Industry Partnered Projects

1. Advanced Composite Materials Assembly Equipment (Kedward)

This project is in cooperation and partnership under a gift with ATK Space Systems located in Goleta.

ATK Space Systems in Goleta is a leading producer of deployable space systems. Products include deployable Booms, Solar Arrays, and Stable Structures and Antennas. With over 69 successful Flight Missions, detailed assembly processes and rigorous testing in simulated space environments are key elements in maintaining our 100% mission success. Recent programs include the NASA Mars Phoenix Lander Solar Arrays and Boom Camera Structure as well as GPS Solar Arrays.

You will be designing, analyzing and building a prototype of a semi-automated machine/method for preparing graphite or fiberglass composite rods and strips. The material that this machine would prepare will be used on various Space Flight and Internal Research and Development Programs such as the Solar Arrays for the new Orion Crew Exploration Vehicle.

- The ideal machine would be configurable for different length rods or strips.
- It will need to accommodate various cross-sections such as round and square profiles.
- The machine should be able to abrade a set distance from the rod end or the entire length of the material.
- The machine must be able to abrade in the direction of the fibers.
- Level of abrasion should be adjustable but it is critical that once set the abrasion over entire part is consistent.
- Machine should be optimized for ergonomics, minimal floor space, mobility, cost, ease of use, and power consumption.

Desired results would provide proper levels of abrasion, higher quality, faster and reduced labor compared to traditional manual techniques, with less than one per ten-thousand instances of damage to the composite rod such as broken fibers, nicks, cracks, delaminating, or other defect.

Implementation of this machine is expected to be a significant advancement over current manufacturing processes. Consequently, this is a high visibility project for ATK Goleta Operations Management. Participants of this project will receive exposure to a variety of space flight manufacturing processes.

Students will be required to sign a Confidentiality Agreement and Invention Agreement.
Students are required to be a United States citizen for all facility site visits.

Website: www.atk.com <http://www.atk.com/>

2. Spacecraft mechanisms and deployables (Kedward)

This project is in cooperation and partnership under a gift with Northrop Grumman Aerospace Systems - Space Systems Division located in Redondo Beach, California.

Northrop Grumman Corporation is a $30 billion global defense and technology company whose 120,000 employees provide innovative systems, products, and solutions in information and services, electronics, aerospace and shipbuilding to government and commercial customers worldwide.

Northrop Grumman is a premier developer, integrator, producer and supporter of manned and unmanned aircraft, spacecraft, high-energy laser systems, microelectronics and other systems and subsystems critical to maintaining the nation’s security and leadership in science and technology. These systems are used, primarily by government customers, in many different mission areas including intelligence, surveillance and reconnaissance; communications; battle management; strike operations; electronic warfare; missile defense; earth observation; space science; and space exploration.

Northrop Grumman Space Technology develops a broad range of systems at the leading edge of space, defense and electronics technology. Building on a heritage of innovation, we create sophisticated products that contribute significantly to the nation's security and leadership in science and technology.

Project Description

Mechanisms and deployables are an important aspect of any spacecraft design due to the likely loss of the mission if a failure on deployment occurs. Students will design, build, and test a deployment mechanism that may be used on a variety of spacecraft payloads (antennae, sensors, or caging devices). The resulting design must concurrently meet stringent launch load requirements, controlled deployment parameters, and strict deployed characteristics to ensure mission success. Typical driving parameters include thermal environments, launch loads, deployment speed limits, size and mass, latching mechanism, deployed stiffness, and reliability. Verification of the design will also require students to develop a test fixture which simulates the zero-g environment of space.

The company requires US citizenship for all site visits and a Confidential Disclosure Agreement.

This project may require travel to company facility and may require periodic teleconferences.
3. Neurosurgical Shunt Physiological Test System (Laguette)

This project is in cooperation and partnership under a gift with Medtronic Neurosurgery located in Goleta.

Medtronic Neurosurgery (MNS) is a local medical device company that is a leader in the field of neurosurgical implants and devices. Medtronic is the global leader in medical technology, alleviating pain, restoring health and extending life for millions of people around the world.

Hydrocephalus is a physiologic condition where the cerebrospinal fluid (CSF) that is produced within the ventricles of the brain is not adequately absorbed by normal pathways. Typically, an implantable device known as a shunt is used to control the CSF. Current hydrocephalic shunts are designed to minimize overdrainage of CSF and maintain intraventricular pressure (IVP) within a normal physiologic range, regardless of patient position.

