

~ 21st Annual ~

UIC Engineering



University of Illinois at Chicago
College of Engineering

APRIL 20, 2010

EXPO

Electrical & Computer

Civil & Materials

Computer Science

Mechanical & Industrial

Chemical

Bioengineering

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**The Felder Family
Dr. Ali Khounsary
Kathy McGuire
Susan Tonon
Andrew Yashchuk
Arlene Norsym**

And many thanks to the
UIC College of Engineering

21st UIC Engineering EXPO

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ENGINEERING EXPO

Engineering EXPO began as the dream of alumna, Kathy McGuire and after 21 years it has fully evolved into the event you see before you! Senior Design students, with the guidance of a faculty and/or industry advisor, developed a project from conception to product design culminating with their presentation at Engineering EXPO. This experience is a crucial one for our seniors as it merges group collaboration, creation, and commitment. With this event our seniors take the first step in engineering their future. We wish all participants the best for a great EXPO!

*Anthony Felder, Student EXPO Chair, Engineering Council
Chris Maria Kuypers, EXPO Chair, College of Engineering*

EXPO 2010 SCHEDULE

7:00 a.m. 7:00-8:15 a.m.	STUDENT REGISTRATION OPENS PROJECT SET-UP
8:30 a.m.	STUDENTS: Briefing - Illinois Room (stage area) JUDGES: Sign-in & breakfast briefing (Cardinal Room)
9:00 a.m.	EXPO OPENS for general public
9:30-11:30 a.m.	PROJECT JUDGING
11:30 – Noon	COLLECTION OF VOTING BALLOTS Attendee/Participant voting ends at noon! Be sure to vote for your favorite project!
12:00 Noon	ROBOTICS DEMONSTRATION (Illinois Room) Engineering Design Team
12:00-1:30 p.m.	VOTING TABULATION
1:30-2:30 p.m.	AWARDS (Illinois Room)

EXPO ORGANIZATION

General Chair:	Chris Kuypers , Undergraduate Administration, COE
Technical Chair:	Houshang Darabi, Ph.D. , Department of Industrial Engineering
Student Chair:	Anthony Felder , Engineering Council
Award Tabulation:	Jim Muench , Undergraduate Administration, COE
Catering:	Mary Larsen , Undergraduate Administration, COE
Cover Design	Lara Ansari , Undergraduate, Department of Bioengineering
Printing	Dustin Fell , Alumni, Department of Civil and Materials Engineering

EXPO FACULTY ADVISORY COMMITTEE

Terry Layton, Ph.D.	Department of Bioengineering
Donald Lemke, Ph.D.	Department of Civil and Materials Engineering
Jeff Perl, Ph.D.	Department of Chemical Engineering
Vahe Caliskan, Ph.D.	Department of Electrical and Computer Engineering
Carmen Lilley, Ph.D.	Department of Mechanical and Industrial Engineering



Dear Students, Alumni, Families and Friends:

Welcome to the College of Engineering Senior Design EXPO 2010!

EXPO is student ingenuity and persistence at its very roots. In 1989, student leaders approached Assistant Dean Arlene Norsym with a plan to create a science fair for engineers. The idea took off, growing in its significance to the College under former Dean Dr. Paul Chung. Today, EXPO is the capstone event in the academic life of our seniors; the opportunity to display advanced design, prototyping and applied research projects.

We invite you to visit a wide array of design projects that draw upon the fundamental engineering skills and creativity of our seniors. Student participants present their research to teams of judges with prizes awarded for the best projects.

In this competitive environment, the College also wins. The EXPO judges, dedicated alumni, friends and faculty members, contribute to the record of performance used by the College in our very demanding accreditation process. Thank you to all our devoted judges for their service to our students and to the College of Engineering.

We would like to give special recognition to the Sara Lee Corporation for its very generous sponsorship of this year's EXPO. A warm thank you to College Advisory Board member, Audra Karalius, Vice President, Environment & Safety, of Sara Lee for helping us obtain this important sponsorship. In recognition of Sara Lee's generosity, there will be a special award this year, the *Sara Lee Environmental and Human Sustainability Prize*.

We also want to thank Caterpillar Inc., alumnus Dr. Ali Khounsary, and Arlene Norsym, Vice President of the University of Illinois Alumni Association and Associate Chancellor for Alumni Relations, for generously renewing their support of Senior Design EXPO. We appreciate all of your help through the years.

We also thank the Felder Family for their annual gift to EXPO, and alumni Sue Tonon, Kathy and Patrick McGuire, and Loxogon, Inc., represented by alumni Andrew Yashchuk and Ashley Poole, for their sponsorship of category awards.

We appreciate the involvement of the faculty advisors who have mentored students through their senior research courses and the sponsors and members of the college who have assisted in the research, development and design of their projects.

We are extremely proud of our talented student EXPO participants. We hope you enjoy the exhibits at EXPO 2010!

A handwritten signature in purple ink that reads "Peter Nelson".

Peter C. Nelson
Dean of Engineering

THANK YOU EXPO JUDGES!

Robert Garcon, BP
Wayne Bunker, AT&T
Kelli McGuire, GE Energy
Keith Alsberg, Square 1 Product Development, Inc.
Harish Naik MS, Argonne National Laboratory
Gerardo Mauleon, University of Illinois at Chicago
Bruce D Gould PE, Will County Department of Highways
Kevin Mitchell MS
Raffi M. Turian PhD, UIC Dept. of Chemical Engineering
William Nakulski, Handywizard, Inc.
Michael Goluszka, LA-CO Industries, Inc
Esennur Demir, Plexus Corporation
Anju Bhatia MS, Illinois EPA
Roland Priemer PhD, UIC Dept. of Elec.& Comp. Engr
John S. Sitasz, University of Illinois at Chicago
Nancy Rocha, BP
Micah Albers, Motorola
Lynn C. Westney MS, University of Illinois at Chicago
Chuck Rodeghiero, Eaton Aerospace
Melanie Myers, US DOT - Federal Aviation Administration
Ashok Kumar, Valdes Engineering Company
Karolina Grib MS
Patricia Davidson PE, Cowhey Gudmundson Leder, Ltd.
Ozlem Yardimci PhD, Baxter Healthcare Corp.
Patrick Driscoll MS, Senn High School
Andrew Skipor PhD
William S. Pietrzak PhD, Biomet, Inc.
Ashley Poole MBA, Loxogon, Inc.
Andrew Yashchuk MHA, Loxogon, Inc.
Patrick F McGuire, UOP
Thomas F. Juliano PhD
Prateek Gupta PhD, MBA
Julie Chang MS, Northrup Grumman Systems Engineering
Craig Carson, BP
Georgette Hlepas PhD, PE, US Army Corps of Engineers
Milos Zefran PhD, University of Illinois at Chicago
Thomas J. Royston PhD, UIC Dept. of Bioengineering
Heather Mayes, Jacobs Consultancy
John Molburg PhD, Argonne National Laboratory

