fit into/ on the boat, have a comparable weight to that of the current system, and must possess user friendly controls.

ALTERNATIVE MOTORBOAT PROPULSION SYSTEM DEVELOPMENT GRAND CANYON

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLES

8 and 9

SPONSOR

Grand Canyon River Outfitters Association

SPONSORING ADVISOR

Mark Grisham

PROJECT MENTOR

Clayton Grantham

TEAM MEMBERS

3515: Sarah Brown (ME)
Cassi Cucuel (ME)
Chad Franke (ME)
Alan Stark (EE)

3683: Bradley Fox (MSE)
William Loehr (EE)
Jorge Lopez (ME)
John Partridge (ME)

PROJECT SUMMARY

Teams 3515 and 3683 were assigned to aid in the environmental preservation of the Grand Canyon. The project was to convert the propulsion systems of river rafts used for the eight day journey down the Colorado River from gasoline based, to a non-fossil fuel method.

The teams decided to use the alternative of an electrically propelled raft. The scope of the project was decided to be a bit wide to tackle with merely a four person team, and so the teams joined together to expand their numbers and expertise. The Mechanical Engineering students joined together to focus on the replacement of the fuel injection system within the provided Honda Outboard casing with an electric motor, while the Electrical and Materials Engineering students worked to create the necessary control systems and wiring that would connect the electric motor to the battery pack, as well as a charging system for the batteries.

The design that has been implemented successfully meets the requirements of providing up to 20 horsepower bursts, while still remaining extremely quiet when submerged in water. These specifications were specially requested as the raft guides require huge bursts of power in order to safely negative the treacherous rocks of the Colorado River. The guides also wished for a quieter alternative to the current motor as they found they would shout themselves hoarse while trying to point out things over the roar of the gasoline engine.

Teams 3515 and 3683 are proud to present their functional prototype for your viewing. While this is only the start of a ten year project to optimize battery and power generation methods, the teams believe they have produced a strong starting point that will be built on for years to come.

APACHE MISSILE BLAST DEFLECTOR

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

10

SPONSOR

Boeing Rotorcraft

SPONSORING ADVISOR

Nathan Adams

PROJECT MENTOR

Anthony King

TEAM MEMBERS

Manuel Gonzales, Team Lead
Michael Sandquist
Bordin Chunharit
Lydell Boone

PROJECT SUMMARY

The AH-64D Apache Longbow is an extremely effective ground attack helicopter. To increase its air to air effectiveness, a new missile is being added to its arsenal. One of the missiles currently under consideration for this role, produces a blast wave when fired, that causes damage to several areas of the helicopter.

Our project, entitled: Apache Missile Blast Deflector, is to deliver an initial concept blast deflector that will attach to the missile launcher and prevent any damage to the helicopter when the missile is fired. The concept must also meet several other requirements, laid out by Boeing Rotorcraft.

The concept we developed does have the ability to protect the helicopter as required. It is able to deflect the damaging blast away from the critical areas of the helicopter. It is lightweight in order to have minimal impact on the helicopter's flight characteristics. It will handle the loads generated on it by the blast, heat, and accelerations produced by the helicopter. It is also mounted using a spring and hinge system, taking enough of the rigidity out of the deflector to reduce reaction forces on the launcher to an acceptable level. This spring/hinge system also gives our deflector blast absorption capability in addition to its deflecting capability.

BIOLOGICAL SIGNAL INTERFACE BOARD

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

11

SPONSOR

Western Design Center

SPONSORING ADVISOR

Charles Higgins

PROJECT MENTOR

Fred Highton

TEAM MEMBERS

Joshua Routh
Jerris Methvin
Jeremy Radtke
Juan Van Alstine
Bryan Richardson

PROJECT SUMMARY

This project will involve studying the design of an existing printed circuit board for biological signal processing and modifying the present design to include a new microprocessor, additional analog circuitry, and extensive software to do real-time processing of biological signals.

The team will build a printed circuit board suitable for simultaneous processing and analysis of 8 parallel streams of neuronal or muscular biological data. This board will be based on an existing functional 3-channel board designed in the Higgins laboratory at the UofA. The new board will be capable of running in real time an algorithm for spike sorting which allows detection of multiple neuron action potentials from groups of four electrodes.

BRAIN WAVE ACTIVITY ALARM
Interdisciplinary Engineering Design Program

CLASS
ENGR 498

EVENT TABLE
12

SPONSOR
Texas Instruments

SPONSORING ADVISOR
Rod Burt

PROJECT MENTOR
Fred Highton

TEAM MEMBERS
Amjad Chatila
Jason VanAsdlan
Manny Fimbres
Henry Barrow
Joseph Bitz
McKay Crowder

PROJECT SUMMARY

A portable low cost alarm designed to send out a wireless signal when a characteristic brain wave activity, such as Alpha wave activity, is detected.

One possible application will be to detect the onset of sleep during the operation of a motor vehicle and alert the driver before a potential accident situation occurs. The device is to be comfortably worn and powered by a single medical type lithium battery (2032). It will contain one or more electrodes to provide skin contact without any special preparation such as gels. An instrumentation amplifier design is needed to amplify the signals in the microvolt level followed by an analog to digital converter and low speed Digital Signal Processing capability.

Components used in this type of design are available and recommended by Texas Instruments Precision Linear and MSP430 groups. A low power radio is also needed to transmit the alarm signal. Texas Instruments also has components for use in the low power wireless designs.

LOOPING TOOL
Interdisciplinary Engineering Design Program

CLASS
ENGR 498

EVENT TABLE
13

SPONSOR
W.G. Medical Systems

SPONSORING ADVISOR
Dr. Andrew Weinberg

PROJECT MENTOR
Kevin Prodromides

TEAM MEMBERS
Julian Aushana
Ricky Mojica
Britney Neitenbach
Blake Randolph
Annette Raymond

PROJECT SUMMARY

A colonoscopy is the procedure of inserting a colonoscope into the colon in order to inspect for tumors, abnormal growths, and overall health. The colonoscope occasionally forms loops due to the shape of the colon, ultimately preventing the tip from advancing. These loops can cause pain and discomfort to the patient and fatigue for the physician.

Our team will design, build, and test a de-looping tool. Loops are currently minimized by partially removing the colonoscope, torquing it to remove the loops and kinks, and reinserting it back into the colon. The de-looping tool will be inserted into the biopsy channel of the colonoscope and adhere to the inner walls near the tip. It will apply an axial or torsional force which will correct the loop at which point the de-looping tool can then be removed. This tool may save procedural time, improve patient comfort, lessen physician fatigue, and allow easier navigation through the difficult shape of a colon.

The de-looping tool itself must be disposable, not damage the colonoscope (scratch, dent etc.), nor injure the patient.

COMMAND AND CONTROL (1/3) UNMANNED GROUND VEHICLE

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

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SPONSOR

Tucson Embedded System

SPONSORING ADVISOR

Jonathan Schwab

PROJECT MENTOR

Bill Richards

TEAM MEMBERS

Carlos Murphy
Hussain Al-Helal
Hyungtaek Chang
Rachit Mohindra
Andrew Zimmerman
Kelly Dougherty

PROJECT SUMMARY

Tucson Embedded Systems (TES) is an Engineering Company that works to create a software system called Computer Driven Architecture (CDA) that allows different platforms, which could include unmanned vehicles, to communicate together and with command stations easily and seamlessly.

TES would like a small Unmanned Ground Vehicle (UGV) that will integrate CDA and be able to perform search and reconnaissance missions autonomously while in communication with other unmanned vehicles and a Command and Control station. This UGV is autonomous and capable of making decisions on-board.

It is able to traverse multiple types of terrain to reach a location received via GPS from an unmanned aerial vehicle and avoid obstacles in its path by utilizing data it receives from sensors. The UGV also sends data back to the Command and Control center and stays in communication with other unmanned vehicles.

COMMAND AND CONTROL (2/3) UNMANNED AERIAL VEHICLE

Interdisciplinary Engineering Design Program

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15

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Tucson Embedded Systems

SPONSORING ADVISOR

Jonathan Schwab

PROJECT MENTOR

Clayton Grantham

TEAM MEMBERS

Ifeyinwa Amene
Nicolas Lee
Po-Chou Su
Steven Varga

PROJECT SUMMARY

An unmanned aerial vehicle (UAV) is an unpiloted aircraft that can be remote controlled or flown autonomously based on pre-programmed flight plans or more complex dynamic automation systems. UAVs are currently used in a number of military situations, including reconnaissance and attack.

They are also used in a small but growing number of civil applications such as firefighting when a human observer would be at risk, police observation of civil disturbances and crime scenes, and reconnaissance support in natural disasters. UAVs are often preferred for missions that are too "dull, dirty, or dangerous" for manned aircrafts.

Our goal is to build and test an unmanned aerial vehicle prototype. We will work with TES engineers to develop system requirements to meet TES goals. The unmanned aerial vehicle must have the following capabilities:

1. Position Awareness
2. Communicate with other vehicles and control nodes
3. Manual override and flight capabilities
4. Autonomous flight capabilities
5. Battery and power management for future expansion
6. Ability to add an array of different sensors and communication technologies

COOPERATIVE UNMANNED VEHICLE PLANNING II

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

16

SPONSOR

BAE Systems
Rex Helton & Tom Deakin

SPONSORING ADVISOR

Dr. Larry Head

PROJECT MENTOR

Bill Richards

TEAM MEMBERS

Ryan Boemi
Joel DeLaRosa
Brandon Ng
Katie Pincus
Austin Rios

PROJECT SUMMARY

The Cooperative Unmanned Vehicle Operations Planning System (CUVOPS) II, sponsored by BAE Systems, is a planning software system that tasks Unmanned Air Vehicles (UAVs) and Unmanned Ground Vehicles (UGVs) in response to emergency events.