Project Description

MNS has a shunt valve test bench system that has not yet been completely developed. The system has the ability to replicate physiological conditions that implanted shunt systems may be exposed to, unlike the current ISO 7197 standard testing.

A physiological understanding of the cerebrospinal fluid system and hydrocephalus will be critical in the design of test system performance.

The project would be to complete development of the test system, develop lab view programs to test valves under different simulated physiological conditions, pulsatile flow, respiratory pulsation, valve orientation. Produce reports characterizing valve performance.

Students will be required to sign a Confidentiality Agreement and Invention Agreement.

4. TEP Surgical Kit (Laguette)

This project has been deleted from consideration.

5. (Deleted)

This project has been deleted from consideration.

6. Multi-Piece Wind Turbine Rotor Blade Joint (McMeeking)

This project is in cooperation and partnership under a gift with Clipper Windpower located in Carpinteria, Ca.

Clipper Windpower is a rapidly growing international company engaged in wind energy technology, turbine manufacturing, and wind project development. The innovative 2.5 MW Liberty wind turbine is the largest capacity wind turbine built in North America and produces enough electricity to power 900 average American homes each year.

Clipper is also in the process of developing the Britannia Turbine, which will have a capacity of 10.0 MW. Britannia is designed specifically for the offshore European market, and when completed will be the largest wind turbine in the world.

Project Description

The objective of this project is to design, analyze, and test a joint that connects multiple pieces of a segmented rotor blade. Shipping is a critical factor in wind turbine and wind farm development. Blade size is often constrained by transportation cost as current technology has reached the upper limit of what can be physically shipped to project sites. A modular blade that can be moved in pieces and later assembled on site will be beneficial, as it will allow for the use of larger turbines, which can produce more power.

Weight, reliability, and cost will be important considerations during the design process. Increases in rotor weight influence the applied loads for the entire turbine. A lightweight joint is necessary to mitigate loads on other turbine components. Unscheduled repair and maintenance is a large expense for wind projects and turbine manufacturers. The students design must be robust and reliable so as not to risk potentially expensive turbine maintenance and downtime. Fatigue analysis will be required to validate that the joint will endure the millions of load cycles it will experience over the 20-year design life of the blade.

Clipper will provide project parameters and operating envelopes.

Students will be required to sign a non-disclosure and an invention assignment agreement.
7. Retractable Mirror Cover for Telescope (Bothman)

This project is in cooperation and partnership under a gift with Las Cumbres Observatory Global Telescope Network (LCOGTN) located in Goleta.

LCOGTN is a nonprofit organization that is creating a network of telescopes to use for both science and education uses. The approximately 40 telescope network will act as a single instrument that will be capable of 24/7 observations in both the Northern and Southern hemispheres and will be able to get continuous coverage of celestial events that vary over minutes, hours, days, and even years. The network will consist of clusters of optical telescopes ranging from 0.4m to 2m that are designed and built by LCOGT in Santa Barbara, California.

For more information please visit our website: www.lcogt.net

Project Description

The objective of the project is to design a retractable and remotely operable mirror cover for an existing LCOGT telescope located in Santa Ynez, Ca. The purpose of the mirror cover is to prevent dust from settling on the mirror when telescope is not in use and also to provide some protection of the mirror when working around the telescope. Since all of LCO’s telescopes are operated remotely the mirror cover must be a reliable remotely controlled device. The mirror cover must have logic that can tell users if the cover is open or closed. The mirror is 0.8m in diameter and the device will mount on a flat surface approximately 0.25m above the mirror. The current optical baffle must be modified for the mirror cover to deploy over the mirror. Consideration for attaching a new baffle must be included in the cover design.

Students can expect a challenge in packaging a safe, reliable mechanism in a pre-existing design envelope. The integration of the electrical components and motivating the system remotely will involve basic knowledge of electronics and control systems.

The telescope is located on the UCSB owned, Sedgwick Nature Preserve in Santa Ynez. Trip(s) to the telescope can be scheduled for inspection of the telescope and mounting restrictions. Opportunities for observing with the telescope will be available. Detailed list of design requirements and 3d CAD models will be provided.
8. Powered Cambering Vehicle

This project is in cooperation and partnership under a gift with Trikke Tech located in Buellton, Ca.

Trikke Tech, Inc. develops, manufactures and distributes sports equipment and recreational vehicles based on its patented 3CV cambering suspension technology. Trikke Tech Inc’s line of products offers fun and fitness to board-sport athletes, families, and older or injured board sports and snow sports enthusiasts. Trikke Tech Inc’s products are for anyone who wants a sensation of speed and fluid motion in their sport.

