COURSE INSTRUCTOR

Mike Johnson

FACULTY OF THE DEPARTMENT OF MECHANICAL ENGINEERING

Shiyi Chen – Numerical Fluid Dynamics, Computational Methods

Greg Chirikjian '88 – Robotics, Self-Replicating Systems, Computational Structural Biology

Noah J. Cowan – Bio-Inspired Robotics, Computer Vision and Control

Andrew S. Douglas – Mechanics of Solids, Tissue Biomechanics

Kevin Hemker – Materials Science, Thermal Barrier Coatings, MEMS

Cila Herman – Heat Transfer, Fluid Dynamics, Thermoacoustic Refrigeration

Joseph Katz – Fluid Mechanics, Cavitation, Turbulence

Omar Knio – Computational Fluid Mechanics, Numerical Methods

Charles Meneveau – Fluid Mechanics, Large Eddy Simulation

Vicky Nguyen – Biomechanics, Materials Science, Fracture Mechanics

Allison Okamura – Robotics, Haptics, Surgical Assistance

Andrea Prosperetti – Fluid Mechanics, Multi-Phase Flow, Underwater Acoustics

K. T. Ramesh – Materials Dynamics, Nanomaterials, High Strain Rate Behavior

William N. Sharpe Jr. '66 – Solid Mechanics, MEMS, Microsample Testing

Lester K. Su – Fluid Mechanics, Combustion, Spray and Droplet Dynamics

Sean Sun – Biomechanics, Biophysics, Molecular Motors

Jeff Wang – BioMEMS and Microfluidics

Louis L. Whitcomb – Underwater Robotic Vehicles, Sensor and Actuator Design

For additional information, please visit www.me.jhu.edu/faculty.html

www.me.jhu.edu/design.html

WHITING SCHOOL OF ENGINEERING: IMPROVING LIVES, SOLVING THE PROBLEMS OF A NEW CENTURY, AND PUSHING THE BOUNDARIES OF RESEARCH AND EDUCATION.

JOHNS HOPKINS
UNIVERSITY
WHITING SCHOOL OF ENGINEERING

SELECTED PAST SENIOR DESIGN PROJECTS

SAFETY-RELATED PROJECTS

A safety bar for school bus seats. In the instance of a crash, the bar locks into place via an inertial braking mechanism.

Childproof handgun safety lock. A handgun safety lock that auto-matically resets when the gun is put down and that cannot be operated by children under eight years of age.

Whitewater safety helmet. The helmet, designed for use by white-water kayakers, was tested for impact against a rock at speeds up to 25 mph. Now mass-produced, the student-designed helmet is available worldwide through the White Water Research Institute and has saved numerous lives.

Child seat installer. The difficulty of installing a child seat in a car was eliminated by this simple device. Applying pressure to the seat of the car, the device enables the user to safely install and tighten a child seat.

Tri-axial accelerometers for understanding impact aftereffects. The team developed a means to mount sensors and send RF signals for analysis of patients who have fallen. The system, designed to be worn by an elderly person, enables remote detection of the occurrence and impact of a fall.

DEVICES TO ASSIST THE DISABLED

A device that enables a quadriplegic to operate a computer from his or her bed. Air blown into a mouth-held device emits a burst of infrared energy that is recognized by the computer's infrared-sensitive keyboard.

An automatic wheelchair brake that is triggered when weight is removed from the wheelchair's seat. The mechanism prevents the wheelchair from moving when a patient is entering or exiting the wheelchair.

A wearable lifting device for the disabled. This garment, which can be attached to a hoist, eliminates the need to position a sling beneath a disabled person.

Tool-changing system for the handicapped. This device enables a person who has lost both arms to pick up a drill motor, change drill bits, and exchange the drill for other power tools without assistance.

Automatic page-turner for the handicapped. A lightweight, inex-pensive unit that turns pages in a book when activated by a breath-operated "puff switch."

Gripping and lifting device for the handicapped. This system en-ables a person with reduced muscular ability to perform tasks such as picking up a glass of water and lifting it to his or her mouth.

Pill-delivery machine for handicapped persons. This machine allows a person with incapacitating physical disabilities to take one or more of 12 different pills at a time without assistance.

Swing for a disabled child in a wheelchair. While swinging can be therapeutic for a disabled child, it can be difficult for a parent to lift a child onto a swing. The students' device, powered by a motor, enables a user to attach a wheelchair directly to a swing.

Tractor for disabled persons. By adding a lifting mechanism and manual controls for braking and accelerating, an ordinary farm tractor was made accessible for unassisted operation by a paraplegic.

Basketball for the blind. A small sound-emitting device placed in a basketball, and another at the backboard, enables sight-impaired persons to play basketball and improve their hand-ear coordination skills.

INDUSTRIAL APPLICATIONS

A sawdust collector for a Black & Decker circular saw. Redesigning the blade housing and adding a container to an existing Black & Decker product made it possible to capture over 90 percent of the sawdust produced by a handheld power saw.

New blade clamp for a power saw. The students redesigned an existing Black & Decker power saw to make it possible to clamp the blade without any external tightening tools.