The critical events which require response from the unmanned vehicles may include emergencies such as fires, car accidents and aftermaths of natural disasters such as earthquakes, hurricanes or tornadoes. For example, if one of the previous circumstances occurred, an unmanned air vehicle would search for the occurrence and task the unmanned ground vehicles accordingly, to provide assistance. The search pattern of the UAV and the tasking of the UGVs are based on algorithms created by the CUVOPS II team. The algorithms will efficiently task the UGVs based on available resources that are kept up-to-date in a database.

The need for such a system is necessary so that the risk of human error and danger to humans are eliminated. The system's utilization of risk and cost factor algorithms will efficiently employ the resources as well.

Customers for this next evolutionary system may include law enforcement and emergency response organizations.

DESIGN / BUILD / FLY
Aerospace Engineering

CLASS
AME 422

EVENT TABLE
17

SPONSOR
Raytheon/AIAA

PROJECT MENTOR
Prof. Thomas Balsa

TEAM MEMBERS
Laura Lund
Krystine Nelson
Justin Novacek
Tyler Ebbitt
Jessica Wittner
Regina Reed

PROJECT SUMMARY

Our project is to design and build an RC plane for the American Institute of Aeronautics and Astronautics – Design/Build/Fly competition. The plane must carry a centerline tank payload of a 4 liter water bottle, weighing 9 lbs when full.

It also must carry 4 patriot missile scale bottle rockets on the wings. The rockets will be remotely released, one at a time and the plane must take-off and fly a lap between each rocket drop. The team had to design the plane beginning at the conceptual design phase and through detailed design for aerodynamic and structural optimization. The team then built the plane, primarily using balsa wood and an electric propulsion system. The plane will be flown in the Design Build Fly competition in Tucson, AZ in April.

DESIGN AND CONTROL OF CONCENTRATED SOLAR COOKING SYSTEM AT A FEW kW LEVEL

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

18

SPONSOR

US Environmental Protection Agency

SPONSORING ADVISOR

Peiwen Li, AME Dept

PROJECT MENTOR

Chuck Hassen

TEAM MEMBERS

Abdulla Al-binali, ME
Kamal Al-hamidi, ME
Javier Heyer, OE
Matthew Morgan, ME
M M Valmiki, ME
Jeremy Wagoner, ME

PROJECT SUMMARY

This concentrated solar cooking system demonstrates the use of a Fresnel lens in conjunction with a thermal fluid loop to capture and transport sunlight energy for heating and cooking purposes.

In recent years the global society has exhibited an increased interest in energy source diversification and efficiency. Using electricity for heating purposes is a poor utilization of high-quality energy and fossil fuels dependence has been stretched to capacity. This system will harness the free and powerful solar radiation energy that surrounds us for heating. Traditional solar cookers can be unsafe, difficult to control, and have garnered little attention from industrialized countries. The team has tried to address each of these issues.

The prototyped system will demonstrate two cooking capabilities: outdoor and indoor use. A dual axis, manual tracking system will allow use throughout the day. The incoming light will be concentrated on a collection surface in contact with thermal transfer fluid. For use outdoors, cooking may be conducted on an area adjacent to the collection surface. For indoor use, a pump will drive the fluid through a pipe loop to a secondary cooking surface, which would be used indoors. The concept has much potential for further development and additional, varied uses.

DIGITAL AUTO-COLLIMATOR
Interdisciplinary Engineering Design Program

CLASS
ENGR 498

EVENT TABLE
19

SPONSOR
Edmund Optics

SPONSORING ADVISOR
Jeremy Govier

PROJECT MENTOR
Chuck Hassen

TEAM MEMBERS
Nick Bielat
Zac Dowson
Steve Molina
Ben Striner

PROJECT SUMMARY


Edmund Optics uses autocollimators in-house to measure the angular deviation of optical systems. These traditional devices require multiple operators and do not give accurate, repeatable results from use to use.

Our digital autocollimator used a CCD array and computer interface to give accurate measurements that can easily be obtained by one operator. This system removed the frustrations of using an autocollimator by:

- Giving instant results in real time
- Reducing the number of operators to one
- Calculating results without human error
- Making repeatable measurements

DYNAMICALLY SCALED OBLIQUE FLYING WING

Aerospace Engineering

CLASS

AME 422

EVENT TABLE

20

SPONSOR

Dr. Hermann Fasel

SPONSORING ADVISOR

Dr. Hermann Fasel

PROJECT MENTOR

Dr. Hermann Fasel

TEAM MEMBERS

Joseph Farrell
Andrew Levine
Isaac Mavis
Brandon Napier
Michael Perillo
Daniel Wibben

PROJECT SUMMARY

The oblique flying wing is an aircraft without a fuselage that is able to change its orientation with respect to the oncoming airstream. This is accomplished by one side of the wing sweeping forward and the other side sweeping backward. Due to this configuration the oblique flying wing is able to fly more efficiently, especially as the aircraft approaches transonic and supersonic speeds.

The purpose of the project is to design an operationally stable, dynamically scaled oblique flying wing. However, in order for the process of constructing a dynamically scaled model to take place a theoretical full size model must be designed. The different physical parameters of the full size aircraft are then scaled down appropriately.

The project plans to design and construct a dynamically scaled oblique flying wing by use of wind tunnel testing, CFD, and CAD modeling, while also building simulator models, mathematical models, multiple free flight models, and an on board computer data logger that will be used to analyze flight data.

FULL SPECTRUM IMAGING SYSTEM
Interdisciplinary Engineering Design Program

CLASS
ENGR 498

EVENT TABLE
21

SPONSOR
Lockheed Martin

SPONSORING ADVISOR
Laura Klein

PROJECT MENTOR
Chuck Lemme

TEAM MEMBERS
Joshua Averyt
Matthew Bergkoetter
Alex Leyva
Matthew Schwab

PROJECT SUMMARY

The Full Spectrum Imaging System (Team 3686) is a proof of concept design for a single aperture imaging system that will operate in the visible, short-wave infrared, and mid-wave infrared spectral bands, as well as collect data used for synthetic aperture radar imaging in the Ka band. The end-goal product will be a fully operational system including an IR laser designator and range finder that is packaged within a 20 inch diameter sensor turret weighing less than 65 pounds total for deployment on the Army's Shadow Class unmanned aerial vehicle. Our specific goal during this iteration of the project is to develop a single aperture system that will be capable of imaging in the visible and IR spectral bands, transmit and receive signals in the Ka band, and still adhere as strictly as possible to the final size and weight constraints of the final desired system. The final deliverable will be a detailed performance analysis of the imaging capabilities of the system, as a performance increase in one spectrum typically creates a tradeoff in the degradation of imaging in a different spectrum.

Our prototype system is based on an 8" Meade Schmidt Cassegrain telescope that we have modified to collect in all three spectral bands: visible, IR, and radar. The primary and secondary mirror coatings have been characterized for performance in all three spectrums which will allow the telescope to act as our single aperture. The bulk of the modifications occur behind the primary mirror where we have attached several extra components to the eyepiece mount of the telescope including a copper-wire grid capable of reflecting radar signals, a dichroic beamsplitter with a cutoff wavelength at 700nm and three mounts for placement of a radar transmitter/receiver horn, a digital Rebel Xsi camera, and an IR detector or camera. The development of a compact multi-spectral imaging system for use in surveillance and reconnaissance is at the forefront of next-generation defense systems and our project aims to be a significant step forward in developing such a system.

GRAVITY ALIGNED COLLIMATOR
Interdisciplinary Engineering Design Program

CLASS
ENGR 498

EVENT TABLE
22

SPONSOR
Professor James Burge
College of Optical Sciences

SPONSORING ADVISOR
Professor Robert Parks

PROJECT MENTOR
Clayton Grantham

TEAM MEMBERS
Brigid Marshall
Oscar Martinez
Antony Mills
Nicholas Cota

PROJECT SUMMARY

The Gravity Aligned Collimator (GAC) is a system designed to direct collimated light in the direction of gravity to within one arcsecond. It will be used to align the 18 segments of the James Webb Space Telescope primary mirror to one another prior to the telescope's launch.

The Gravity Aligned Collimator is a device intended to produce a collimated beam of light oriented in the direction of gravity. This goal is achieved by utilizing a precision electronic bubble level which can measure tip/tilt with resolution of .02 arcseconds, an axis of rotation adjusted by precision picomotors, and an autocollimating optical system with a retro-reflecting corner cube and a flat mirror. The device will be aligned through three main steps: rotational axis alignment, corner cube retro-reflection, and autocollimator alignemnt.

First, a central axis is rotated to two positions where the output of the bubble level is used to adjust the orientation of the rotation axis to the direction of gravity. The output of the autocollimator photodetector is then calibrated through the use of the corner cube. The autocollimator is then used to assure that the output light is aligned to the axis of rotation using the flat mirror. Finally, the collimated light beam from the optical system is rotated to an exit port and the system can then be used to test a specified part of the telescope array.

HIGH RESOLUTION 3D OPTICAL MOBILE INSPECTION SYSTEM

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

23

SPONSOR

Lockheed Martin

SPONSORING ADVISOR

John Alletto

PROJECT MENTOR

Chuck Hassen

TEAM MEMBERS

Zaniar Barzanjy
Patrick Edwards
Christopher Guido
Alex Maldonado
Casey Tambe

PROJECT SUMMARY

Utilizing two optical telescopes, Team 3506 designed a platform capable of long distance, high accuracy Laser Range Finding.

Team 3506 is comprised of Optical Scientists Zaniar Barzanjy, Christopher Guido, Alex Maldonado, Mechanical Engineer Casey Tambe, Electrical Engineer and team lead Patrick Edwards.

The student team is supported by Lockheed Martin engineers John Alletto and Ron Levin from Goodyear, Arizona. This year is part one of a multi-year capstone project to construct a mobile, high resolution, long distance, LiDAR system.