Dennis O'Brien, Jacobs Consultancy
Charles Ventura, Baxter Healthcare
Les Bogdanowicz PhD, ZOLL Medical
Diego Freire MS
Abhay Datta PhD
Robert G. Paluch MS, U.S. Army Corps of Engineers
Didem Ozevin PhD, UIC Dept. of Civil Engineering
Bruce Swiecicki MS, National Propane Gas Association
Patrick Rousche PhD, UIC Dept. of Bioengineering
Hamed Naimipour, University of Illinois at Chicago
Mark R. Bendok MS, Alfred Benesch & Co.
Ketan Patel
Dan Karlak, CNH America LLC
Louis Chrzasc PE, Collins Engineers Inc.
Brandon Hamilton, Hamilton's Solutions, Inc.
Rich Adamczewski, Loyola University Health System
John Fudacz MS, UIC Dept. of Physics
Ira Wolke MD, PhD
Ron Kirschner, Heartland Angels
Amjed Shafique MS, PolyScience
William Sonna MS
Kenneth Belcher MS, Argonne National Laboratory
Said Al-Hallaj, AllCell Technologies
Joe Mulvey
Jonathan Abon MS, Tellabs
Katie Owens, 2IM Group
Deivya Bansal MS
Dave Barriball
Peter Dombrowski MS, PE, SE, RJN Group
King Moy MS, Herbst LaZar Bell
James Vaughan, Ectropics, Inc.
William Hayes, Acciona Energy NA
Daniel Hernandez MS, The John Marshall Law School
Craig Pellegrini MS, UIC Dept. of Physics
George Balaban, C.E. Niehoff & Co.
Eduard Karpov PhD, UIC Dept. of Civil Engineering
Dennis Demoss MS, Sargent & Lundy LLC
Nick Gruzauskas PhD UIC Dept. of Radiology
Michelle Ho, Sargent & Lundy, LLC

EXPO 2010

PROJECTS BY CATEGORY

1. Assistive Technology Devices

1.BioE.1	Visual Stimulus System for Glaucoma Diagnosis
1.BioE.2	Bionic Tray
1.BioE.3	Design of Prosthetic Finger (SMA's)
1.MIE.4	The Foot Strengtheners
1.MIE.5	Easter Seals Bicycle Project

2. Mechanism and Device Design

2.ECE.18	Sump Pump Monitoring System
2.MIE.19	Dual-levered Sink Handle
2.ECE.20	Low Cost Function Generator
2.MIE.21	Improved Speed Freight Bogie Suspension
2.ECE.22	Blind Eyes

3. Chicagoland Infrastructure

3.CME.38	Elgin-O'Hare Expressway Westbound Extension
3.CME.39	Design of a High-Speed Rail System
3.CME.40	IL-171 Over Long Run Creek
3.CME.41	Left Side Ramps in Chicago
3.CME.42	The Lake Shore Drive S-Curve Improvement

4. Environmental and Energy Conservation

4.MIE.28	SEN Payback
4.ChE.29	Production of Polyactides: The Alternative Whey
4.ChE.30	Separation of Phenols from Pyrolysis Oil for Green Adhesive Production
4.CME.31	Lake Michigan: Powering the Windy City
4.CME.32	Feasibility for Installation of Alternative Electricity Sources for Educational Facilities

5. Structure and Site Design

5.CME.43	Flexural Performance of Lightweight Concrete Beams
5.CME.44	Texas Retaining Wall Failure
5.CME.45	Pedestrian Bridge Over an Intersection
5.CME.46	Flexural Behavior of Lightweight Concrete Beams Reinforced with Basalt Fiber Bars
5.CME.47	Science Engineering Lab/Student Center East Connection Bridge

6. Water and Environmental Infrastructure

6.MIE.33	Water Distribution System for the Community of Cerro Alto
6.MIE.34	NALCO Water Softener Improvement Project
6.CME.35	Green Parking Garage
6.CME.36	Spring Water Collection and Treatment System for Logba-Tota, Ghana
6.CME.37	Flood Mitigation in Spencer, Indiana

7. Energy and Specialty Electronics

7.ECE.48	Greener Outdoor Lighting
7.ECE.49	Light Drive: An Application of L.E.D. Data Transmission
7.ECE.50	Rabbit Recorder
7.ECE.51	Wireless Power Transfer
7.ECE.52	Frozen Pipe Monitoring and Prevention System

8. Electronic Conveniences

8.ECE.53	Smart Seatz
8.ECE.54	Room Illuminator: The Smart LED Lighting Alternative
8.ECE.55	Automated Electronic Dog Whistle
8.ECE.56	Automatic De-icing System for Cars
8.ECE.57	Sound Security

9. Medical Devices

9.BioE.6	User-controlled Valve Interface for Microfluidic Devices
9.BioE.7	Novel Drug Delivery Catheter for Chronic Total Occlusions
9.BioE.8	Ident-a-Pill: Pill Identification System
9.BioE.9	Acoustic Detection Device for the Audible Human Project

10. Medical Applications

10.BioE.10	Aqueous Diffusion of Bioactive Proteins from Demineralized Bone Matrix Graft
10.BioE.11	SNEO Sentinel-Silver Nanoparticle Embedded Antibacterial Coating on Ti Alloy
10.BioE.12	GNP-Tumor Interaction Model
10.BioE.13	Physical Models of Concepts in Neuromuscular Dynamics

11. Chemical Processes

11.ChE.14	Production of Dimethyl Sulfoxide from Black Liquor
11.ChE.15	Production of Paraffin Wax via Syngas from Trees
11.ChE.16	Production of Polyethylene from Sugarcane
11.ChE.17	Algae Oil to Functional Food

12. Production Methods and Facilities

12.MIE.23	NALCO Truck Unloading Safety Upgrade
12.MIE.24	Nitric Acid Distribution System
12.MIE.25	Turntable Manufacturing Line Layout
12.MIE.26	Manufacturing Process Optimization for Radioactive Implants
12.MIE.27	Warehouse Heating

EXPO 2010

Projects by Department

Bioengineering

9.BioE.9	Acoustic Detection Device for the Audible Human Project
10.BioE.10	Aqueous Diffusion of Bioactive Proteins from Demineralized Bone Graft Matrix: Implications for Graft preparation and Function
1.BioE.2	Bionic Tray
1.BioE.3	Design of a Prosthetic Finger Using Shape Memory Alloys (SMAs) to Re-create Anatomical Movement in the Hand
10.BioE.12	GNP-Tumor Interaction Model
9.BioE.8	Ident-a-Pill: Pill Identification System
9.BioE.7	Novel Drug Delivery Catheter for Chronic Total Occlusions
10.BioE.13	Physical Models of Concepts in Neuromuscular Dynamics
10.BioE.11	SNEO Sentinel: Silver Nanoparticle Embedded Antibacterial Coating on Titanium Alloy
9.BioE.6	User-Controlled Valve Interface for Microfluidic Devices
1.BioE.1	Visual Stimulus System for Glaucoma Diagnosis

Chemical Engineering

11.ChE.17	Algae Oil to a Functional Food
11.ChE.14	Production of Dimethyl Sulfoxide from Black Liquor
11.ChE.15	Production of Paraffin Wax via Syngas from Trees
4.ChE.29	Production of Polyactides: The Alternative Whey
11.ChE.16	Production of Polyethylene from Sugarcane
4.ChE.30	Separation of Phenols from Pyrolysis Oil for Green Adhesive Production