The company has proposed 2 projects for student consideration. The student team may select the desired project from the following options.

Project Description – Option 1 Jet-Ski Trikke

Integrate a jet-ski motor into the Trikke Tech vehicle platform. Analyze and optimize buoyant effects, fluid flow, performance and safety. The jet-ski motor shall be mounted in the front center of the vehicle with the foot decks trailing behind.

The integration of the jet-ski motor to the vehicle frame will need to be designed and analyzed for structural integrity as well as for optimal fluid flow. Vehicle balance is also critical so weight distribution will need to be analyzed.

Consideration will need to be given to steering mechanisms which utilize a keel design or otherwise manipulate the direction of the thrust.

The trailing arms where the foot decks are located will need to articulate as the vehicle leans into turns in order to maintain the “feel” of the carving action expected from Trikke Tech, Inc products. The trailing arms will also need to be modified to accept floatation devices that help the vehicle remain buoyant.

The jet-ski Trikke should float with a passenger onboard weighing up to 250lbs. Trikke Tech, Inc. will work closely with the students through the processes of design, analysis, prototyping and testing. There will be a heavy emphasis in fluid dynamics analysis and hands-on prototyping and testing.

Project Description – Option 2 ATV Trikke

Integrate a 250cc gas powered motor into the Trikke Tech vehicle platform. The motor shall be located near the front wheel at the center of mass of the vehicle. Design mechanism to transfer power from the motor mounted near the front wheel to the rear wheels which includes a differential. Analyze and test the structural integrity of the power transfer design. Analyze performance characteristics including acceleration, torque, top speed and fuel efficiency.
Integrate front and rear suspension intended for off-road application. Analyze performance characteristics including optimal travel length, optimal spring force and structural integrity.

The ATV Trikke should be designed to handle a passenger weighing up to 350lbs. Consideration should be given to reinforcing the vehicle frame to handle the off-road application.

The ATV Trikke should still articulate to maintain the carving feeling expected from Trikke vehicles.

Trikke Tech, Inc. will work closely with the students through the processes of design, analysis, prototyping and testing. There will be a heavy emphasis in structural and dynamic analysis as well as hands-on prototyping and testing.

Students will be required to sign a Confidentiality Agreement and Invention Agreement. Website: www.trikke.com

9. Robotic Arm (Meinhart/Hare)

This project is in cooperation and partnership under a gift with SpectraFluidics, located in Goleta.

SpectraFluidics is a start-up company spun out of UCSB research in the mechanical engineering and chemistry departments. The mission of SpectraFluidics is to incorporate our laboratory-proven technology into a handheld detector for the real-time identification of airborne molecules emanated from explosives and other substances.

The SpectraFluidics chemical detection technology does not require any sample preparation, swabbing, and other handling techniques which can otherwise impede detection capabilities in the field. Our detector enables airborne-particle bomb detection with greater sensitivity and specificity than even our most skilled competitors: bomb sniffing dogs. The applications of the technology not only include bomb detection for land mine removal and airport security, but farther reaching applications such as airborne disease detection, non-invasive medical diagnosis, and countless others.

One of the most immediate applications of the explosives detection system is land mine detection. The damage land mines cause worldwide is staggering. It is estimated that there are between 15,000 and 20,000 new land mine casualties each year, 90% of which are civilian. To increase safety for the user during bomb detection SpectraFluidics would like a UCSB student team to develop a low-cost, light-weight, portable, robotic arm to allow increased stand-off between the detector and user.
UCSB student team members must sign non-disclosure and intellectual property agreements. Students will not come in contact with any explosive or hazardous materials in the course of this project. Non-US citizens may have reduced access to Spectrafluidics information and equipment.

For more information: [http://www.spectrafluidics.com](http://www.spectrafluidics.com)

**10. Mix-Meter Dispensing System** (Faculty TBD)

This project is in cooperation and partnership under a gift from Applied Silicone Corporation.

Applied Silicone Corporation, a leading producer of FDA registered implantable silicone for medical devices based in Santa Paula, supplies raw material and technical and regulatory support to manufacturers of long term implantable devices used in neurological, orthopedic, urological, cardiovascular, reconstructive and general surgery.

**Background**

There are many commercially available mix-meter dispensing devices for silicone materials. Most depend on flow rate and controlled time intervals to control volume. They are generally reliable and accurate to +/- 1%. These systems have the potential to go off ratio due to changes in pressure, viscosity or air entrapment. When an off ratio event occurs, there is no easy way to detect it. If random quality testing identifies a non-conforming product, the entire batch must be rejected at a cost that could easily exceed $50,000.