In the Inaugural year, 3506 constructs a laser range finding system as a springboard for future LiDAR implementation. Armed with two large telescopes on loan from Lockheed Martin, the team has designed a platform capable of sensing the distance to a target with extremely high precision, and while doing so at extreme ranges.

INFRARED THERMAL IMAGING CAMERA

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

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SPONSOR

BAE Systems

SPONSORING ADVISOR

Kenneth Ryan

PROJECT MENTOR

Bill Richards

TEAM MEMBERS

Isidro Valdivia
Daniel Valine
Maria Parra
Manuel Robles
Erik Huerta
Garland Brock

PROJECT SUMMARY

The team will design a low cost all weather Multiple FOV Long Wave IR Imaging camera. The design will be centered around performance specifications of a commercially produced FPA Array, with particular attention devoted to maximum optical detection range, field of view and relatively low cost to manufacture. Design of all mechanical assemblies within system to include shutter, focus/autofocus and multiple FOV mechanisms with Team/Project Photo associated drive circuitry to validate operational requirements. Selection of materials fits and finishes to meet performance requirements over operational conditions. Analysis of mechanical design elements to verify integrity and compliance to functional requirements over operational spectrum. Trade studies of size, weight, cost and performance. Electrical Design of power, communications and signals systems and interfaces. Design of systems to enable power driven mechanical components including software code. Perform power budget analysis and trade study. Thermal management analysis of electronics and electrical components. Design of optical system to meet objective performance specifications including autofocus capability. Detail design of specific optical elements within system. Analysis of optical design elements to verify integrity and compliance to functional requirements over operational spectrum. Systems engineering to integrate the mechanical, electrical and optical elements. Perform system level trade studies for size, weight, performance and cost. Potential for full prototype build. Full prototype build decision at mid-year review. Develop industrial engineering plan to commercially produce telescope in a competitive market. Trade Analysis of production technologies for each subsystem.

INSERT INSTALLATION AUTOMATION SYSTEM

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

25

SPONSOR

BE Aerospace, Inc.

SPONSORING ADVISOR

Dave Dorey
Karola Pompa

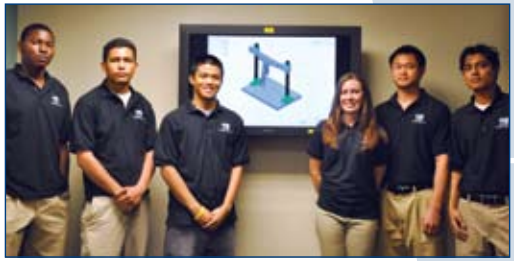
PROJECT MENTOR

Kevin Prodromides

TEAM MEMBERS

Kevin Hsu
Stacy Borowicz
Shah Shafin Zaman
Alonso Rodriguez
Arvin Parco
Oluwafisayo Olayinka

PROJECT SUMMARY



BE Aerospace, Inc. is the world's leading manufacturer of cabin interior products for commercial aircraft and business jets. Currently at BE Aerospace, extensive manual labor is required to install inserts into interior aircraft cabin panels. The current process requires an operator to visually identify the correct inserts needed and manually place them in the composite panels. After the inserts are installed, adhesive is manually applied to secure them to the panel. This process results in long cycle times and high chance for human error which collectively increase the cost of production.

To improve the current process of installing inserts into aircraft composite panels, an automated system has been designed to perform the task. The automated system will keep different inserts sorted, place them into their corresponding holes, and apply adhesive to secure them to the composite panels. The automated system utilizes equipment with high precision and repeatability rates to improve accuracy, consistency, and reliability, resulting in improved cycle times and reduced human error.

IRRIGATION FLOWSTREAM ENERGY EXTRACTION AND STORAGE VIA TURBINE

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

26

SPONSOR

Rain Bird

SPONSORING ADVISOR

Kevin Irwin

PROJECT MENTOR

Clayton Grantham

TEAM MEMBERS

John Saenz
Chris Sandy
Juan Lopez
Carlos Lopez
David Addai
Scott McLeod

PROJECT SUMMARY

This project was designed to provide a power source to a standalone commercial irrigation valve assembly by means of extracting kinetic energy from the flow of the water through the pipe.

This was accomplished by designing and building a turbine that sits in the water flow and transforms the kinetic energy into electrical energy thus recharging a battery. This system was required to operate under typical flow conditions (30 to 80 gallons per minute), incur no more than a 5 psi pressure drop across the turbine, and recharge the battery in 5 minutes or less.

LASER SENTRY
Interdisciplinary Engineering Design Program

CLASS
ENGR 498

EVENT TABLE
27

SPONSOR
Insight Technology, Inc.

SPONSORING ADVISOR
Russ Heard

PROJECT MENTOR
Fred Highton

TEAM MEMBERS
John Pittman
George Runger
Ian Cubbon
Andrey Alenin
Kokou Gniningan
Michael Dalpiaz

PROJECT SUMMARY

Team 3513 has designed a man portable sensor system to enhance site security for small tactical teams. It provides early detection and location of approaching threats at sufficient standoff range to allow the team operational reaction time to assess the situation and take appropriate action.

Features include a modular, flexible network of sensors and Near Infra-Red (NIR) illuminators allowing the user to configure the system for up to 360-degree coverage and a hand-held remote control device that communicates with the sensors, alerts the user to threats, and provides the capability for automatic or user controlled NIR pointing and illumination of suspected breach areas.

The detection/illumination modules may be mounted to poles, trees or other available structures, or deployed on uneven terrain. Once activated, the motion sensors will trigger NIR illumination of the suspect region and alert the user via remote control. The user will be able to adjust the NIR illuminator divergence to zero in on targets of interest.

LEAVE BEHIND REMOTE SENSOR
Interdisciplinary Engineering Design Program

CLASS
ENGR 498

EVENT TABLE
28

SPONSOR
Raytheon Missile Systems

SPONSORING ADVISOR
Brian Perona

PROJECT MENTOR
Fred Highton

TEAM MEMBERS
Mark Brodie
Megan Whitney
Ross Miller
Brian Adelson
Kyle Van Renterghem

PROJECT SUMMARY

Raytheon Missile Systems desired a covert sensor package that could be dropped off at a remote location and operate mostly autonomously. The device would be used for gathering data on movements and activities of people and vehicles. Raytheon Missile Systems requested that existing technology be implemented as much as possible into the project design to aid in the rapid deployment of the device and reduce production costs. The customer envisioned the Leave-behind Remote Sensor as having Border Patrol, Department of Homeland Security, and possible Department of Defense applications. There is currently no product like this on the market. Raytheon Missile Systems wished to fill this void starting with having our team do a proof of concept.

The device was required to be able to run on full power for at least 30 minutes and have a field life of at least 3 weeks. Additionally, it had to be able to recharge using solar power. Also, the audio and visual data collected needed to be transmitted wirelessly at a range of at least 1 mile back to a command post. The device was to have an operating environment of a temperature range of -30 °C to 50 °C (outside temperature) and up to 85% non-condensing humidity. The device had to be able to withstand a 50G ½ sine shock pulse lasting 33 ms.

MEASURING THRUST RECOVERING VALVE PERFORMANCE

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

29

SPONSOR

Honeywell

SPONSORING ADVISOR

Darrell Horner
Kevin Prodromides

PROJECT MENTOR

Chuck Lemme

TEAM MEMBERS

Randon Walters
Alex Smith
Kevin Shearer
Daniel Madrid
Aaron Ray
Jorham Jaramillo

PROJECT SUMMARY

The purpose of the project is to design, fabricate and implement the first device to measure aft force generated by a Honeywell Thrust Recovery Outflow Valve (TROV). The TROV is a device used on an aircraft to regulate internal cabin pressure and provide additional forward thrust by converting outflow of excess pressure into an aft force.

To measure this force, the design utilizes static moment balance by suspending the valve from a rotational joint and restricting aft motion with a stationary force gage. When the valve is engaged using Honeywell's existing simulation facility, the generated aft force will create a moment about the joint that is then counteracted and measured by the gage.

To implement the design, the team completed extensive structural analysis in ABAQUS, fabricated multiple custom aluminum components, developed a 130 in 2 rubber sealant gasket assembly, and produced finite statistical measurement analysis on collected data. The project sponsor will utilize the design and measurement to support TROV technical specifications, verify theoretical thrust calculations, and develop scaled versions of the design for alternate TROV models.

MECHATRONIC MEDICAL DEVICE DEPLOYMENT SYSTEM

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

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SPONSOR

W. L. Gore & Associates

SPONSORING ADVISOR

Engracia Dang

PROJECT MENTOR

Chuck Lemme

TEAM MEMBERS

Jeremy Coleman
Ehude Bezalel
Alejandro Covarrubias
Andrew Pyzdek
Joshua Grosman
Matthew Weiner

PROJECT SUMMARY

W. L. Gore and Associates began in 1958, when Bill and Vieve Gore set out to explore opportunities for fluorocarbon polymers, especially polytetrafluoroethylene (PTFE). Today, Gore is comprised of approximately 8,000 associates in more than 45 locations around the world. The fluoropolymer products provide innovative solutions throughout industry, in next-generation electronics, for medical products, and with high-performance fabrics.

Our team worked directly with the medical branch of Gore to design and build a multi-functional controlled deployment system for a catheter delivered medical device, which has already been developed by Gore. The specific device in which we interfaced with is used to treat abdominal aortic aneurysms by deploying a stent graft. The customer asked us to develop a device, or handle, to control the deployment of the graft. The purpose of having a handle to control and guide a user through the deployment process is due to the increasing complexity of the new devices delivered via catheter. The customer provided that the deployment system must electronically control a mechanical system that will manipulate and deploy the device. The final design must be hand held, intuitive for physicians to use, and prevent the operations from being performed out of sequence. In order to meet these requirements and help simplify the deployment process of the new device, we developed a mechanical/electronic handle that guides the user through the deployment process step by step. The handle has an LCD screen that prompts the user for inputs that will be entered through simple "Yes" and "No" buttons. This new deployment system will eliminate human error and ensure the safety of the patient.