Crack detection device. Huge steam boiler headers in BGE power plants can now be inspected internally with this remotely operated device that carries NDE crack-detecting equipment to any desired site within the vessels.

Thermocouple removal/insertion device. This tool allows BGE technicians to reach into deep, dark, hot holes and safely remove broken temperature monitors from the bearings on steam turbines and other large rotating machinery.

Automated cutting system. A fully computer-controlled system enables machine operators at the Pall Company to cut cylindrical filters to any required length.

DEFENSE-RELATED PROJECTS

Snakelike surveillance vehicle. The U.S. Army Research Labs requested that the students, using only binary actuators, devise a way for the unit to move in a snakelike manner.

Robotic remotely controlled land mine detector. Students developed a machine that can detect land mines and mark their location with paint while operated from a remote location and viewed via closed-circuit TV.

Reconfigurable mast. For Lockheed Martin, students designed a full-scale mast on which it is possible to lower a ship's sensors and antenna so that maintenance and repairs can occur on the ship's deck instead of returning the vessel to port in order to perform these tasks.

Remote aerial tagging system. The student team modified an off-the-shelf remote controlled helicopter to accept a gimbal with video feedback, distance measuring and a paint ball gun. The system is used to mark and track suspect vehicles.

SPECIAL TESTING DEVICES

Charpy impact test machine upgrades. Modifications students made to a 240 ft-lb test machine for the U.S. Naval Surface Warfare Center provided fully instrumented impact test results up to 350 ft-lbs.

Miniaturized solar sensor for telemetry. This team made modifi-cations to ballistic testing telemetry devices for the U.S. Army Research Labs that minimized the device's number of parts, overall size, cost, and assembly time.

Senior Design Projects

MECHANICAL ENGINEERING

2008–2009

LETTER FROM THE CHAIR

Tuesday, May 5, 2009

Dear Friends,

Welcome to the Whiting School of Engineering's 28th Annual Mechanical Engineering Design Day.

Today's events provide a clear illustration of the Mechanical Engineering Department's many strengths—our innovative curriculum, the quality of our students and the faculty who have taught, encouraged, and inspired them, and the commitment to excellence that is evident in all that they do—and especially in the work you'll see today.

I also want to recognize a group of people whose belief in our students, faculty, and the entire Whiting School of Engineering has made today possible—our Design Day sponsors. In addition to providing students with problems that need to be solved and the financial support to solve them, it's their dedication to our students, and the time, energy, and guidance they offer throughout the year, that makes this experience so valuable. I know you join me in offering thanks for their support.

Enjoy today and stay in touch.

Best regards,

Kevin Hemker
Chair,
Department of Mechanical Engineering

COURSE DESCRIPTION

The Senior Design Project, a unique two-semester course, is the capstone of Johns Hopkins' Mechanical Engineering program. In the class, students working in small teams tackle specific design challenges presented by local industry, government, and nonprofit organizations.

The sponsors provide each team with a budget, access to world-class resources, and technical contacts. Ultimately, each team conceptualizes a novel solution to the sponsor's problem and then designs, constructs, and tests a real-world prototype before presenting the finished product and specifications to the sponsor.

The course requires students to draw upon the four years of knowledge and experience they've gained in their engineering studies and put it to practical use. Throughout the year, they produce progress reports as they design, build, and test the devices they're developing.

Combining engineering theory, budget and time management, and interactions with real clients, the senior design project is critical to students' preparation for the transition from school to the workplace.

ADDITIONAL SUPPORT PROVIDED BY

Pitney Bowes DMT
Lockheed Martin

JUDGES, REPRESENTING AMERICAN SOCIETY OF MECHANICAL ENGINEERS

E. Gordon Brown
R.W. Davies '50
Andy Rogers
Neil Rothman '94
Harry W. Sutton '50, Chief Judge

2008–2009 PROJECTS

For more details and photos, please visit: www.me.jhu.edu/design.html

PROJECT ASTRO
Actuation System for Throwable RObot
SPONSOR: JHU APPLIED PHYSICS LABORATORY
Contacts: Mehran Armand, Mike Kutzer '07 & Christopher Brown

Team ASTRO was charged with making it possible for a small, spherical surveillance robot to climb stairs and move rapidly across a flat surface. Such a robot could be used in a variety of ways, including as a means to search for people in a burning building. The team's principal challenge was creating the thrust necessary to lift the robot the height of a stair riser using an actuator that fit within a very small space.

Project Designers: David Ferguson, John Kegelman, Joe Lefkowitz, Taig Rajpal

PROJECT BORN2FOLD
SPONSOR: PITNEY BOWES DMT
Contacts: Mark MacLeod '07 & John Masotta '95

This team was asked to create an adjustable paper-folding mechanism that would improve the function of a Pitney Bowes high-speed, automated mail-handling machine. Previously, when the number of sheets or the thickness of the paper in the machine was modified, it was necessary to stop the machine and manually adjust the folding mechanism. The students have created a device that automates this process. Now, without stopping the machine, the folding mechanism can quickly and automatically adjust to accommodate a range of conditions.