**Project Description**

The subject project requires an accuracy of +/- 0.5% and the ability to determine that each mix/meter event meets the process requirements. The proposed project intends to identify and isolate off ratio events in real time. Shot volume should be controlled by a hydraulic cylinder with a linear position transducer, although a ball-screw with stepper motor control is a possibility. Shot verification should be controlled by real time weighing devices utilizing sensitive calibrated load cells. One of the design challenges is the sensitive load cells, which will see force beyond their capacity during the injection cycle unless they are protected.

The proposed system will require the linear position and load cell systems to be controlled by an Allen Bradley PLC interface controlled by Lab View software, or equivalents. The successful software system will automate most operator functions and, ideally, automatically determine shot size by interpreting requirements from a batch record lot number and record verification of proper delivery.
Another aspect of this project is software validation, the parameters for which are described in CFR 21, Chapter 11. It must be proven that under all circumstances and challenges, the software commands will deliver the proper performance. When completed, the system must be tested with the actual silicone components.

This project combines the elements of several elements of good mechanical design, hardware specification, contamination control, electronic control interfacing, computer programming and quality control, plus the successful result will be commercially viable. The ideal equipment would take 2 components consisting of thick liquid in closed drums and meter each component into a preselected volume between 50 and 400 cc's. The preselected volumes would then be simultaneously mixed and dispensed at about 14 bar. 100% quality delivery and verification thereof is required.

The machine should provide for simple operator use, interface with batch control records and create an electronic quality data base per the requirements of CFR 21, Chapter 11.

Students will be required to sign a Non-Disclosure Agreement and any successful design resulting from this project will be licensed to Applied Silicone Corporation without fee.

Website: www.appliedsilicone.com

11. Thermally Controlled Scintillator Detector (Mathys)

This project is in cooperation and partnership under a gift with Lawrence Livermore National Laboratory located in Livermore, California.

Lawrence Livermore National Laboratory's primary mission is national security, but it also provides R&D expertise in energy, the environment, and biotechnology. At LLNL, teams of physicists, engineers, chemists, biologists and other researchers work together to achieve technical innovations and scientific breakthroughs and transform these advances into solutions to nationally important problems. In Engineering, we undertake projects with high technical risk, integrate and extend technologies concurrently, and use the extremes of both ultrascale and microscale to achieve results. We develop systems that push technologies to their extremes.

This project’s objective is to design and build a fully enclosed, thermally managed platform for a scintillator radiation detector.

Radiation detection is a growing field that has immediate applications in keeping our borders and ports safe and secure from transportation of dangerous nuclear devices. Scintillation-based radiation detectors utilize a light-emitting material called a scintillator, which is coupled to a photodetector. High energy radiation is converted into visible photons in the scintillator, the visible light is detected by the photodetector and the light
pulse is converted into an electrical signal. In this project, recently discovered high light-yield garnet-ceramic scintillators will be coupled to avalanche photodiode (APD) photodetectors and enclosed in a compact, thermally stable system. Avalanche photodiodes have potential to enable low-cost, high-performance scintillator detectors, however, their response is very sensitive to temperature, and must therefore be temperature-stabilized.

The enclosure should satisfy the following requirements:
- Achieve and maintain very low temperatures (-20°C) with great stability.
- Be compact and operable enough to be carried and used by one person.
- Have very low power consumption.
- Be shielded from electronic noise.
- Prevent all water condensation.

Students that have interest in semiconductor electronics, low power portable devices, cooling and thermal control systems, and electronics packaging would find this project to be a challenging, rewarding, and completely unique cutting edge research and design opportunity.

This project may require travel to company facility and may require periodic teleconferences.

Website: [https://www.llnl.gov/](https://www.llnl.gov/)

12. **Adjustable DTS Guide Surgical Instrument** (Laguette)

This project is in cooperation and partnership under a gift with NuVasive located in San Diego.

NuVasive is a bio-medical company and was founded in 1997 on a commitment to develop better surgical solutions for spine patients. Today, NuVasive continues to revolutionize minimally disruptive surgical solutions, allowing surgeons to treat spine conditions while minimizing the surgical trauma experienced. NuVasive procedures have consistently garnered exceptional results – shorter surgical times, less tissue damage, less blood loss, quicker release from the hospital, and a more rapid return to normal activities.