MOBILE SECURITY-SURVEILLANCE UNIT

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

31

SPONSOR

CAID Industries

SPONSORING ADVISOR

Rob Assenmacher

PROJECT MENTOR

Fred Highton

TEAM MEMBERS

Nicole Ernst
Thomas Flake
Stephen Klein
Sean Marshall
Adam Ngo

PROJECT SUMMARY

Our mission is to produce, at a competitive cost, the next generation security-surveillance unit that will provide its user with a means of detecting theft or vandalism of a customer's property. This product is intended to assist many industries by monitoring construction sites, storage yards, parking lots, and special events.

The scope of the project is to design and prototype, with the manufacturing help of the sponsor, a mobile security-surveillance unit that has WIFI capabilities and can be solar powered.

MULTI-ZONE WIRELESS ENVIRONMENTAL MONITOR

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

32

SPONSOR

Texas Instruments

SPONSORING ADVISOR

Marco Gardner

PROJECT MENTOR

Clayton Grantham

TEAM MEMBERS

Joshua Reed
Christopher Hall
Brian Parish
Matthew Molitor
Christopher Weeks

PROJECT SUMMARY

The Multi-Zone Wireless Environmental Monitoring system gathers temperature data at multiple nodes and relays them wirelessly back to a base-station to be displayed on a personal computer for the user. One of the target applications for this product is that of a green home ventilation system. By measuring the temperature in multiple locations and throughout the house, the user will be able to set temperature thresholds in each room so that the system can independently control the temperature in the room, thereby saving energy by not cooling or heating rooms that are not in use.

This system is controlled through a Graphical User Interface (GUI) by the user where they are able to add or remove sensors, change temperature thresholds, or do manual overrides of the system's regular performance to open and close vents at will.

In summary, after the system is setup, it monitors the temperature in each of the rooms with a sensor, sends that data back to the GUI to be displayed, and makes a decision about whether or not to send a signal to open or close the vents in the room. The actual operation of opening or closing the vent is outside of the scope of the project, but there is a visual indicator of a signal being sent.

PedOne – Pediatric Electronic Medical Records

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

33

SPONSOR

Seventh Rank Management

SPONSORING ADVISOR

Mark Ginsburg

PROJECT MENTOR

Anthony King

TEAM MEMBERS

Erin Prenger
Michael Schreiber
Joseph Wahl

PROJECT SUMMARY

The PedOne Pediatric Electronic Medical Records system is designed to simplify access to, and storage of, pediatric medical records. Designed with smaller practices in mind, the system is designed to promote general ease of use, safeguard patient data, and reduce unnecessary complexity when recording information.

The application is entirely web-based, allowing a unified gateway for any web-enabled device. Modularity is key, allowing an incremental design process. Adobe Flex and MySQL are being used in the design process. Additional integration with a variety of external databases will aid doctors in performing quick and accurate diagnoses.

PEPPER SPRAY MOUNT FOR AN M-16 RIFLE

Agricultural and Biosystems Engineering

CLASS

ABE 498

EVENT TABLE

34

SPONSOR

Venum and Bosque Engineering

SPONSORING ADVISOR

Dr. Muluneh Yitayew

PROJECT MENTOR

Mr. Peter Livingston

TEAM MEMBERS

Upsana Chandarana
Wesley Williamson
Anvesh Cherukupally

PROJECT SUMMARY

The purpose of this design project is to mount a non-lethal weapon system to the M-4/M16 family of rifles. This would allow the operator of the rifle to incapacitate a target without taking away from the possible need to fire the rifle. The design makes it possible for law enforcement and military forces to subdue potential threats in a life saving manner.

This design report contains the detailed description of this non-lethal weapon system and how it attaches to the Piccatanny Rail System of M4 and M16 rifles. Also contained are the design specifications, conditions of use, method of operation for the Pepper Spray device taking the place of the 'Gangster' style grip already incorporated into these rifle platforms.

The main purpose of this project is to design a non-lethal weapon, pepper spray mount, system that is attachable to the M-16 and M-4 family of rifles for use in modern urban combat situations.

PHOTOVOLTAIC ENERGY SYSTEM FOR REMOTE POWER APPLICATIONS

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

35

SPONSOR

Dr. Raymond K. Kostuk

SPONSORING ADVISOR

Dr. Raymond K. Kostuk

PROJECT MENTOR

Kevin Prodromides

TEAM MEMBERS

David Knapp
Raymundo Marquez
Omar Mahmoud
James Meyers

PROJECT SUMMARY

Many people living in rural areas such as Native American Reservations do not have access to electrical power. In many cases this is due to their distance from an available electrical power grid connection. Photovoltaic modules are currently available however their performance is typically rated at standard test conditions and not the real world conditions found at an installation site. Furthermore, new thin film amorphous solar panels have not been extensively tested by independent researchers.

Our project compares one of these newer amorphous panels with a more conventional poly-crystalline silicon panel under identical, real world conditions. We will compare the power curves of both types of panels and see if one is better than the other and how they both are affected by temperature and solar radiation spectrum.

The data collected from this can be extrapolated to estimate how much power an array of each of these panel types will generate at the location that we gather data.

PORTABLE GLUTEN BIOSENSOR

Agricultural and Biosystems Engineering

CLASS

ABE 498

EVENT TABLE

36

SPONSOR

The University of Arizona

SPONSORING ADVISOR

Dr. Muluneh Yitayew

PROJECT MENTOR

Dr. Mark Riley

TEAM MEMBERS

Kevin Miller
James Nimlos
Jeremy Williams

PROJECT SUMMARY

The purpose of this design project was to develop a design for an effective solution for helping individuals with celiac disease determine if certain foods are safe for them to eat, i.e. have acceptably low levels of gluten concentration (20ppm). This is solved by the development of a commercial biosensor for the detection of gluten in foods, primarily for use in a restaurant setting. Celiac disease is an autoimmune disorder that causes sensitivity to gluten and an inability to properly digest it. As no cure or treatment for celiac disease is available, afflicted individuals must avoid ingesting gluten by limiting their diet to gluten-free foods or food products low in gluten.

Because people with celiac disease must avoid gluten-containing products, there is a need to test foods for their gluten concentration. Even foods marketed as gluten-free often have higher than acceptable gluten concentrations, as the FDA has not yet set a standard in the United States. Gluten testing kits are available, but contain multiple components and are not convenient or automated.

Our design consists of an automated gluten biosensor, which would be practical to a restaurant setting. The device first grinds up food samples and then extracts gluten with an ethanol solution. A system of syringe pumps are then used to extract the required volume of sample for detection, after which the sample flows through an automated, flow-through enzyme-linked immunosorbent assay (ELISA) detection method. By measuring the color changed induced in a chromogen, which is proportional to the amount of gluten in the original food sample, an electrical output circuit outputs if the sample is safe to eat or not (i.e. having less than 20 ppm gluten) by providing a binary response in the form of either a red or green LED turning on. The cost for the prototype device is estimated to be $598.66, although this would be reduced in mass production of the device.

RAPID CAPTURE, ANALYSIS, AND STORAGE OF IMAGES OF INTEGRATED CIRCUITS FOR DEFECT DETECTION AND DATA ANALYSIS

Interdisciplinary Engineering Design Program

CLASS
ENGR 498

EVENT TABLE
37

SPONSOR
Intel

SPONSORING ADVISOR
Michael A. Mahler

PROJECT MENTOR
Anthony King

TEAM MEMBERS
Frederick Chyan
Maribel Hudson
Jonathan Nation
Travis Rippstein
Mark Wiley

PROJECT SUMMARY

Intel presently has the ability to capture high resolution images (in the visual spectrum) of packaged units during the manufacturing process. These images are used for defect detection and data analysis. Defects may include chips or cracks in the die, misaligned components, stains or foreign material. Based upon these images we can detect manufacturing defects.

To improve the detection of these defects the students will explore new methods of image capture possibly including the use the light outside of the visible spectrum. The full project will include defect detection and categorization of rejects into known defect types. Additionally a new method of image storage/compression is needed, potentially based upon delta to reference images. (Goal is 10x of standard compression types).

RAYTHEON SILENT UAV
Aerospace Engineering

CLASS
AME 422

EVENT TABLE
38

SPONSOR
Raytheon

SPONSORING ADVISOR
John Otto

PROJECT MENTOR
Thomas Balsa, Professor

TEAM MEMBERS
Michael Sargent
Mark Simpson
Rebecca Rodriguez
David Horvath
Neil Nguyen

PROJECT SUMMARY
The Silent UAV project is focused on the conceptual design of a UAV which is inaudible to humans at 500 ft altitude. The UAV must be capable of 6.0 hour endurance with a 25 pound payload.

Following the completion of a conceptual aircraft design, the Silent UAV group is focusing on reducing the acoustic signature of the propulsion system by designing a novel low-noise propeller.

REMOTE IMAGING SYSTEM ACQUISITION (RISA)

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

39

SPONSOR

The Johnson Space Center, NASA

SPONSORING ADVISOR

S. D. Holland, JSC-3

PROJECT MENTOR

Anthony King

TEAM MEMBERS

Wade Lichtsinn
Evan Mckelvy
Adam Myrick
Dominic Quihuis
Jamie Williamson

PROJECT SUMMARY

NASA's future manned space missions will require a single versatile imaging system which will be capable of fulfilling the requirements of many different mission objectives. A commercial camera system capable of meeting these requirements currently does not exist. To fill this void, the Remote Imaging System Acquisition (RISA) project was ignited.

NASA will need the RISA system to image the surface of Mars, the Moon and other celestial bodies. This system will be instrumental in monitoring the structural integrity of the space vehicle, assessing astronaut health and monitoring environmental conditions.

The harsh space environment in which the camera system must operate injects specific constraints to the hardware. The RISA Camera system requires non-browning lenses and radiation hardened components in order to survive the extreme levels of radiation that exists outside the earth's protective atmosphere.