Civil and Materials Engineering

3.CME.39	Design of a High-Speed Rail System
3.CME.38	Elgin O'Hare Expressway Westbound Extension
4.CME.32	Feasibility for Installation of Alternative Electricity Sources for Educational Facilities
5.CME.46	Flexural Behavior of Lightweight Concrete Beams Reinforced with Basalt Fiber Bars
5.CME.43	Flexural Performance of Lightweight Concrete Beams
6.CME.37	Flood Mitigation in Spencer, Indiana
6.CME.35	Green Parking Garage
3.CME.40	IL-171 Over Long Run Creek
4.CME.31	Lake Michigan: Powering the Windy City
3.CME.42	The Lake Shore Drive S-Curve Improvement
3.CME.41	Left Side Ramps in Chicago
5.CME.45	Pedestrian Bridge Over an Intersection
5.CME.47	Science Engineering Lab/Student Center East Connection Bridge
6.CME.36	Spring Water Collection and Treatment System for Logba-Tota, Ghana
5.CME.44	Texas Retaining Wall Failure

Electrical and Computer Engineering

8.ECE.55	Automated Electronic Dog Whistle
8.ECE.56	Automatic De-Icing Car System
2.ECE.22	Blind Eyes
7.ECE.52	Frozen Pipes Monitoring and Prevention System
7.ECE.48	Greener Outdoor Lighting
7.ECE.49	Light Drive: an Application of L.E.D. Data Transmission
2.ECE.20	Low Cost Function Generator
7.ECE.50	Rabbit Recorder
8.ECE.54	Room illuminator: the Smart LED Lighting Alternative
8.ECE.53	Smart Seat
8.ECE.57	Sound Security
2.ECE.18	Sump Pump Monitoring System
7.ECE.51	Wireless Power Transfer

Mechanical and Industrial Engineering

2.MIE.19	Dual Levered Sink Handle
1.MIE.5	Easter Seals Bicycle Project
1.MIE.4	The Foot Strengtheners
2.MIE.21	Improved Speed Freight Bogie Suspension
12.MIE.26	Manufacturing Process Optimization for Radioactive Implants
12.MIE.23	NALCO Truck Unloading Safety Upgrade
6.MIE.34	NALCO Water Softener Improvement Project
12.MIE.24	Nitric Acid Distribution System
4.MIE.28	SEN Payback
12.MIE.25	Turntable Manufacturing Line Layout
12.MIE.27	Warehouse Heating
6.MIE.33	Water Distribution System for the Community of Cerro Alto

DEPARTMENT OF BIOENGINEERING

9.BIOE.9

Acoustic Detection Device for the Audible Human Project

Stefanie Broviak, Meghan Grebic, Maria Kamran, Jacqueline Thomas

Advisor: Thomas Royston, PhD
UIC Dept. of Bioengineering /
Mechanical Engineering

In the health care field, the quick and effective diagnosis of pulmonary conditions is often necessary to ensure maximum patient well-being. Many times, conditions such as pulmonary embolisms or collapsed lungs are misdiagnosed, which can be detrimental to patient health. Current diagnostic devices such as the stethoscope and computing tomography machines are limited in their measurement and analyzing capabilities, as well as their lack of portability.

Advancements have recently been made in developing a portable sensor array capable of measuring passive and active sound transmissions of the pulmonary system. Our goal was to create a similar device to adequately measure, record, and analyze pulmonary acoustic sounds. The device would be able to detect the pathway of air movement through the lungs and could be used to create an effective laboratory acoustic model. Specific requirements include the ability to produce repeatable results, eliminate noise and establish a uniform contact pressure for all oscillative points. The sensor array has been constructed on a mesh-backed chair to optimize patient comfort during signal acquisition. The array consists of 60 Piezoelectric sensors, located in six columns of ten sensors, each of which maintain constant

and uniform contact with the patient's back. Each sensor is connected to a computer interface which allows the output to be viewed and analyzed graphically. This device will be used in the Acoustics and Vibrations Laboratory for the Audible Human Project, which aims to eventually market a product that could be used clinically in diagnosing critical pulmonary conditions.

10.BIOE.10

Aqueous Diffusion of Bioactive Proteins from Demineralized Bone Matrix Graft: Implications for Graft Preparation and Function

Michael Dow, Jerry Gomez, Meghan Soulvie, George Tsiagalis

Advisor: Bill Pietrzak, PhD
Biomet Corp.

Orthopedic surgeons will implant demineralized bone graft (DBM) in patients in order to treat defects due to abnormal growth, trauma, or surgery. Within the DBM is what is known as bone morphogenetic proteins (BMP). The BMP relevant in this case is specific to bone and is known as BMP-7. BMP-7 serves to attract osteoblasts-bone forming cells-to the site of injury.

The goal of this project is to characterize the diffusion of BMPs from the DBM in an aqueous medium to simulate what happens in the body and model it so that there can be a better understanding of how DBM grafts function. To assess the effect of elution time in bone graft materials the Enzyme Linked Immuno Sorbant Assay (ELISA) will be utilized to determine BMP-7 concentration after various diffusion times. This study will involve sorting bone particles into three size ranges under 710 microns, demineralizing them for 90 minutes in 0.5 N HCl, rinsing, then placing in buffer bath solution of 7.4 pH for various times at room temperature. Next,

the particles are placed in solution with Guanidine HCl to serve as a protein denaturant to remove the BMP-7 from the bone matrix. Dialysis is then performed against the buffer in order to remove it and allow the proteins to resume normal conformation. Then, an ELISA is performed to determine the final concentration of BMP-7 for various elution times. Finally, a mathematical model is formed to predict elution rate based on the size of the DBM particles

1.BIOE.2

Bionic Tray

Mahmoud Alsharbini, Unberto Garcia, Khoa Mai, Brandon Stoffregen

Advisor: Judy Gardner, MA. CCC-SLP
Easter Seals DuPage

Arthrogryposis is a rare congenital disorder that causes people affected by it to develop joint contractures and muscle weakness. The main cause for this disorder is reduced movement during labor, due to insufficient room in the uterus for normal movement. Currently, in the United States, 1 in 3,000 live births are affected by this disorder. There is no cure for this disorder; however, there are treatments available to improve the quality of life for affected individuals, such as physical therapy. Additionally, orthopedic surgery can be performed to correct severely affected joints. The proposed device is a supporting tray designed to help our four year old client to be able to independently feed himself. The device works by using a motor which controls the motion of his arm to his mouth. Also, the device depends on the clients side-to-side shoulder motion to access other food items on the tray. The device is designed to be easy to setup for the client, easy for the client to use, and it is also designed to avoid causing any discomfort.

1.BIOE.3

Design of a Prosthetic Finger Using Shape Memory Alloys (SMAs) to Re-create Anatomical Movement in the Hand

Dustin Goetz, Asma Syed, Brian Vetter, Grace Yu, Saismrithi Peravali

Advisor: James Patton, PhD
UIC Dept. of Bioengineering

The goal of our project is to use Shape Memory Alloys to recreate the anatomical structure of the finger for a more realistic looking and functioning prosthetic finger. After completing a successfully moving finger capable of both flexion and extension, our model could be used as a foundation for future prosthetic hand devices. Basing our model of the anatomy of a human finger and hand we want to achieve both a more realistic and fluidic motion in our device. In order to achieve this movement SMAs were used to mimic the function of muscles involved in the fingers motion. Once fully developed, this prosthetic could be used to replace not only a lost appendage but would give functionality comparable to a biological hand. Creating a prosthetic hand from shape memory alloys has been attempted in the past, but the current general consensus is that motors are "better". However, with advancements in the technology of Shape Memory Alloys over the past 20+ years we feel that SMAs should be reconsidered in the use of prosthetics.