The majority of the spine market is concentrated on fixing the degeneration of discs. Other problems include but are not limited to: tumor, trauma, infection and instability. NuVasive’s business is centered around a unique and nominal spine surgical technique that revolutionized the way in which surgeons address and tackle these problems. As
opposed to a typical anterior (front) or posterior (back) surgical approach, NuVasive became the pioneers of a patented, lateral (side) surgical procedure. This procedure, known as XLIF (Extreme Lateral Interbody Fusion), permits safe and easy access to the lateral aspect of the spine while preventing excess blood loss and limiting the morbidity of the surgery (resulting in quicker patient recovery).

A common problem in surgery is coming in contact and harming nerves en route to the spine. Therefore, a key compliment to the XLIF procedure is a nerve detection system. This device works with the XLIF instrumentation, reading electrical signals from the nerves that send audible feedback to the surgeon. The audible feedback allows the surgeon to dictate his instrument location with respect to surrounding nerves. This way, the surgeon can find the safest route to the spine without damaging any nerves.

NuVasive is the fifth largest spine company with top competitors such as Medtronic, DePuy, and Stryker. Their portfolio includes products for the cervical, thoracic and lumbar spine as well as the previously mentioned nerve detection system. NuVasive has approximately 700 employees and is located in San Diego, CA with a distribution center in Memphis, TN.

Project Background:
A cervical plate is a spinal implant used during what is referred to as an ACDF (anterior cervical discectomy and fusion) procedure to provide neck stability, enhance fusion rates and minimize the need for a neck brace following surgery. More information regarding how the product is used is available online via Google “ACDF surgery” searches.

DESIGN BACKGROUND: The dual-barrel DTS (drill-tap-screw) guide is an instrument that nests into the teardrop-shaped slots at the ends of the cervical plates (with the barrels lining up collinear with the screw holes in the plate), and allows the surgeon to drill, tap, and place bone screws thru the guide barrels to affix the plate to the spine. The guide helps to provide a favorable trajectory of the bone screws relative to the plate and cervical spine bones.

Project Proposal:
Students must propose a design for an adjustable DTS Guide. The guide must be compatible with the cervical plate provided and is required to be adjustable in three ways:

1. Length:
   a. So that the surgeon may change the depth of the hole according to anatomical and physiological variations.

2. Angle of insertion:
   a. So that the surgeon may change the angle at which he/she inserts the bone screws into the vertebral body.

3. Maneuverability:
a. The surgeon may change the way he/she holds the DTS Guide by moving the handle to any angle he/she sees fit.

Each of these features must be easy enough to adjust so that a surgeon may use them “on the fly” during surgery. Students must conduct relevant patent research as well as benchmark current products in order to provide a viable design proposal. FDA regulations should also be considered when working with medical instruments and devices.
Research Partnered Projects

13. Cardiovascular Device Physiological Test System (Paden/Bamieh)

This project is funded by a National Science Foundation grant with Professor Bamieh as the principle investigator.

Controlled fluid flows are used in the development of medical devices that treat thousands of patients. For example, pulsatile bioreactors mimic cardiovascular pressure and flow trajectories to incubate bioengineered blood vessels, and pulse duplicators are used to test artificial heart valves. Moreover, mock circulatory loops are employed to study native heart function and arterial impedance, to develop cardiovascular devices, and model aortic flows in the study of atherosclerosis. In spite of the great need for devices and control algorithms to emulate cardiovascular flows, there is no reconfigurable device suitable to the broad range cardiovascular pressure waveforms, flows, and fluidic impedances.

Useful flow synthesis devices do exist, but have limitations and narrow areas of application. Engineers at Harvard Apparatus have designed a motor/crank/piston “pulse duplicator” for testing artificial heart valves, but this device has a fixed waveform and cannot simulate arterial impedances. Vivitro Systems, Inc. has developed a system for developing artificial hearts, but their device cannot simulate arterial impedances, produce steady flows or track a programmable pressure waveform.

The objective of this design project is to design a highly responsive servo-controlled gear pump that can, via pressure feedback, produce a wide range of flow behaviors including fluidic resistance, compliance, and inertance and combinations thereof. In particular, the simulation of the cardiovascular system for testing a ventricular assist device is an objective.

Participants will be asked to sign an invention assignment agreement so that proceeds from inventions or designs will be given to the ME department to support future undergraduate design projects.

14. Morphable Telescope Backing Structure (Lubin)

This project will be under the direction of Prof. Philip Lubin of the Physics department.