ROBOT FOR INTERNAL STRENGTHENING OF PIPES WITH BRAIDED CARBON FABRIC

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

40

SPONSOR

Quake Wrap

SPONSORING ADVISOR

Mo Ehsani

PROJECT MENTOR

Chuck Hassen

TEAM MEMBERS

Joel Rhode
Carlos Del Valle
Olzhas Kenzhebulatov
Derek Lukas
Travis Bloss

PROJECT SUMMARY

This project revolves around designing a robotic device that will adhere and cure braided carbon fiber to the interior of a twelve-inch diameter pipe. QuakeWrap Inc. is focused on providing customized solutions for repair, retrofit and strengthening of structures using innovative Carbon Fiber Reinforced Polymer (FRP) products.

The primary purpose of the design is to effectively place a carbon fiber braided sleeve within a small diameter concrete pipe, mitigating human associated errors and ensuring a high-level of retrofit quality. The device must be easily transportable and assembled for use quickly by the crew that would be present at the worksite. The device must be reusable, and function on power methods currently available at the worksite like an onsite power generator. For this project, the robotic device uses a squeegee action to press the carbon-braided fabric to the interior of the pipe. The design is mobilized by using a winch line pulling system that is attached to the squeegee assembly. All the functional requirements have been met and the robotic device was constructed within budget.

ROBOT FOR INTERNAL WRAPPING OF PIPES WITH CARBON FABRIC

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

41

SPONSOR

QuakeWrap Inc.

SPONSORING ADVISOR

Mo Ehsani

PROJECT MENTOR

Kevin Prodromides

TEAM MEMBERS

Sajan Bhakta,
Matthew Mokler
Corey Stedwell
Jonathan Dufek

PROJECT SUMMARY

QuakeWrap is a company focused on providing customized solutions for repair, retrofit and strengthening of structures using Carbon Fiber Reinforced Polymer (FRP). One FRP application is the strengthening of large diameter Pre-stressed Concrete Cylinder Pipes (PCCP) with carbon fabric. PCCPs ranging from 3-12 feet are frequently used in water and sewer networks throughout the world. Hand laying carbon fabric inside PCCPs becomes a labor and time intensive process when common pipe lengths are considered. Large projects, where thousands of feet of pipe need to be quickly reinforced, become impossible with the current system. A new kind of carbon laminate was developed and recently patented to overcome this obstacle. This new system is a carbon fiber which is pre-infused with epoxy and pre-hardened, then spooled. Due to being pre-hardened, the laminate attempts to unspool. The self-straightening and pre-hardened properties of the material will be taken advantage of to increase installation speeds. This is accomplished by using the self-straitening nature of the laminate to self form to the contour of the pipe.

Our group has been contracted for the design and implementation of a robotic system to install the new carbon laminate. This robot will increase the company's efficiency and market share within the industry by allowing for faster and cheaper installation of carbon laminate within PCCPs. Reductions in installation cost will be achieved by the small number of workers needed to operate the new system. In some cases as little as one worker is needed on site. This robot provides a substantial decrease in the per foot installation time.

We have designed and constructed the mechanical prototype that applies carbon laminate in a spiral manner while controlling overlap. The overlap is necessary to create a shingle effect so liquid does not penetrate the barrier between the pipe and laminate. The carbon laminate will provide hoop stress reinforcement within a pipe, which will protect against further deterioration of the pipe walls and potential rupture.

SPARTAN UNMANNED AERIAL VEHICLE

Aerospace Engineering

CLASS

AME 422

EVENT TABLE

42

SPONSOR

Specworks

SPONSORING ADVISOR

Roberto Furfaro

PROJECT MENTOR

Michael Popescu

TEAM MEMBERS

(*)Rossana Bolin
(*)Joshua Nelson
Kazbek Kazhyken
Cale Dodge
Gerardo Cornejo

(*)=not pictured

PROJECT SUMMARY

SPARTAN Phase 1 of the SPEC Works autonomous aerial vehicle (UAV) Spartan Ranger serves as a preliminary build with a commercial off the shelf (COTS) autopilot system. The project also dedicates students to the engineering process.

Key performance parameters will be in the fields of aircraft performance, autopilot performance, and reconnaissance performance. Functionally, the system shall take off, fly a designated path, execute reconnaissance operations, return to a designated point, and land. Future builds will focus on The University of Arizona developed autopilot system software.

SCALED MODEL WIND TURBINE WITH ACTIVE FLOW CONTROL TECHNOLOGY

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

43

SPONSOR

The University of Arizona, Department of Aerospace and Mechanical Engineering

SPONSORING ADVISOR

Dr. Hermann Fasel, Professor
Dr. Andreas Gross, Assistant Research Professor

PROJECT MENTOR

Bill Richards

TEAM MEMBERS

Cory Pearman, Mech. Eng. (Team Lead)
Faisal Al-Mahmoud, Mech. Eng.
Khalid Mustafawi, Mech. Eng.
Nathan Welborne, Mech. Eng.

PROJECT SUMMARY

Nearly all modern wind turbines are designed to operate in a certain range of wind speeds. When the wind speed falls outside this nominal range, the turbine's efficiency decreases, or at worst, it stops producing power altogether. The objective of this project is to increase the efficiency of a scaled model wind turbine through the use of Active Flow Control technology.

The team began by scaling down an NREL (National Renewable Energy Laboratory) research wind turbine to a 2 meter blade diameter, while maintaining the turbine's important aerodynamic properties. Incorporation of Active Flow Control is accomplished by using a loudspeaker to pulse sound waves through openings in the blade surface. This allows airflow to stay attached to the blade longer, under varying wind conditions. As a result, the nominal wind speed operating range of the turbine is increased, and this could also allow the turbine to start rotating (and generating electricity) at lower wind speeds.

The team utilized commercial off-the-shelf products wherever possible, including the generator, planetary gearbox, driveshaft bearings, and sound amplifier. The turbine blades were rapid prototyped at Ventana Medical Systems due to their complex shape and structure. Finally, everyone on the team would like to thank our sponsors and project mentor for the invaluable advice and guidance they have provided along the way.

SOLAR DECATHLON – ADAPTIVE BUILDING ENVELOPES

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

44

SPONSOR

UA Department of Architecture

SPONSORING ADVISOR

Christopher Domin

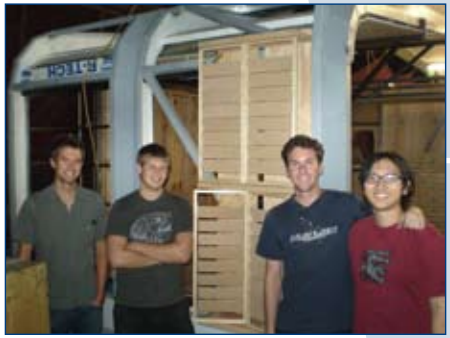
PROJECT MENTOR

Chuck Lemme

TEAM MEMBERS

Andy Cheung
Brett Klein
Sean McCormack
Tyler Roberts

PROJECT SUMMARY



The University of Arizona is submitting a house emphasizing sustainable solar design for the 2009 Department of Energy Solar Decathlon competition in Washington D.C. The competition is held biennially and is judged on 10 categories, including engineering.

Team 3677 of ENGR 498 is responsible for the development of the adaptive building envelope for the southern wall of the house. For the purpose of this design, the envelope's main purpose is to modulate the level of light and heat that are allowed in the building.

The design presented accomplishes this by using a louver system which rotates on two axes and is powered by solar cells mounted to the louvers. One axis of rotation consists of one foot sections are allowed to rotate a total of 90° in either direction to track the sun, enhancing light blockage and efficiency of the solar cells. The second axis of rotation controls the pitch of louvers individually mounted in each one foot section. The system is connected to a building control system that is programmed to actuate the louver system to modulate light effectively.

SOLDIER POSITION REPORTING SYSTEM (SPURS)

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

45

SPONSOR

Raytheon Missile Systems

SPONSORING ADVISOR

Steve Larimore

PROJECT MENTOR

Clayton Grantham

TEAM MEMBERS

Thomas Craney
Ivan Barnes
Garrett Ellis
Alex Moore
Bernabe Ortiz
Barry Shearer

PROJECT SUMMARY

Raytheon Missile Systems requires a device that can accurately track soldiers in combat situations in real time. The scope of this project is to develop a working proof of concept that meets these requirements.

The proof of concept of the SPURS device consists of a fully functional bread board layout of all electrical components. The device receives a signal telling it when to power on, receives its location through GPS satellites, and transmits data back to a command station via RF. The command station consists of a laptop computer that is programmed and formatted for receiving information from the device and plots the device's location on a map displaying its exact location. A non-functional prototype has been developed and a cost analysis was performed to evaluate the potential cost of mass producing SPURS devices. The non-functional prototype is the actual size and contains simulated components grown in a 3-D printer of a SPURS device if it were to be put into production. Furthermore, trade studies and research was carried out to determine the optimum material to house the SPURS device in order to withstand the rugged and hazardous battlefield environment. The fully functional, robust, and cost-effective SPURS device is a very useful military tool. It offers many tactical advantages as well as life saving applications. With our country currently being at war in the middle east and the constant threat of terrorism, this device will be very desirable, marketable, and effective.

STABILIZED HELICOPTER LANDING PLATFORM

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

46

SPONSOR

Boeing Rotorcraft–Mesa, Arizona

SPONSORING ADVISOR

Bill Charlton
Chief Liaison Engineer
Rotorcraft Division
Integrated Defense System

PROJECT MENTOR

Chuck Hassan

TEAM MEMBERS

Sullivan Edwards
Kevin Bredehoft
Clinton Hillman
Bryan Cook
Chris Wezdenko

PROJECT SUMMARY

Boeing Rotorcraft has displayed an interest in improving the capabilities of their AH-64d Apache Longbow attack helicopter. Based out of Mesa, Arizona, Boeing Rotorcraft employs 1100 engineers and is responsible for developing the AH-64 Apache. Specifically, Boeing would like a system that deploys a helicopter landing platform that self-stabilizes in reference to the horizon on a U. S. Navy Guided Missile Frigate.