10.BIOE.12

GNP-Tumor Interaction Model

Yevgeniy Bezhlebetskiy, Harish Vijayaganesh, Chris Zbasnik

Advisor: G. Ali Mansoori, PhD
UIC Dept. Of Bioengineering

Cancer is a global killer resulting in hundreds of thousands of deaths according to the US Center for Disease Control. The two most prevalent types of cancer, noted from the US Center for Disease Control, are prostate and breast cancer. This project concerns itself with modeling how to cure these two types of cancer. The idea for our model is that gold nanoparticles (GNPs), when attached with folate, will seek out the cancerous cells folate receptor sites and be taken in by the cell. Once the GNPs are within the cells an external laser source will irradiate the infected region. A laser is utilized since gold has a natural property to convert light to heat energy very efficiently. This excess heat will then only effect the cancerous cells containing the GNPs thereby killing the cancer. For our model to be successful two modules were needed, one of the modules giving a distribution of the GNPs, while the other representing the heat energy and how it will flow. From our studies we found that around a temperature of 40°C the cancerous cells would start to terminate, this being only slightly higher than body temperature of 37 °C. The initial design for this model was to incorporate differential equations so that it would be more realistic, however due to hardships within the project we settled with a linear model. However differential equation modeling is still a secondary objective and if given more time would be the next phase for the project.

9.BIOE.8

Ident-a-Pill: Pill Identification System

Martin Brennan, Elizabeth Ferraz, Chadi Haddad, Josh Padovano, Jeanette Rzepka

Advisor: Patrick Rousche, PhD
UIC Dept. of Bioengineering

Identifying an unrecognized pill is currently a time consuming process for medical personnel. Accomplished manually by looking up pills in the Physician's Desk Reference (PDR) and various other databases, the process takes an estimated 10-20 minutes per pill. This device will automatically identify pills using image analysis and pill characters/imprints to reduce the time spent identifying pills and increase the accuracy of the process.

Ident-A-Pill consists of a receptacle, which houses a digital camera, lighting and a platform designed to take a consistent picture of a pill. Using MatLab, a program which contains algorithms necessary for image analysis and the appropriate image acquisition technology, the camera captures a high contrast picture of an individual pill and processes it based on the pill characteristic of size. The program also asks the user to input the characters located on the pill for further verification. Using a pill database within the program, the pill is identified and its name and drug facts are presented to the user. The objective of the project is for the device to identify 10 discrete pills. The ultimate goal is to have a free-standing device which is intended for use by healthcare professionals, police departments, crime labs, poison control centers and school nurses.

9.BIOE.7

Novel Drug Delivery Catheter for Chronic Total Occlusions

Gregory Czaplewski, Vikrant Jagadeesan, Amit Paul, Quanglong Truong

Advisor: Terry Layton, PhD
UIC Dept. of Bioengineering

Chronic Total Occlusion (CTO) is an advanced form of coronary artery disease that affects approximately 33% of all patients referred for

coronary angiography. A CTO is characterized by a severely calcified, complete occlusion of a major artery for a minimum of 30 days. The favorable treatment option is interventional catheterization, which utilizes minimally invasive catheter insertion to reduce patient inconvenience and recovery time. However, the success rate of this treatment is limited by the physician's ability to control the catheter head positioning at the proximal end of the CTO. The purpose of this project was to design a macroscale model of a novel catheter system with a mechanism for catheter head stabilization within the artery at the proximal cap of the CTO in order to prevent arterial perforation. The ability to stabilize and center the catheter head would allow for safe drug delivery and facilitate guide wire crossing for treatment of the CTO. The prototype consists of a retractable shell controlled by the physician that deploys anchor mechanisms at the catheter head to increase stability. Once secured, the physician is able to advance any inner delivery device to the center of the CTO. COMSOL Multiphysics Modeling and Simulation software was used to verify the absence of any turbulent stresses in the blood flow dynamics that are possible with catheters. The prototype is functional at the macroscale level, but future work should be directed toward manufacturing the catheter system on the scale of the human cardiovascular system.

10.BIOE.13

Physical Models of Concepts in Neuromuscular Dynamics

Zubair Ali, Smit Naik, Priya Viswanathan

Advisor: Jim Patton, PhD
UIC Dept. of Bioengineering

It is not uncommon for a science educator to occasionally come across a concept or idea that is difficult to communicate to students. Too

frequently the educator must attempt to define a complicated physical concept or process with a simple verbal explanation. Predictably, a large amount of both knowledge and understanding becomes lost through this simplification. Thus, to combat the loss in translation, physical models which demonstrate scientific processes are often employed in order to facilitate the student's visualization of those difficult concepts. Similarly, because educators in bioengineering and medicine commonly encounter this problem regarding various processes of neuromuscular dynamics, there arises the need for a physical model that demonstrates these processes. Specifically a physical model which demonstrates the concepts of muscular co-contraction, induced acceleration, and muscle robustness was called upon. To create such a model, a systematic procedure was undertaken which best facilitates its completion given specific design and temporal parameters. This procedure has included heavy research into various design possibilities and potentials as well as the design and construction of a model which fits the parameters. Our final design accurately communicates the aforementioned three aspects of neuromuscular dynamics.

10.BIOE.11

SNEO Sentinel- Silver Nanoparticle Embedded Antibacterial Coating on Titanium Alloy

Arman Butt, Ying Hsu, Andrew Kim, Bhavana Kurian

Advisor: Christos Takoudis, PhD
UIC Dept. of Bioengineering / Chemical Engineering

In 2003, 220,000 Total Hip Replacements (THR) were performed and the figure is expected to rise. Of the surgeries performed, 8% of the THR's result in infections and require revisions.

Biofilms are matrices of bacteria enveloped in proteins and polysaccharides which evade the immune system. The goal of this project is to inhibit bacterial colonization with a silver nanoparticle infused linseed oil coating on Ti90Al6V4 alloy which will prevent biofilm formation and avert infection. Previous research has shown that silver nanoparticles provide potent and sustainable antibacterial properties. Silver nanoparticles are non-toxic to living tissues with diameters less than 30nm. In this project, the silver nanoparticles form by means of the autoxidation process that occurs during the drying of the linseed oil rich in polyunsaturated fatty acids. The abstraction of hydrogen from the fatty acid chains creates free radicals that will react with silver benzoate to release silver nanoparticles. The confirmation of nanoparticle formation and range of diameters will be determined via transmission electron microscopy. Two experimental groups consisting of coated Ti90Al6V4 pins and two control groups consisting of uncoated Ti90Al6V4 pins will be exposed to *Staphylococcus aureus* and *Escherichia coli*, respectively. The bacterial growth in these four groups will be quantified at 8, 24 and 48 hours by phase contrast microscopy. Furthermore, coated pins will be stored and continually tested for long term stability during three weeks of experimentation. The results will be analyzed to validate the infection-free properties of the silver nanoparticle coating.

9.BIOE.6

User-Controlled Valve Interface for Microfluidic Devices

Gaurangi Mittal, Jonathan Stoia, Shuping Zhao

Advisor: David Eddington, PhD
UIC Dept. Of Bioengineering
Marie-Elena Brett

Microfluidic channels are revolutionizing the evaluation of chemical reactions by controlling the movement of fluids through finite spaces to induce specific results. Consequently, there is significant interest to improve the methods by which fluid flow can be precisely controlled. More specifically, the goal of this project is to fabricate easily maneuverable valves that allow or block flow of solutions through specific channels. Currently, fluid flow is controlled using screws which can be twisted in and out of the device. However, screw valves do not efficiently prevent leakage and are often tedious to manipulate. To achieve this goal, we designed and prototyped a push-pin valve that is easy to use and can withstand multiple on/off cycles without introducing air bubbles into the channels. The pin was constructed from materials commonly found in microfluidic laboratories; namely poly(dimethylsiloxane) (PDMS) and hollow stainless steel pins. Our design consists of 1in. long, hollow stainless steel pins that are filled and tipped with PDMS. Since PDMS has self-sealing properties, the tip is the component that blocks the channel. Our design allows for easy integration into standard microsystems laboratories due to its simple design and accessible material components.