Large telescopes (10+ meters in diameter) are too large and too expensive to be made with monolithic mirrors. We are working on a new type of telescope with a goal of building a low cost 10 meter diameter telescope that uses individually served panels with servo feedback from a laser interferometer. The hexagonal panels are individually machined on a CNC and are about 1 meter in size. The panels are actuated using a stepper motor driven screw drive that is software controlled with feedback from the laser
interferometer. Each panel vertex has a laser retroreflector. A single laser scans each vertex in sequence and using this information the vertex is servoed into position.

This project involves FEA modeling and construction of a Morphable Mirror Telescope.

This telescope, which will be used to study the Big Bang, is designed as an arrangement of 1 meter sized mirror panels that fit together to form a parabola. The intended size is 10 meters in diameter with an option of going to 30 meters. Such structures are impractical to make as single pieces so segmented designs are used.

In this telescope we are using a new approach and servoing the vertex point of each panel in order to form the proper surface shape. Due to effects of temperature changes, wind loading, material flow and changing gravitational loads as the telescope is pointed the overall structure must "morph" and reconfigure itself to maintain alignment.

Previous Capstone groups have worked on sub sections of the system but we are now ready to "bring it together" with a full laser interferometer based servo feedback system. A critical challenge in this project is designing a practical and buildable backing structure to hold the mirror panels and servo elements. This involves understanding the thermal, gravitational and dynamic wind loadings of such a large and precise structure. Over the 10 meter size scale of this telescope we are trying to maintain accuracies of order 10 microns. This is very challenging.

The students involved will work as a team with the experimental cosmology group in the Physics department in designing, modeling, building and testing a model backing structure and measuring its performance with a laser interferometer. The understanding of both complex modeling and modern metrology methods will be explored and discussed as a part of this project.

For more info: [http://www.deepspace.ucsb.edu/people/prof/](http://www.deepspace.ucsb.edu/people/prof/)

Independent fund raising efforts will be necessary to support project efforts.

**15. Design and Mock-Up Testing of a New Irradiation Facility for the Advanced Test Reactor** (Odette)

This project will be conducted under the direction of Prof. Robert Odette and will be sponsored by the US DOE National Laboratory (INL).

Nuclear power supplies approximately 20% of the US electricity production and is our major source of C-free energy. This project will support the safe and efficient life extension of the current fleet of US nuclear power reactors. It addresses the issue of predicting the effects of service on the properties of steels used in massive reactor pressure vessels (RPV) for extended operating periods of up to 80 years.
The design project would be part of a larger effort to design and construct a highly instrumented facility to carry out controlled RPV steel neutron irradiations in the Advanced Test Reactor (ATR) at the INL. A large number of RPV steel alloys in the form of a variety of specimens used for post irradiation mechanical testing, and other types of measurements, must be kept at three precisely controlled and monitored temperatures during the year long irradiation in the ATR. The radiation environment in the ATR uniformly deposits heat in materials, in this case at a rate of about 1 watt/g. The combination of nuclear heat deposition and removal dictates the temperature and temperature variations in the materials being irradiated. The heat removal rate is controlled by a precise gas mixture (e.g., He and Ar) gap that produces a temperature drop between the heated specimens and cooled capsule wall. The temperature drop is controlled by the combination of total heat flow, the conductivity of the gas mixture and the dimension of the gap. The outer capsule wall is cooled and held at a fixed temperature by flowing water that removes all the internally generated heat. In many cases, it is useful to supply specified amounts of extra heat by heater wires to more precisely control the specimen temperatures.

The capstone project would be first use FEA to carry out a thermal design of a simplified ATR irradiation facility. The design objective will be to produce and control precise sample temperatures for conditions where the heating varies with time and position. The temperature control parameters are the total heating in the specimens, the gas mixture and gap dimensions, and any extra heat that is supplied by heaters, if they are used. The second part would be to construct a simplified mockup of the final design and to evaluate its thermal performance using heaters inside the specimen mock up region, a static gas mixture gap and an array of thermocouples to measure the temperatures at key locations.

The costs of the project would be supported by a research grant. Technical advice and support would be provided by Professor Odette and his experienced research group as well as by a very capable team of design engineers at INL. It is expected that the design team would visit INL in Idaho to tour the ATR and carry out discussions with INL staff, and that one or more INL engineer would participate in the design reviews.

Professor Odette and his research group focus on developing robust methods for predicting the performance, reliability and lifetime limits of materials and structures in extreme environments, especially as applied to advanced energy and aerospace systems, and on developing new high performance materials. His research closely integrates experimental and modeling studies of microstructural evolutions that take place during long-term service in hostile environments using a variety of state-of-the-art computational and experimental tools. The consequences of atomic to meso-scale structural evolutions to deformation and fracture are assessed by innovative small specimen testing methods he has developed.