The platform should perform three main tasks: extend vertically away from the ship's hull, stabilize with the horizon (independent of ship's motion), and return to the deck of the ship. Stabilizing the platform should neutralize the pitch and roll of the ship in rough seas. Furthermore, it should accommodate the size of the helicopter, survive the lifetime of the ship, and optimize power, weight, and cost considerations. Finally, the ship is assumed to provide any power requirements the design has. The team collaborated with various The University of Arizona professors, Lieutenant David Hollon (USN), and Bill Charlton to develop technical requirements for the platform. What the team is presenting at Design Day is a scale prototype of the design, in order to deliver Proof of Concept to Boeing.

STAND ALONE
Interdisciplinary Engineering Design Program

CLASS
ENGR 498

EVENT TABLE
47

SPONSOR
BE Aerospace

SPONSORING ADVISOR
Bruce Patterson
Karl Fiebelkorn

PROJECT MENTOR
Bill Richards

TEAM MEMBERS
Angelica Jacobs
John Colville
Obaid Mazrouei
Ramon Monton
Kurt Slocum
Ben Terris

PROJECT SUMMARY

Our team was contracted to redesign the entertainment system used in BE Aerospace's airline suites. BE Aerospace's Tucson locations deal primarily with first class airline cabins that offer luxury and comfort on many of the leading airlines across the globe.

The goal for our group was to redesign the entertainment system so that it reduced the system's weight of nearly two tons by fifty percent while simultaneously reducing the system's complexity thus reducing installation cost and time. Also in order to reduce the system's complexity, off-the-shelf parts were primarily utilized.

Transportation of the media will now be done on portable storage devices allowing for more flexibility in the quantity of media being provided, and thus removing the need for the bulky, expensive, and heavy single server. This required more detailed and robust security implementation for the media, and the individual CPU. This also required a new user interface that our team has provided.

STOCHASTIC RESONANCE
Interdisciplinary Engineering Design Program

CLASS
ENGR 498

EVENT TABLE
48

SPONSOR
Lockheed Martin

SPONSORING ADVISOR
Richard Tansey

PROJECT ADVISOR
Franko Kueppers

PROJECT MENTOR
Anthony King

TEAM MEMBERS
Katia Shtyrkova
Matthias Whitney
Leslie Wu
John Armstrong

PROJECT SUMMARY

Stochastic resonance is a phenomenon where a weak signal is amplified and optimized by the assistance of noise. In order to demonstrate the effect, three basic components are required:

1. Energy barrier (threshold)
2. Weak signal
3. Noise

With those three components present, the system responds in a resonant-like behavior, where at certain noise parameters resonance is maximum, thereby allowing signal recovery.

Stochastic resonance will be investigated and applied to the recovery of an optical signal. Optical signal with various parameters will be generated, and acquired with a detector. The outcome will be coupled with the controlled noise, and noise parameters will be varied until stochastic resonance is achieved. The following design components were established: optical signal below detector threshold value, noise generator, and threshold detector with signal recovery unit. The signal generator consists of a laser diode modulated by a laser current driver, which is in turn modulated by a function generator. The optical signal is converted into an electrical signal with a variable gain silicon detector. A noise generator is provided by LabView virtual instrument, which allows tochange type and bandwidth of the noise. The noise is coupled with the signal and sent through threshold detector, which is followed by a signal recovery circuit.

Because mathematical theory behind stochastic resonance is highly complicated, optimal noise parameters have to be determined experimentally.

SYSTEM FOR THE ENVIRONMENTAL ANALYSIS OF LUNAR SEALS (SEALS)

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

49

SPONSOR

Paragon Space Development

SPONSORING ADVISOR

Grant Anderson

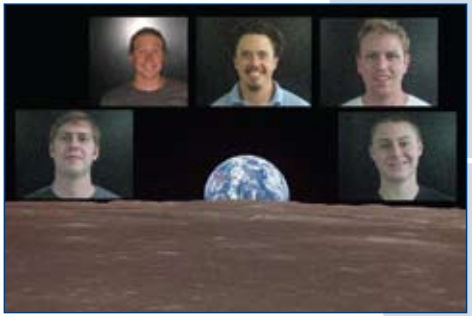
PROJECT MENTOR

Bill Richards

TEAM MEMBERS

Walter Seaman
George Tim
Matthew Leavy
Mr. Albino Wilson
Justine Schluntz

PROJECT SUMMARY



The team's mission is to design and deliver a low cost working prototype of an apparatus that will test rotary shaft seals and will provide repeatable, reliable results in an accurately simulated lunar atmosphere.

The product will replicate the lunar environment and provide clear evidence of the effectiveness of each rotary shaft seal. The tests will present qualitative evidence of a seals' performance against specified terms of use and a predetermined number of cycles. In turn, this product will help Paragon in determining if the material used for the seals is suitable for the desired application.

This apparatus will have a price that is a fraction of what comparable products cost. Up to five seals will be tested simultaneously and the system will allow for linear and angular offset of the shafts, a function not available in competitive machines. This application will accommodate vacuum testing in order to more accurately simulate lunar conditions and provide data more relevant to actual mission scenarios.

UA SOLAR CAR PHOTOVOLTAIC ARRAY DESIGN

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

50

SPONSOR

UA Solar Car Club
AzRISE

PROJECT MENTOR

Fred Highton

TEAM MEMBERS

Kodjo Salokoffi
Tyler Steele
Mitch Wilson
Eric Lopez
Phillip Toussaint

PROJECT SUMMARY

Project summary starts here We have redesigned the solar array for the Solar Car Club's next vehicle, aiming to incorporate known technologies and new frontiers to maximize efficiency. The goal was to design a tracking system to orient the cells towards the sun regardless of the car's orientation.

This team worked in conjunction with two other design teams to integrate the system with the car/chassis and hybrid power system. The project included a mechanical design for moving the panels, as well as an electrical and software design to support the motion. The vehicle will take part in International competition, showcasing The University of Arizona's Engineering program to others. This will benefit all parties through hands-on experience and a display of UA pride.

UA SOLAR CAR POWER SYSTEM
Interdisciplinary Engineering Design Program

CLASS
ENGR 498

EVENT TABLE
51

SPONSOR
UA Solar Car Club
AzRISE

SPONSORING ADVISORS
Oliver Stickroth
Collin Mechler
Wei Ren Ng

PROJECT MENTORS
Kevin Prodromides
Rick Workman

TEAM MEMBERS
Lou Casey Blanco
Jeffrey Egan
Arun Ganesan
Sean Whitsitt

PROJECT SUMMARY

Our design team was commissioned by the University of Arizona's Solar Car Club to design and fabricate a power system for their new Urban-Solar concept vehicle. The vehicle was raced in the Shell Eco-Marathon, and may be entered into the North American Solar Challenge as well.

The power system is designed foremost for energy efficiency. It dynamically utilizes multiple energy sources and storage devices to deliver energy to the motor efficiently under varying conditions.

Our team has worked collaboratively with both the UA Solar Car Chassis and Solar Array design teams in an effort to design, build, and test the vehicle with total vehicle architecture in mind.

UA SOLAR CAR VEHICLE DESIGN

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

52

SPONSOR

Arizona Solar Racing Club
AzRISE

SPONSORING ADVISOR

Oliver Stickroth
Colin Mechler

PROJECT MENTOR

Fred Highton

TEAM MEMBERS

Alberto Arvayo
Dan Gurney
Carolyn Hutchins
Trevor Lee

PROJECT SUMMARY

UA Solar Car Club would like to compete in the Shell Urban Concept EcoMarathon Racing Series with a new solar/hybrid car, as their current car does not fit the constraints of the competition. A redesign of the car frame, suspension, steering, tires, brakes, aerodynamics, ergonomics, and safety will be required.

They will all need to be optimized for weight, durability, performance, and must all fit within the Shell EcoMarathon Rules. If this project is not completed in the time allotted the car may not be ready to race in the Shell EcoMarathon.

UA BAJA FRONT SUSPENSION

Interdisciplinary Engineering Design Program

CLASS

AME 412

EVENT TABLE

53

SPONSOR

UA Baja Racing

SPONSORING ADVISOR

Braaden Schmidt

PROJECT MENTOR

Mr. Chuck Lemme

TEAM MEMBERS

Eric Noda
Andrew White
Braaden Schmidt
Chris Rogers
Mohammed Al-Binali

PROJECT SUMMARY

UA Baja Racing is a student run chapter of SAE (Society of Automotive Engineers) International at The University of Arizona.

The premise of the organization is to compete in an annual collegiate design challenge in which teams design and fabricate a single seat off road utility vehicle. Once completed, the vehicle is tested in an arduous national competition performing in a variety of static and dynamic events.

Essential to the challenge is to design the entire vehicle with mass-scale production in mind. The market for the vehicle is the off-road recreation enthusiast and thus the vehicle must be designed in a matter that would allow a firm to maximize sales. To obtain a high sales volume and reach expected system performance goals it will be important to adhere to customer requirements and the integration of unique features.

The scope and role of the UA Baja Front Suspension team is to design and integrate a capable and thoroughly analyzed front suspension system into the 2009 UA Baja Racing vehicle. Through careful analysis and informed decision processes, the UA Baja Front Suspension team will develop the most capable and cost effective system for its customer, the UA Baja Race Team.