1.BIOE.1

Visual Stimulus System for Glaucoma Diagnosis

Muniba Anwar, Palak Shah, Shinita Thomas,
Faisal Wasseem

Advisor: John R. Hetling, PhD
UIC Dept. of Bioengineering

Glaucoma is an eye disease that causes progressive vision loss due to retinal ganglion cell degeneration, beginning from periphery advancing to the central visual field.

Approximately 4 million people are affected and 120,000 people are blinded by glaucoma in United States. 2.5 billion dollars are spent every year for the treatment. Glaucoma symptoms are evident after 40% ganglion cell loss making early detection crucial. To accomplish this, we aimed at fabricating a visual stimulus system that: I) provides patterned high contrast stimulus that enhances ganglion cell response, II) covers entire visual field of one eye, III) has 80 cd/m² luminance and 0.80 check size following ISCEV Pattern Electroretinography guidelines, IV) emits 8Hz frequency and 530nm wavelength light, V) is portable desktop device, applicable with any electroretinography technique. Our final design is a 24" diameter dome lined with sixty 8x8 and 5x7 green light emitting diode (LED) matrices each, with a fixation cue (single LED) at the center of the dome. The device parts were ordered and LED matrix luminance was tested. The final prototype meets goals I, IV and V, while goals II and III had to be modified. Our system covers only the peripheral visual field as it is sufficient for early Glaucoma detection. LED matrices of 30 μ cd and 25 μ cd intensity are used since they provide adequate stimulus brightness. Furthermore, 120 check size is used as periphery has scattered ganglion cells. These modifications helped to meet our budget. The stimulus system will eventually be tested in Neural Engineering Vision Laboratory, UIC.

DEPARTMENT OF CHEMICAL ENGINEERING

11.ChE.17

Algae Oil to a Functional Food

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Advisor: Dan Rusinak, P.E.
Middough

Healthy eating is a rapidly growing industry in the 21st century, with more consumers becoming aware of the need for a balanced and nutritious diet. Omega-3 fatty acids are becoming a more integral part of this healthy diet. One specifically, docosahexaenoic acid (DHA) is linked to the healthy development of infants, and the lack of DHA is affiliated with Alzheimer's disease. DHA in the past has come from fish oils, but there is potential for mercury or dioxins contamination as well as a fishy odor and taste. Recently, it has been found that DHA can be extracted from algae instead of fish oils. Specific algae strains with high concentrations of DHA can be grown in a controlled environment and then processed, providing an uncontaminated, highly concentrated, and completely vegetarian source of DHA. Once extracted, the DHA-rich oils can then be utilized to create a functional food, such as a healthy margarine. About \$5.4 billion worth of margarines and table spreads are sold every year, however a DHA-fortified margarine is not currently sold in the United States. As word about the benefits of DHA spreads, it is apparent that the desire for foods fortified with this omega-3 fatty acid will grow. A margarine that is fortified in DHA will be both profitable in industry and beneficial to a public hungry for a healthy diet.

11.ChE.14

Production of Dimethyl Sulfoxide from Black Liquor

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Umbach

Advisor: Shannon Brown
Ambitech Engineering

Black liquor is an aqueous solution obtained as a byproduct of paper production from a paper mill. This solution contains approximately 60% of the energy originally in wood, and due to this high energy density, black liquor is usually burned in a recovery boiler to provide energy for the paper production process as well as recovering the salts used in paper production. Black liquor contains a polymer called lignin, which is synthetically useful. By reacting black liquor directly with molten sulfur, lignin can be partially converted into dimethyl sulfide (DMS), which can then be oxidized to a useful solvent, dimethyl sulfoxide (DMSO). DMSO is a polar, aprotic solvent, useful in chemistry due to its ability to solvate a wide range of molecules, in addition to being essentially non-volatile. In addition, DMSO is a greener solvent than most other solvents of its type, as it exhibits remarkably low toxicity to humans and aquatic life. The overall process consists of two reactive steps, the first being a pressurized aqueous S_N2 -like reaction between a sulfide anion and the methoxy groups of the lignin polymer, and the second being a vapor-phase oxidation of DMS with nitrogen dioxide (NO_2). Other key components of the process include a two-phase turboexpander, as the first reactive step occurs at 18 bar of pressure.

11.ChE.15

Production of Paraffin Wax via Syngas from Trees

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Advisor: Dennis O'Brien, P.E.
Jacobs Consultancy

The production of chemicals and fuels from renewable resources is a better substitute for more conventional sources such as coal. This is because fuels and chemicals derived from

biomass produce significantly lower amounts of harmful emissions when compared to its counterparts. The primary goal of this project is to design a process that converts Hybrid Poplar wood biomass into Paraffin wax. Hybrid Poplar trees will be shredded and dried before they are fed into a unique three step Carbo-V gasification process to produce synthesis gas; a combination of Hydrogen gas and Carbon monoxide. The Synthesis gas will then be conditioned and purified to remove unwanted byproducts in the previous gasification step. The conditioning phase is used to adjust the mole ratio of Hydrogen and Carbon monoxide to a desired amount for the subsequent step. Finally, Purified Synthesis gas will then be fed into a Low Temperature Fischer-Tropsch's Reactor, where they will react under the aid of a cobalt catalyst, to form linear high molecular weight Hydrocarbons, commonly known as Paraffin wax. The wax produced can be used to make candles, plastic, and other medical and cosmetic products. In addition, the byproducts of this process can be further fractionated to yield diesel fuel and naphtha.

4.ChE.29

Production of Polylactides: The Alternative Whey

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UIC Dept. of Chemical Engineering
Patrick Shannon
Senior Staff Engineer, Middough Engineering

Since 1977, when plastic bags made from petrochemicals were first introduced in the United States, there has been a yearly rise in their usage, growing to an EPA-estimated 90 billion plastic bags in 2009. Of these, only about 1% are recycled. The majority of them end up in

limited available landfill space, where their incineration continually produces noxious fumes into the atmosphere. The rest end up in the oceans and other bodies of water where they cause the loss of over 100,000 marine animal lives yearly. Bio-degradable plastics are a highly needed alternative. Plastics made from Polylactic Acid (PLA) are currently recognized industrially as viable replacements to those made from petroleum by-products. Polylactide, a polymerization derivative of PLA has been shown to be more tensile and adaptive to the elements than its PLA precursor.

Our process circumvents the ethical concerns that have arisen from producing PLA from a food source, namely corn starch. As an alternative, our primary feedstock is whey, a dairy waste product available in gross quantities at minimal cost. The process will produce lactic acid by fermentation using *Lactobacillus helveticus*; a high-yield, homofermentative bacteria. The lactic acid is then treated and isolated via electro-dialysis and multi-step vacuum evaporation. Afterwards, the lactic acid is converted to lactide which is subsequently polymerized via tin (II) 2-ethylhexanoate ($\text{Sn}(\text{Oct})_2$) catalyst to the final product of 100,000 lb/lb-mol molecular weight polylactide. Once large scale production is deemed feasible this process will provide an environmentally friendly source of green plastics that will ultimately replace the current overwhelming market dependence on petroleum based plastics.