Students are required to be a United States citizen for all facility site visits.

For more information: http://atransuf.inl.gov/
Student Organizations and Design Competitions

16. **SAMPE Competition** (Kedward)

This project has been deleted from consideration.

17. **Eco-Marathon Supermileage Vehicle Competition** (Beltz)

This project is a collegiate competition sponsored by Shell Oil. The Eco-Marathon competition provides engineering and technology students with a challenging design project that involves the development and construction of a single-person, fuel-efficient vehicle. Students have the opportunity to set a world fuel economy record and increase public awareness of fuel economy.

The Shell Eco-marathon...

- challenges students around the world to design, build, and test vehicles that travel further using less energy.
- is an educational platform that encourages innovation, reinforces conservation and fosters the development of leading technology for greater energy efficiency.
- is a global forum for current and future leaders who are passionate about finding sustainable solutions to the world’s energy challenge.
- is a visible demonstration of Shell's deep commitment to face head-on the growing demand for energy worldwide in a responsible way. It is an invitation to others to do the same.

The Shell Eco-marathon Americas was first held at the California Speedway in 2007.

The principle of the Shell Eco-marathon is simple: to design and build a vehicle that uses the least amount of fuel to travel the farthest distance. At all events, teams can enter futuristic prototypes: streamlined vehicles where the only design consideration is reducing drag and maximizing efficiency. Conventional fuels such as diesel, petrol/gasoline and liquid petroleum gas, as well as alternatives like GTL, solar, ethanol, hydrogen and biofuels can power the vehicles. As long as teams adhere to safety rules, the design of their vehicles is limited only by their imagination.
Contest rules are available for review on the Shell website www.shell.com/ecomarathon

This project is a continuation of a project that was started last year. This year’s project will entail understanding the proposed design and improving the performance. It is desired to complete a functional vehicle capable of competition.

This project may include competition in Southern California supported by Shell Oil.

Independent fund raising efforts will be necessary to support this project and travel to the competition.

18. Mini Baja Car Competition (Faculty TBD)

This project has been deleted from consideration due to lack of fund raising efforts.

19. Omnivision for Robotics (Bullo)

The goal of this project is to design a camera and mirror system to give robots a useful 360 degree horizontal field of view, and facilitate the efficient and cost effective manufacture of multiple systems for use in research at UCSB.

There are two intended applications for this system, and the design will need to accommodate both:
1) As an object detection and tracking device in current robotics research experiments at UCSB.
2) As a key component of potential future entries to RoboCup mid-size league competitions.

The design must meet the following specifications:

1) Easily attach to a CMUCam3 or other widely available robotics video camera to provide a 360 degree horizontal field of view using a catadioptric (lens + mirror) setup.
2) The optics and mirror should be designed to provide good resolution directly around the robot and out to 5 meters, while also showing any soccer-ball sized objects on the ground out to at least 18 meters (size of robot soccer field).
3) Attach easily and securely to our existing robot hardware, without interfering with the field of view of the onboard laser rangefinder.
4) Sufficiently light weight to mount at the top of future RoboCup robots, similar to the designs of other teams.
5) Either lock in the proper alignment of camera and other optics, or provide an easy way to quickly correct the alignment.
6) Sturdy metal construction, all black.
7) Cost less than $500 for parts (excluding camera).
The top teams competing in the 2009 RoboCup mid-size league all had omnidirectional cameras mounted on top of their robots. Each team's version seems to be custom and there are some differences. A rough diagram of the second place team's system (one of the better ones) can be found at: http://www.techunited.nl/index.php?p=11

There also exist a few commercial vendors of omnivision systems, including RemoteReality, Versacorp, FullView, NewVision, and 0-360.com. However, these products have not been designed with our application in mind. With all of these systems either the vertical field of view is inappropriate for the target application, the cost is prohibitive, or both.

WORK ENVISIONED:
1) Preliminary work will involve research into existing designs used by commercial products, RoboCup teams, and research hardware.
2) The second stage would be to develop a design based on the best existing technology plus any new ideas conceived of by the team.
3) The third stage would be to construct and test a prototype.
4) The final stage will involve refining the design based on lesson learned from the prototype and manufacturing four instances of the final hardware.

At the end of the project the goal is for the vision system to be mounted onto the robots in the lab and to provide a demonstration that it captures 360 degree video.