UA BAJA REAR SUSPENSION
Mechanical Engineering

CLASS
AME 412

EVENT TABLE
54

SPONSOR
UA Baja Racing

SPONSORING ADVISOR
Jyoti Mukherjee

PROJECT MENTOR
Anthony King

TEAM MEMBERS
Rocio Araiza
Allen Godard
Jorge Tellez
Adam Wagner

PROJECT SUMMARY

UA Baja racing has tasked our team with the design, fabrication and testing of a rear suspension system for their vehicle for use in the 2009 Baja SAE Competition. The project is highly mechanical in nature, and our team is comprised entirely of mechanical engineering students.

The SAE Baja competition challenges hundreds of teams from colleges all over the world to design, fabricate, test and compete a single-seat off-road vehicle under the premise of presenting the design to a fictitious investor for mass production. The competition involves several static and dynamic events – static events including design reports and presentations; dynamic events including mud bog, acceleration, traction, and an endurance race. The goal is a lightweight, agile, and durable vehicle.

Our final design is a three-link independent suspension system. The design process included consideration for material selection, mass distribution, and structural dynamics, as well as simple, OTS component selection This design improves on the previous year's design by cutting the overall weight in half, and we believe it will provide a significant edge at competition this year.

UVC PURIFIERS
Interdisciplinary Engineering Design Program

CLASS
ENGR 498

EVENT TABLE
55

SPONSOR
Meridian Design Inc.

SPONSORING ADVISOR
Dan Matthews

PROJECT MENTOR
Chuck Lemme

TEAM MEMBERS
(clockwise from left)
Melissa Zaverton | Optical
Andrew Leonard | Mechanical
Mark Leick | Bio-Systems
Mensah Folly | Electrical
Iva Segalman | Mechanical
(Team Lead)

PROJECT SUMMARY

Meridian Design Inc.'s UVC Purifier project is the design of a cold pasteurization device for use by dairy farmers in rural areas of developing countries. This project recently won a Bill and Melinda Gates Foundation Grant and is scheduled for beta testing in Africa this summer.

This ultraviolet light, UVC, purifier is durable, moveable, and intuitive to use. It is made from vacuum formed, FDA approved HDPE plastic. The base houses the UVC bulbs, circuitry and fluid flow chamber in addition to stabilizing the reservoir and the reflector. Like the electricity available in the focus regions, power is supplied by a 12V motorcycle battery. Dimensions are 10" x 12" x 9" to facilitate transport in a suitcase to Africa for its beta test.

The challenge of this project was to make a device that could cold pasteurize cow's milk at low cost, have a minimum of parts, and was easy to operate. From the reservoir, milk is delivered into the fluid flow chamber at a rate of 0.5L/min, where it is exposed to UVC light. With passive mixing, the milk is fully exposed to the UVC light, neutralizing the pathogens present, before it exits into a storage container. Once purification is complete, the spout is sealed, and the device is cleaned by a simple chlorination rinse.

UNMANNED HOVERING SCOUT
Aerospace Engineering

CLASS
AME 422

EVENT TABLE
56

SPONSOR
Aerial Robotics Club

SPONSORING ADVISOR
Cory Pearman

PROJECT MENTOR
Dr. Fasel

TEAM MEMBERS
James Donovan
Chad Franke
Cal Gosla
Seth Janiga
Nick Lee
Whitney Shiba

PROJECT SUMMARY
The University of Arizona Aerial robotics club intends to compete in the 5th International Aerial Robotics competition to be held in July 2009. This Competition imposes a scenario in which a nuclear reactor melts down, and video of a control panel inside must be obtained without human intervention.

This group of aerospace seniors has been tasked with designing and constructing the unmanned autonomous vehicle that will enter the building and go on to complete the specified mission. The craft must be fully electric and can never touch the ground. A size restraint of .75 m tall and .5 m wide will be imposed and it shall not exceed 1.5 Kg. When joined with the efforts of the ARC's programming and autopilot team, the craft must be capable of flying through the window, and finding the control room while avoiding objects such as columns, walls, and furniture. Video of the control panel must be transmitted within ten minutes of crossing the vertical plane of the window.

WIRELESS SENSOR NETWORK PROJECT

Interdisciplinary Engineering Design Program

CLASS

ENGR 498

EVENT TABLE

57

SPONSOR

International Telemetering Conference

SPONSORING ADVISOR

Dr. Hao Xin
Dr. Michael Marcellin
Electrical and Computer Engineering Department
The University of Arizona

PROJECT MENTOR

Kevin Prodromides

TEAM MEMBERS

Michael Crawford Moore
Kevin Michael Wood
Michael Zack Stephens
Thurston Thi Ha Hane

PROJECT SUMMARY

In today's battlefield triage situations, doctors and corpsmen cannot count on accuracy and speed of delivery and security for patient data and treatments. They do, after all, rely on a primitive form of record keeping that we are all familiar with: the good old-fashioned clipboard. While a much-relied on system, the clipboard has inherent flaws including but not limited to lack of speedy access, secure data storage and transmission, and a high probability of misinterpretation of information. Team 3670 set out to solve this task using a wireless sensor network system to create a much more effective and secure method of handling patient data and create a way to enhance the care of our service members.

This project set out to completely replace the current battlefield triage system and provide a mobile system that manages, stores, and provides quick and secure access to patient data for use in a battlefield triage system. This project will seek to provide instant verification of patient and practitioner proximity and provide patient data access to authorized personnel within range of the patient. The new system design will be defined and diagrammed later in this document.

This product will be marketable to services in need of a "field-deployable" system to handle treatment of patients. Initially we will focus on a battlefield triage scenario, however, this will be expandable to doctors working in remote regions, areas where proximity detection may be needed, and any further applications that could use a "presence-awareness" system. The end result of this project will be not only to provide a working demonstration of these abilities, but also provide an academic paper for presentation at the International Telemetering Conference in Las Vegas in the fall of 2009.

CHILLED WATER SYSTEM
Chemical and Environmental Engineering

CLASS
ChEE 422

EVENT TABLE
A

SPONSOR
UA Facilities Management

SPONSORING ADVISOR
Dr. Kim Ogden

PROJECT MENTOR
Mark Marikos

TEAM MEMBERS
Tristan Day
Jake Davis
Wade James
Justin Slagle

PROJECT SUMMARY
Our project is to increase the efficiency of the UA's chilled water system. We will do this by increasing the cycles of concentration in the system's cooling towers, i.e., we will provide the towers with cleaner water so that they may use the water longer before they have to throw it away. Furthermore, instead of dumping the wastewater down the drain, we will recycle it by piping it into the UA's irrigation system.

We are investigating the use of ultrafiltration, microfiltration, and fast-sand filters as pretreatment processes and nanofiltration as our main treatment process. We must consider the effects of seuqestrants, corrosion inhibitors, and biocides on the membranes used in these systems.

DUAL PHASE EXTRACTION
Chemical and Environmental Engineering

CLASS
ChEE 422

EVENT TABLE
B

SPONSOR
Zelen Environmental

SPONSORING ADVISOR
Mike Kazz

PROJECT MENTOR
Mike Kazz

TEAM MEMBERS
Kyle Heckel
Mandy Kiesl
Chris Lewis
Adam Manasse

PROJECT SUMMARY

The water table beneath Bennett Bulk Plant, in Prescott, Arizona has been contaminated by spillage of fuel product (gasoline, diesel, kerosene, and other hydrocarbons). Dual phase extraction will be used to remove contaminated soil vapors and groundwater. Free product will be separated from the groundwater by use of a gravity decanter. The contaminated water will then be remediated by an air stripper and the dirty gas will be combined with the stream of soil vapors. This stream will then be cleaned by a granulated activated carbon (GAC) unit. In order to avoid costly disposal of the spilled fuel products, a catalytic hydrocarbon cracking process will be utilized to produce methane gas which can then be sold for additional profits.

HYDROFLUOROETHER (HFE) PLANT
Chemical and Environmental Engineering

CLASS
ChEE 422

EVENT TABLE
C

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PROJECT SUMMARY
A plant was designed for the synthesis of a hydrofluoroether (HFE), part an emerging class of non-ozone depleting, low Global Warming Potential (GWP) compounds with promising potential as refrigerants for automobiles, refrigerators, industrial cooling applications, etc. Currently, hydrofluorocarbons (HFCs) are the most widely-used refrigerants on the market.

While HFCs do not harm the ozone, they have large GWPs and contribute significantly to global warming. The plant design presented here analyzed the feasibility of producing a HFE to replace existing HFCs at a competitive cost to customers while also using more environmentally-benign processing techniques and lowering process waste.

HYDROXYETHYLHYDRAZINE (HEH) PLANT

Chemical and Environmental Engineering

CLASS

ChEE 422

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D

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Ivann Hsu
Andrew Wong
Phillip Zinsli

PROJECT SUMMARY

The goal of this project is to design a manufacturing plant with the capacity to produce 200 metric tons per year (MTPY) of military grade 2-hydroxyethylhydrazine (HEH). Additionally, 960 MTPY of hydrazine hydrate is produced for non military applications. The proposed process purifies the HEH to meet mil spec requirements through a series of distillation and chromatography columns.

Approximately 3200 MTPY of mill spec hydrazine is provided to the United States government for a wide range of military and aerospace applications. This toxic anhydrous hydrazine is currently used widely by the government in everything from satellites to the space shuttle and military ordinance. HEH is proposed as an ingredient in a more benign alternative propellant to replace mil spec hydrazine.

Hydrazine hydrate is widely used in industry as a blowing agent, in air bags, as a polymerization initiator, in pesticides, water treatment and even as a precursor to many pharmaceuticals. This large and varied market is expected to increase as developing countries' economies grow.

REGASIFICATION PLANT
Chemical and Environmental Engineering

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PROJECT SUMMARY

Natural gas is an inexpensive commodity where produced; however, it is very difficult to transport to markets in vapor form. Liquefaction has immerged as a necessary step in the transportation of the fuel to market.

The resulting fluid requires storage and transportation at -260°F to allow for holding in near atmospheric pressures vessels. The liquid spontaneously cools by constant boil off, but the transport and storage vessels still require cryogenic insulation and often auxiliary cooling components. The re-gasification process necessary to convert the LNG back to vapor for distribution in pipelines holds a set of unique challenges.