11.ChE.16

Production of Polyethylene from Sugarcane

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Advisors: Jerry Palmer
Ambitech Engineering
Adam Kanyuh

UOP
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UIC Dept. Of Chemical Engineering

We are aimed to use renewable resource to produce bio-based polyethylene as part of an environmentally sustainable project. Polyethylene (PE) is an important engineering material, uses ranging from medical equipment, food packaging and variety of industrial products. In a radical new approach to polyethylene production, ethanol derived from renewable and eco-friendly sugar cane is used to make ethylene, which is then converted into polyethylene using standard processes. Our main feedstock for this process is Molasses, a byproduct of sugar industry. Polyethylene is traditionally produced using either naphtha or natural gas liquids, both of which are petroleum products. Sugarcane derived ethanol has energy balance seven times higher than ethanol derived from corn. The environmental benefits of Green PE process includes significantly less CO₂ production compared to the traditional polyethylene manufacturing process.

Production techniques, chemistry and the process to produce ethylene monomer for polymerization to produce PE, and process economics associated with the process are the main topics of this project. Molasses will be converted to ethanol using a fermentation process followed by distillation. Ethanol then will be converted to ethylene monomer by a fluidized bed dehydration process and polymerized further using fluidized bed reactor. In our continuous effort to optimize the use of naturally derived bio waste product we will use bagasse, the fibrous residue remaining after sugarcane is crushed to extract their juice, to supply steam and power for the plant. In summary, we now have a bio-based, renewable product with a low carbon footprint.

4.ChE.30

**Separation of Phenols from Pyrolysis
Oil for Green Adhesive Production**

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Currently 1.2 billion pounds of phenol mixture is made per year for the use of making phenolic resins for the adhesive industry. Phenol is primarily derived from petroleum and other petrochemicals, thus the resources for this material are limited in the long run and are in use by the highly demanding fuel industry. However, recent technological advancements have been made in the area of converting renewable biomass, particularly biological material created from forest residue such as branches and woodchips, into a phenol mixture. This would be highly beneficial as it reduces the demand for fossil fuels, is an environmentally friendly carbon neutral process that creates less pollution, and improves the structural properties of adhesives.

The fast pyrolysis of biomass produces bio-oil that can be further separated into chemicals, specifically phenols. The aim of this project is to produce a phenol-rich mixture which can be utilized for the replacement of phenol in phenol-formaldehyde resins currently used in the adhesives industry. By having the separation unit directly connected to the pyrolysis system, the issue of storing the unstable pyrolysis oil is resolved. The separation process used is based on the concept of liquid-liquid extraction to remove phenols from the pyrolysis oil mixture. The resulting phenol mixture can be a highly useful and valuable green substitute in the adhesive industry as compared with petrochemical derived phenol.

**DEPARTMENT OF
CIVIL AND MATERIALS
ENGINEERING**

3.CME.39

Design of a High-Speed Rail System

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Engineering

“There’s no reason why we can’t do this. This is America.” - words spoken by President Barack Obama in his message detailing the need for high speed rail in America. Nations in Europe and Asia have used this proven technology to connect cities separated by hundreds of miles. Based on research performed for this project, our team has deemed the corridor between Chicago, Illinois and Saint Louis, Missouri to be an excellent candidate for an American high speed rail system. The 300-mile distance makes it uncomfortable to drive, yet inconvenient to fly. The trains would reach top speeds of 220 miles per hour and reduce travel time to less than two hours between the two ends of the system. Stations would also be created in several population centers along the track, connecting more communities to the bigger markets in the Midwest. Aside from the benefits of fewer cars on the road, and decreased travel times, many jobs would be created in both the construction and operation of a new rail system. The scope of this project focuses on the planning of a route, design of a safe track foundation, preliminary environmental impact analysis and evaluation of materials and

construction costs needed for a high speed rail system in Illinois.

3.CME.38

Elgin O'Hare Expressway Westbound Extension

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Engineering

Located in the western Chicago metropolitan area, the Elgin O'Hare Expressway was meant to connect Elgin, IL, a town of over 100,000 people, to O'Hare International Airport, one of the busiest airports in the United States. However, only the middle segment was constructed connecting the suburbs of Hanover Park and Itasca. Recently, the Illinois Department of Transportation set aside \$159 million for engineering, land acquisition, and initial construction on the eastern section of the highway. Due to this appropriation of funds, the Elgin O'Hare Transportation Group felt that a Phase 1 Report should be assembled to prepare for the eventual western completion. Currently, cars exit at Lake Street, the western terminus of the highway. Many of these cars turn on a 30 mph residential street called Greenbrook Avenue which turns into two-lane Stearns Road. The proposed extension would decrease congestion on current routes, improve current and future levels of service, and increase safety on those roads that were not designed for the current traffic flows. Several schools lie along the current routes, and the large traffic volumes endanger the elementary children at those schools. Other community and social gathering locations would also be greatly benefitted from the project along the current routes.

Connecting the western edge of Elgin to O'Hare Airport would provide business growth potential and population growth accommodation. Northwest Cook, northern DuPage, and eastern Kane counties would greatly benefit from the convenient access to O'Hare airport, major freight areas, and the downtown Chicago area via Interstate 290. As these industries continue to extend to the western suburbs, this link would alleviate the higher demand for route choices and the greater pressure on current infrastructure. The extension would also provide direct access for booming far western suburbs that are experiencing large population increases. The project will show two alternative routes for the proposed extension with technical, economic, environmental, and social information related to the proposed extension. This report will aid the eventual completion of the Elgin O'Hare Expressway for the benefit of the people of Illinois.

4.CME.32

Feasibility for Installation of Alternative Electricity Sources for Educational Facilities

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Engineering

In Illinois today, our educational systems are faced with continual budget shortfalls and cutbacks in funding. There is also an increasing call to provide energy in a more environmentally friendly manner. With this in mind, this project investigates the plausibility of using solar power via photovoltaic cells to offset the electrical costs of daytime lighting usage in a local high school. The daytime lighting represents a significant portion of the schools daily electrical usage. This study looks at all aspects of the required solar

power system, from initial equipment and installation costs to maintenance and possible structural upgrades. The subject of this study is the Chicago Public School of Benito Juarez Community Academy located on the near south side of the city. It was chosen due to its representative size and favorable roof layout. If the system is found to be successful, this school presents the basis to expand this project to include many more of the areas schools.

5.CME.46

Flexural Behavior of Lightweight Concrete Beams Reinforced with Basalt Fiber Bars

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Engineering

Concrete is a durable, inexpensive, and strong material. Nonetheless, it does have its flaws. Concrete is strong in compression, but volatile and weak in tension. In order to counteract this performance discrepancy, reinforcement is needed to assist with the tensile stresses. The typical reinforcement for concrete is steel. However, corrosion is one major disadvantage of using steel as reinforcement and, at times, replacements may be sought. Various studies have already shown that basalt is non-corrosive and nonreactive with most elements; therefore, this project will examine the flexural behavior of light weight concrete reinforced with basalt rebar. The target of the project is to confirm the yielding strength of the basalt and compare the results with lightweight concrete having steel reinforcement.