Project Designers: Louis Agon, Vijay Aiyer, Alex De Simone, Ben Pressman

PROJECT CLASS
Commercial Label Automated Splicing System
SPONSOR: HUB LABELS, INC.
Contact: Anton Dahbura '81, '82, '84

This project's sponsor manufactures printed labels that are used in a variety of ways, including the labeling of canned foods. When the labels are printed, they are mounted on a web—a continuous backing strip made of paper. When imperfections are found in the labels, that section of the web must be removed and the remaining pieces spliced together—a process that is time consuming and potentially dangerous. The student design team has solved this problem by creating a small, semi-automated device that enables the operator to quickly and safely splice web sections.

Project Designers: Hoe-Joon Kim, Jonathan Ryan, Kevin Uy

PROJECT DIAPER
Design to Immediately Assure Parental Error Reduction
SPONSOR: JHU CENTER FOR INJURY RESEARCH AND POLICY
Contacts: Akisha Price & Stephanie Parsons

The sponsor operates a clinic where parents may bring their child safety seats and learn how to properly install them. The clinic can only serve a limited number of people who could benefit from assistance with this difficult and complex installation process. This team tackled this challenge and provided fool-proof solutions to two of the most common errors that parents make: placing the car's safety belt into the wrong belt path on the child seat and switching the seat from rear- to forward-facing before the child is large enough.

Project Designers: Rosemary Bauer, Kelly Dyer, Paul Stegall

PROJECT POSS
Post-Op Sternum Stabilizer
SPONSOR: SYNTHES, INC.
Contacts: Tom Albertson & Ray Schmitt

The methods now used to reattach the two severed halves of a sternum after chest surgery have numerous drawbacks—none is fully satisfactory to surgeons or to the patients' healing process. The specially coated tie-cable created by the student design team minimizes the problem of wires digging into fragile bone and can be fastened quickly, safely, and securely.

Project Designers: Chris Floyd, James Shin, Doug Karlsberg, Hiroshi Yamaguchi

PROJECT RIPS
Recharging Integrated Power Systems
SPONSOR: NORTHROP GRUMMAN UNDERSEA SYSTEMS
Contact: Dan Barvenik '94

Small unmanned underwater vehicles (UUVs) are used for a variety of applications, including long-term surveillance missions. Ideally, when these vehicles' batteries must be recharged, the operation should occur underwater. Team RIPS devised a method to recharge the UUVs' batteries automatically and while the UUV is submerged at significant depths.

Project Designers: Prasanna Chandrasekhar, Ryan Farmer, Steven Gillmeister, Ed Wisneski

PROJECT ROTORS
Remote Operated Technology for Off-Road Systems
SPONSOR: GENERAL DYNAMICS ROBOTICS SYSTEMS (GDRS)
Contact: Steve Rotundo

One of the many unmanned systems created by this sponsor is a four-wheeled vehicle that can traverse rough terrain. Attempts by GDRS to automate the braking of these vehicles with a hydraulic system have been unsatisfactory. This student team was tasked with, and succeeded in, developing a purely mechanical system that can be quickly switched from remote-control to driver-operated mode.

Project Designers: John Clarke, Rachel Geary, Doug Komoroski, Taylor Reese

PROJECT SPARK
Setting Poles And Rotating Korrectly
SPONSOR: BALTIMORE GAS & ELECTRIC COMPANY (BGE)
Contacts: David Barnard '03, Frank Elliott & Bruce Hirsch '71

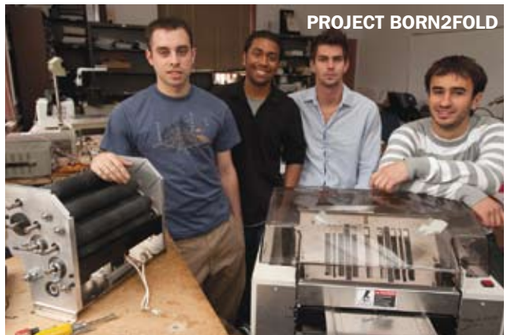
This design team was charged with developing a way to rotate electrical utility poles so that they are oriented correctly before they are set in the ground. The company's current manual methods for doing this are both strenuous and potentially dangerous. The students' answer was to retrofit a hydraulically powered rotating mechanism onto BGE's "Polecat," a vehicle that, until now, could lift only the tall, heavy utility poles.

Project Designers: Omar Almagri, Alex Bodell, Brian Ejsmont, Kai Selterman

PROJECT WAC
Workstation And Chair
SPONSOR: VOLUNTEERS FOR MEDICAL ENGINEERING, INC.
Contact: John Walker

Although Nancy Glowacki has made a tremendous recovery after falling approximately 80 feet during a parachuting accident, she has suffered permanent disabilities that now prevent her from remaining in any position for a prolonged period of time. Team WAC created a specialized home office for Glowacki, including features that enable her to use her computer from a variety of physical positions and provide her with easy access to her keyboard, mouse, and printer.

Project Designers: Steve Ianelli, Ana Johnson, Kelly Vaden


PROJECT BORN2FOLD


PROJECT CLASS


PROJECT DIAPER


PROJECT WAC

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