In the past seawater has been the most common source of heat used to re-gasifying LNG. The use of sea water has proved hazardous to wildlife and expensive as it requires brine compatible pumps and heat exchangers. Air may also be used to supply the energy for re-gasifying LNG, more specifically the water vapor present in the air may be condensed and thus provide sufficient energy for re-gasification. As ambient air temperatures and humidity vary seasonally, an auxiliary heater is utilized to make provide additional energy. Our design project entailed the design and layout of a standard receiving and re-gasification plant.

REVERSE OSMOSIS (RO)
Chemical and Environmental Engineering

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PROJECT SUMMARY

In the dry climate of Arizona, the scarcity of water resources leads to careful regulation of water quality and quantity. Tucson Water can withdraw only a limited volume of groundwater each year without causing significant water-level declines, as regulated by the Arizona Water Settlements Act (AWSA).

In order to alleviate groundwater demands, Colorado River water is delivered to Tucson as part of the Central Arizona Project and is blended with native ground water. Since an acceptable blend is considered to have a TDS concentration of 450 mg/L, a portion of the Colorado River water must be treated to reduce the average concentration from its current 650 mg/L.

This project focuses on reverse osmosis (RO) treatment of the river water in order to provide Tucson with sufficient amounts of quality water and ultimately designs an optimal and environmentally friendly method of disposing the highly concentrated brine byproduct of RO. An evaporation pond system is designed due to the inland location of Avra Valley and favorable climatic conditions for steady and rapid evaporation rates. Parameters considered for the process include land area, pond depth, pond system configuration, energy required, brine residence time, and method of solids disposal. We propose an evaporation pond system for RO brine disposal to reduce the environmental impact of the RO process by preventing the brine from being injected back into the aquifer and further contaminating valuable groundwater.

SYNGAS PRODUCTION
Chemical and Environmental Engineering

CLASS
ChEE 422

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G

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PROJECT SUMMARY

Production of syngas from energy-rich biomass material. The idea of alternative fuels has become more appealing in recent decades. With a limited supply of natural resources, scientists and engineers alike have turned to a new technology involving the use of biomass to produce products such as liquid fuels (ethanol) and gaseous fuels (syngas). The problem with the use of biomass today is the unanimous one-track mind of agricultural-based material. When using the crops necessary for survival (corn, sugarcane, etc.) we are only driving up the prices of these materials and limiting the source for human consumption. In order to make production both logical and profitable, different material must be researched and ultimately used as biomass.

Guayule is a native plant of the USA, Mexico and Australia. It is primarily used to product latex products with almost 90% of the plant being energy-rich waste, bagasse. Bagasse is made up of 50% cellulose, 25% hemicelluloses, and 25% lignin. This plant waste will drive our process through various processes to produce syngas. The bagasse is initially introduced to pyrolysis, and gasification, followed by a network of heat exchangers and quench tower/cyclone. The reactors will be powered by a burner to produce the necessary energy to run the process.

The production of syngas will ultimately yield four main gases including hydrogen, carbon monoxide, carbon dioxide, and methane and bottoms of water, char and tar. These products will be sold, recycled, or cleaned up to meet standard laws and regulations. The goal is to produce an alternative fuel that focuses on sustainability from the utilization of bagasse material as biomass.

WASTE WATER TREATMENT FACILITY
Chemical and Environmental Engineering

CLASS
ChEE 422

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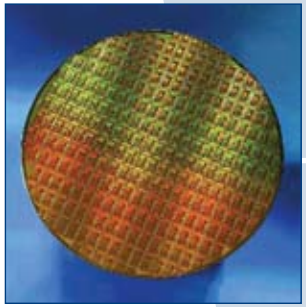
PROJECT SUMMARY



The purpose of this project is to design a waste water treatment facility for the purpose of treating the effluent streams of a 500 mm semiconductor wafer production facility. Due to the large number of chemical components in actual semiconductor waste, our project focuses on the major issue components. These components are those which are regulated by the Environmental Protection Agency at the federal, state, and regional level. Our goal is to treat this waste as efficiently and economically as possible, and to meet these regulations. If waste regulations do not exist, our goal will be to meet the maximum contaminant level (MCL) for drinking water regulations.

Our secondary goal is to have all our waste products in a harmless environmentally benign form and to be able to sell our final waste product.

YELLOW GREASE BIODIESEL
Chemical and Environmental Engineering

CLASS
ChEE 422

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PROJECT SUMMARY

The problem assessed with this project involves reducing the energy and cost of producing biodiesel from yellow grease. Yellow grease must be heated to 60 °C before it is fed into a reactor. In the past, individuals have relied solely on the use of fossil fuels to provide the energy required to heat the yellow grease. Due to the abundance of sunny days in Tucson and the land available for the proposed biodiesel plant, it is practical to use passive solar heating to preheat the yellow grease. The goal of this project is to simulate, design, and test passive solar heating techniques in order to reduce energy consumption and thus make biodiesel production more sustainable.

One approach to this problem includes using a greenhouse to enclose 300-500 gallon tanks. Using previously developed simulators and heat transport phenomena, a theoretical temperature profile of the yellow grease in each tank can be determined. Temperature variations throughout the day in each of the tanks can also be predicted. The preheated yellow grease from the greenhouse can then be pumped into a smaller tank that will be housed in a breadbox shaped passive solar heater. This heater is expected to heat the yellow grease to a higher temperature than what the greenhouse is capable of. Physical testing can be done using thermocouples and a data acquisition system to compare theoretical calculations to actual data gathered at the pilot plant.

Yellow grease that is heated in the greenhouses but not consumed in the reactor will be stored in large insulated tanks. Collecting all of the warm yellow grease into a large storage tank will create a large thermal mass. Having a large insulated thermal mass should result in minimal heat losses over the course of the night relative to the heat losses that would occur in multiple smaller tanks in the greenhouse. Investing in this storage method should result in having yellow grease that is still relatively warm at the start of the next day. It is hoped that a series of theoretical calculations and actual data acquisition will lead to a method of heating yellow grease and producing biodiesel that is both cost effective and sustainable.

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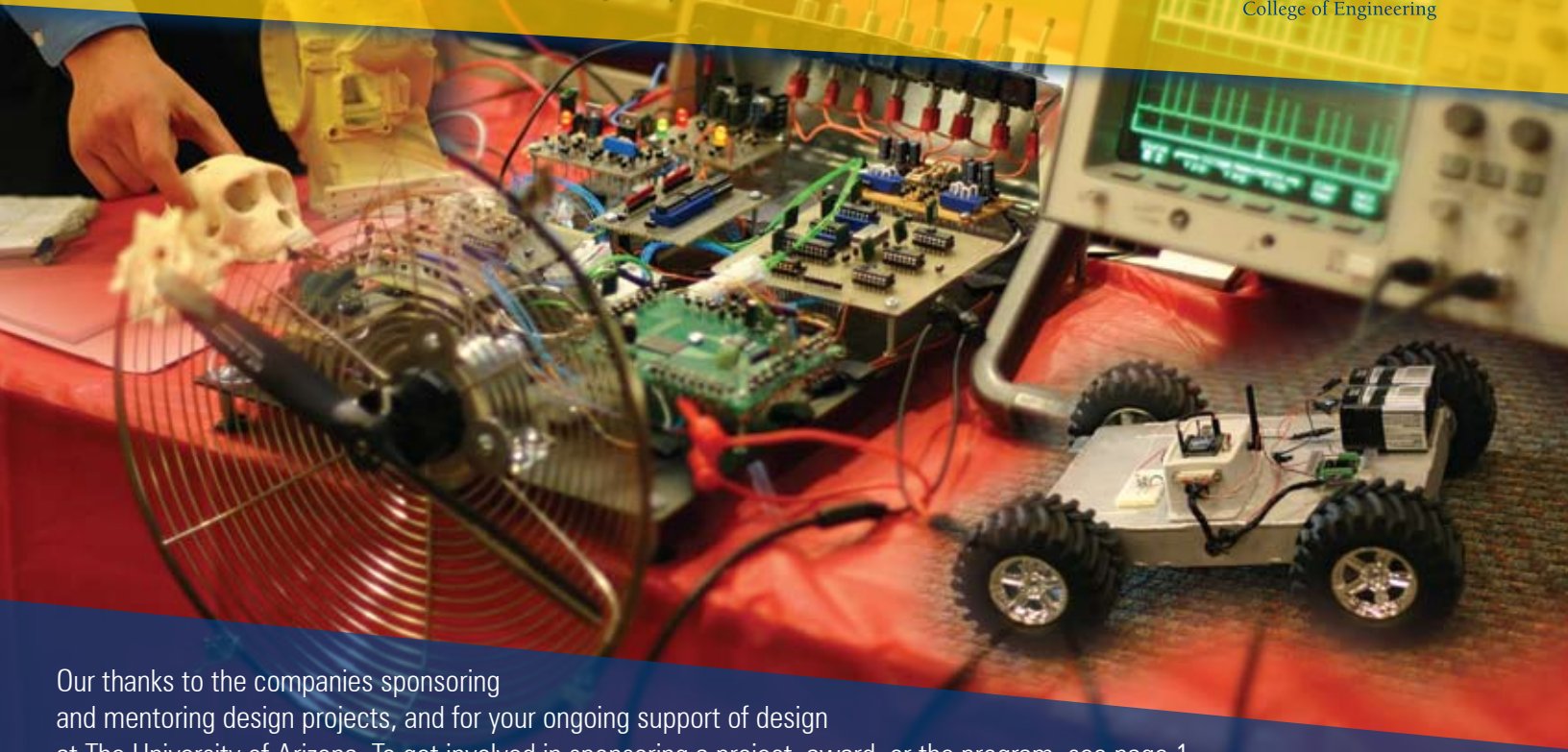

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