5.CME.43

Flexural Performance of Lightweight Concrete Beams

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Engineering

The purpose of this experiment is to determine the viability of using reinforced lightweight concrete (density << 120 pcf) in beams subjected to loads regularly supported by normal weight concrete (density = 150 pcf) beams. If the experiment yields satisfactory results in terms of ultimate load and final deflection, the benefit would be significant due to the better qualities of lightweight concrete in terms of workability, better absorbency of shocks, ease of transport, thermal benefit, reduced dead load and behavior in a beam in flexure.

A total of four beams are to be built, two of each kind, using different main reinforcement and lightweight concrete of different compression strengths (varying from 6000 psi to 10000psi). They will be tested, the final deflection and ultimate load are going to be recorded for each group of 2 identical beams and the average of these values will be compared to existing data obtained in similar tests involving normal weight concrete. The distribution and design of the reinforcement, the quality of the reinforcing cage construction, the uniformity of the concrete placement and the accuracy of the testing process are all important factors to be observed during the experiment, with eventual issues addressed as they occur. Successful testing will prove lightweight concrete as a revolutionary construction material for the future.

6.CME.37

Flood Mitigation in Spencer, Indiana

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Engineering

The rural town of Spencer, Indiana is located approximately 50 miles southwest of Indianapolis on the northern banks of the White River. On June 6-7, 2008, a storm event produced rainfall that exceeded the 1000 year recurrence interval and resulted in White River water levels that surpassed the 100 year flood and the declaration of a Presidential Disaster. In addition to the millions of dollars in property and infrastructure damage, for several days following the storm, the Spencer Sewage Treatment Plant was running in "flood mode" due to river surcharging of the outfall. This required partial shutdown of treatment operations. While sewage collection never ceases during flood mode, treating all sewage prior to discharge is not possible. The use of an aerated equalization basin to divert and temporarily store untreated influent in combination with a duckbill check valve to prevent the surcharging of river water into the outfall pipe will eliminate the problem of partial sewage treatment plant operations. There are many infrastructure problems that result from flooding. Preventing discharge of untreated effluent is one of the many necessary solutions to mitigate flood events.

6.CME.35

Green Parking Garage

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Engineering

The project is to design a parking garage that utilizes the latest green technologies and processes. The design of the garage has six main considerations:

1) Architectural/Structural Systems: the facility is currently being designed to meet general spacing and geometric requirements. Also, a basic structural system will be designed.

2) Energy Systems: the facility will utilize technologies to reduce energy usage. Ideas being considered are: solar panels, wind turbines, energy efficient lighting, electrical outlets for electric plug in automobiles, and a garage navigation system that will direct drivers to the closest available parking spaces.

3) Runoff Systems: the facility will be designed with a green roof and green walls to collect and retain runoff. Also, an in house water treatment facility will be designed to treat pollutants left behind by cars. These pollutants run off into the drainage system where they will be collected and treated before released.

4) Construction: waste from construction should be diverted from landfill for reuse or recycling and the location of materials should be local to reduce transportation expenses and fuel consumption and pollution.

5) Business Plan: the location and project conception has been designed to be profitable. The location of the garage is on the southwest corner of the Addison and North Sheffield directly across the street from Wrigley Field. Currently, a parking lot and a 7-11 occupy those lots. The idea is to buy out the parking lot and 7-11 owners and build on this 200 square foot area. The first floor will retain space for retail stores.

6) Decrease Traffic Congestion via Increasing Available Parking.: The justification for the project is the lack of parking available in the area. In particular, during games and on weekends the parking situation is extremely poor. The lack of parking in the area may increase traffic in the area as motorists search for available parking. It is possible that a large

parking garage could reduce traffic congestion in the area.

3.CME.40

IL-171 Over Long Run Creek

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Advisor: Mohsen Issa, PhD
UIC and HBM Engineering Group,
LLC.

The current bridge over Long Run Creek on IL RTE 171 is considered to be in poor structural condition. The abutments and piers are deteriorating and the existing box girder beams are in need of replacement. In addition, the structure and the structures flood plain, currently, do not meet IDOT requirements for the 50 year high water elevation and is not up-to-code with current IDOT roadway geometric requirements. A Bridge Condition & Survey Report (BCRS) was conducted by MACTEC Engineering & Consulting Inc and was submitted to IDOT investigating several alternatives to meeting the aforementioned requirements. IDOT has selected the alternative for a complete structural removal (superstructure & substructure) and replacement with either W-shape steel beams or pretensioned/precast concrete beams as the superstructure in addition to addressing the issues of high water elevation and geometrics. Our scope is to evaluate different superstructure options and to perform a cost analysis to determine the most feasible solution. Using manual calculations we determined the bridge loading while conforming to the AASHTO LRFD and IDOT code requirements. Upon completion of the superstructure design we narrowed down our girder options to using the most economical composite, steel, W-shape beam and pretension/precast concrete beam (PPC) section, which still meet high-water elevation

criteria. In addition to our manual calculations, a 3D, finite element model was created in SAP2000. Using this model we were able to verify our hand calculations and complete our final superstructure design alternatives. Once these alternatives were determined, we completed a cost analysis to examine the cost feasibility and to select the most acceptable option. Upon completion of this project the scope of our work has been completed as planned. An appropriate and economically feasible superstructure design has been chosen. To fully complete the bridge design requirements for IDOT, a substructure design needs to be completed. Without appropriate subsurface information we were not able to proceed with this design. The next phase in this project would be to complete the substructure design.

4.CME.31

Lake Michigan: Powering the Windy City

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Engineering

Affordable and reliable electrical energy production is essential to a healthy economy; the energy consumption by Chicago alone is astronomical. However, traditional means of power generation (i.e. coal, gas, nuclear) negatively impacts the environment through air pollution, unusable waste, and consumption of natural resources. For these reasons a growing desire for affordable and sustainable clean energy generation exists. Wind energy is one such solution that produces no pollution, and in addition the turbines can be recycled at the end of their life span.

The purpose of this design project is to investigate and design an economically viable offshore wind farm on the waters of Lake Michigan. Placement of wind turbines on the lake takes advantage of the high lake winds while still remaining close to power transmission lines. Structural and foundation problems are addressed in addition to environmental challenges and public concerns. Both gravity and floating foundations were analyzed to ensure selection of the optimum foundation design. This project has been developed to cause minimal impact upon lake users and people on shore while providing affordable power to consumers and fulfilling all structural requirements. The benefits of this project are extensive. An increased energy supply would serve to reduce prices while excess power may be sold creating additional income potential. The energy provided could replace power currently provided by polluting sources, such as coal plants, and thus reducing pollution in and around Chicago.

3.CME.42

The Lake Shore Drive S-Curve Improvement

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Chicago Department of Transportation

Most commuters familiar with Lake Shore Drive can easily identify the roadway between Oak and Division Streets as a major problem in the highway's design. Commonly referred to as the Lake Shore Drive "S-Curve" this stretch of roadway is known for slowing down traffic and causing over 100 accidents annually. This is despite the current posted speed limit of 25

miles per hour in this stretch of road. Our design intends to improve the quality and safety of this highway and remove this hazard from an otherwise serene and picturesque commute. A redesign and reconstruction of the road is necessary for a permanent fix. The primary focus of improving the Lake Shore Drive S-Curve will deal with the reconstruction of a new roadway, which will help ease traffic conditions, and reduce the hazardous nature of the highway's current alignment. The S-Curve's 25 mph speed limit is increased to 45 mph and will improve traffic conditions while offering a safer commute alongside Lake Michigan. The design calls for shifting the roadways current location to be repositioned into a part of the Oak Street Beach. The road's geometric properties are combined with a proper fill foundation and retaining wall. The creation of this new roadway will stabilize Chicago's infrastructure and improve one of the city's major transportation issues.