ABOUT PROF. BULLO:
Francesco Bullo joined the UCSB Mechanical Engineering faculty in 2004. His research focuses on geometric and dynamical systems methods in control theory, motion planning and coordination algorithms, and distributed and adaptive control. Application areas include (i) the design of autonomous, reliable, and agile vehicles and robots and (ii) the coordination of autonomous vehicle and sensor networks.

Independent fund raising efforts will be necessary to support project efforts.

20. AbilityOne Design Challenge (Laguette)

This project has been deleted from consideration.

21. Chlorine dispenser for rural water systems (EWB project) (Bothman/Dinh)

Engineers Without Borders – USA is a non-profit organization that supports community-driven development programs worldwide through the design and implementation of sustainable engineering projects, while fostering the development of internationally
responsible engineering students. EWB-USA partners university students and working professionals with underserved communities worldwide in need of technical assistance.

Chlorine is frequently used to disinfect drinking water. Our EWB-UCSB team currently works in the Andean highlands of Peru where rural communities are required by the local government to chlorinate their water supply as a means of ensuring safe drinking water. However, the chlorine dispenser provided to the communities by the government does not effectively meter chlorine. At times the chlorine level is too high and not pleasant to drink which deters communities from chlorinating their water. At other times, the chlorine level is too low and not enough to properly disinfect the water. A dispenser that can maintain chlorine levels within an appropriate range of concentration would encourage and facilitate rural Peruvian communities in maintaining a consistent supply of safe drinking water.

The design must meet the following criteria:

- The chlorine dispenser must maintain an appropriate chlorine concentration over the range of flow rates seen in the village.
- The materials and supplies required for operation and maintenance must be locally available in Cusco and economically feasible.
- Any energy source required for operation must be economically feasible and locally available. A system that doesn’t require any energy sources for operation is preferable.
- The dispenser should be easily operable and maintainable by community members who may have little exposure to modern technology.

A successful chlorine dispenser design has the potential to have a large impact. EWB-UCSB has been working with Peruvian communities in the province of Colcha since 2004 and has a good working relationship with both the communities as well as with the local government. Through these relationships, EWB-UCSB could effectively implement and share new technologies.

This project would be an excellent opportunity for students interested in fluid mechanics, clean water systems, and engineering for developing communities.

Independent fund raising efforts will be necessary to support project efforts.
**Independently Created Projects**

**22. MEMS Lab Projects** *(Turner/Bothman)*

This project selection has been revised.

This project is in cooperation with the MEMS lab and Prof. Kimberly Turner.

Dr. Turner's interests involve many areas of Microsystems, especially dynamics and characterization, and applications utilizing interesting dynamics. In 1994 she earned her B.S. in Mechanical Engineering from Michigan Technological University. She received her Ph.D. (1999) in Theoretical and Applied Mechanics from Cornell University, where she did primarily MEMS-based work. She joined the department of Mechanical & Environmental Engineering at UCSB in August 1999, where she is continuing her research in the areas of MEMS and nanosystems.

The lab has proposed 2 projects for student consideration. The student team may select the desired project from the following options.

**MEMS gyroscope safety shield**

Our group tests innovative MEMS gyroscopes on a spinning table in our lab. We need to have a safety shield designed that will be installed around the table to keep users from getting too close to the spinning test equipment, and to protect them in the event that components break loose from the table.

Tasks include: analysis of the energy that the shield will need to absorb, calculation of forces on the shield system, design and fabrication of the shield, and incorporation of safety switches that will prevent the table from spinning if the shield is not in place.

For more information: [http://www.engr.ucsb.edu/~tmems/index.html](http://www.engr.ucsb.edu/~tmems/index.html)

Independent fund raising efforts may be necessary to support project efforts.

**MEMS chip scribe and break system**

Several groups here fabricate MEMS devices on thin glass wafers (100mm diameter, 0.5 - 1.0mm thick). After fabrication in the cleanroom is complete we need to cut the wafer into smaller rectangular pieces (~20x80mm).
We challenge the students to design and build a simple machine that will allow the user to scratch a straight line on the wafer with a diamond stylus, and then break the wafer along the scribed line. The broken edge needs to be located within 0.5mm of the desired location.

For more information: http://www.engr.ucsb.edu/~tmems/index.html

And http://www.nanotech.ucsb.edu/

Independent fund raising efforts may be necessary to support project efforts.

23. (Deleted)

This project has been moved to project 22. MEMS Lab Projects for further consideration.

24. TBD

This project has been deleted from consideration.