3.CME.41

Left Side Ramps in Chicago

Al Huff, Tom Kaminski, Gianni Romozzi, Neill Tabotabo

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UIC Dept. of Civil and Materials Engineering

I-290 in Chicago has a major traffic congestion problem, which results in countless hours of lost productivity in work and personal lives of the thousands of people who use this interstate every day. The most common source of this problem can be traced to the use of left side ramps at the Austin and Harlem interchanges. Studies have shown left side ramps to be more dangerous than their right side counterparts, and to significantly reduce the level of service for highways, which is why they are strongly recommended against by current AASHTO regulations. Typical traffic flow has the left lane

designated as the "Passing Lane", which means vehicles in this lane move faster than the ones in the right lane(s). Because of this higher speed and design of the ramps as well as the location, drivers have to increase their speed at a faster rate in a shorter time to enter the system, or have to make awkward and often sudden lane changes to exit the system. This project will deal with several ways to increase the level of service of the interstate, by either redesigning the ramps, moving the ramps over, or the possibility of moving the ramps to the right side, thereby making the highway more uniform and alleviating confusion and frustration for users, in addition to increasing safety of the system.

5.CME.45

Pedestrian Bridge Over an Intersection

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UIC Dept. of Civil and Materials
Engineering

The purpose of this project is to design a pedestrian bridge over the intersection of Michigan Ave and Monroe St. The pedestrian bridge would improve the flow of traffic in and around the intersection. It would also allow pedestrians to cross the intersection and access the beautiful landmarks, such as Millennium Park, the Art Institute of Chicago and other stores and restaurants. This also ensures the safety of pedestrians. The Bridge would have an X-shape design and the spans, cable and arch beam would be made of steel. The column and the footing would be made of reinforced concrete. The length of the bridge would be 90ft. The column and footing would comply with the ACI 318-08 reinforced concrete manual, the steel part would comply with the AISC steel

construction manual. The bridge itself would comply with the AASHTO bridge design code.

5.CME.47

Science Engineering Lab/Student Center East Connection Bridge

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Engineering

Students at the University of Illinois at Chicago (UIC) often find themselves walking from class to class in unfavorable weather conditions. This results in students having to attend lectures wet and cold, potentially distracting them from their studies. The purpose of this project is to design a pedestrian bridge connecting the second floor of the Science Engineering Lab (SEL) building with the second floor of the Student Center East (SCE) building so that students can walk back and forth without having to encounter any possible bad weather. This bridge would also reduce the amount of time required to travel between the two buildings, allowing students to quickly get their meals and return to their studies. The pedestrian bridge conforms to standards in the AISC Steel Construction Manual, and the ACI 318-08 Reinforced Concrete Manual. The bridge was designed to have aesthetic appeal, since it runs parallel to Halsted Street and would be easily visible to passers-by. Pedestrian traffic counts were taken in order to get an estimated live load for the bridge, however since it can be assumed that a new bridge would increase traffic between the two buildings, a traffic load of approximately double the average current load was designed for to ensure the safety of the students.

6.CME.36

Spring Water Collection and Treatment System for Logba-Tota, Ghana

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Advisor: Amid P. Khodadoust, PhD
UIC Dept. of Civil and Materials Engineering

Logba-Tota is a village in the Volta region of Ghana. The village is located close to a spring that flows down a mountain. The problem the village faces is that it does not have convenient access to the water because it is located 4 kilometers away. The goal of this project is to design a system that will collect the spring water and transport it to the town, where it will be treated before consumption. This system will provide the village with adequate drinking water throughout the year. The challenge of the design group was to design an intake system, pipeline, filtration system, and reservoir for the town. Since we are dealing with an impoverished town, the major restriction was cost. To collect the water, a ditch intake was designed to allow for a sufficient flow of water. A pipeline made of PVC was designed to transport the water to the filtration system in the town. A major advantage of the elevation of the water was that no pumping was required to transport it to the village. The water was also under sufficient pressure that no additional energy was required to get it through the filtration system. The designed filtration system consists of a slow sand filter and a chlorinator. Finally, a reservoir was designed to meet the long term water needs of the village. With the design parameters and restrictions for the village's water collection, water treatment, and cost efficiency, the proposed design will satisfy the initial goals first set forth.

5.CME.44

Texas Retaining Wall Failure

Juan Almaraz, Scott Bucek, Gerardo Fierro, Helene Maldonado

Advisor: Krishna R. Reddy, PhD
UIC Dept. of Civil and Materials Engineering

On January 24, 2010 ninety-one homes were immediately evacuated from the Hills of Rivermist subdivision in San Antonio, Texas due to a land slide accompanied with a retaining wall failure. Upon further investigation, the City of San Antonio Development Services suspended the certificate of occupancy for 25 of the nearest homes to the incident and allowed the rest of the evacuated residents to return back to their homes. The failure of the 30-foot tall, 1000-foot long retaining wall has caused extensive structural damage to many nearby homes. A San Antonio city official who inspected a collapsed region of the retaining wall said that the wall was not constructed according to the design engineer's plan. Local experts speculate that the improperly built retaining wall failed due to added pressure from soil swelling caused by recent rainfall. Our goal is to design a reinforced concrete retaining wall for the San Antonio subdivision based upon the available dimensions of the existing structure. The retaining wall will be designed using applicable building codes and local soil characteristics of the San Antonio area.

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

8.ECE.55

Automated Electronic Dog Whistle

Ivan Martinez, Jorge Perez, Marwin Quito

Advisor: Vladimir Goncharoff, PhD
UIC Dept. of Electrical and Computer Engineering

Approximately thirty-nine percent of US homeowners own at least one dog. While dogs can be considered great companions, there are several problems that may be encountered by dog owners while raising and training their pet. Most dog owners are familiar with the difficulties of training a dog to stay quiet, a problem that has its list of ramifications such as loud and unwanted group barking amongst neighborhood dogs. As of 2009, the threat exists of being fined by the City of Chicago from \$50 to \$250 for a continuously noisy offender. There are several solutions to this problem currently available on the market. They include an inexpensive dog whistle which requires the user to be present at the time of the barking; and also expensive automated devices, which utilize DSP to detect the bark and trigger electronics to release a high-frequency tone.

Our proposed solution to this problem is an automated dog whistle that generates a high pitch tone a short time after continuous barking is detected. The concept is to train the dog to associate its abrasive barking episodes with the discomfort of the high-pitched tone. The product is designed to utilize only the most basic analog components, therefore rendering the product much cheaper than currently existing digital competitors in the market. The increased affordability of this particular solution would assist many owners who currently deal with a barking problem.

8.ECE.56

Automatic De-icing Car System

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Advisor: Masud H. Chowdhury, PhD
UIC Dept. of Electrical and Computer Engineering

Many drivers in the Chicago area and cities around the world every year deal with extreme snow weather conditions. Along with winter comes winter storms and frozen car windows. Running the defroster will eventually melt the ice away, but will likely take more time than you have available. Scraping the ice away is another option for removing the ice, but one that is labor intensive and requires you to expose yourself to the elements.

The objective of this project is to design a system for a car that will clean the windshield when the automobile is not running.

This Product will use a micro-controller to control the sensors mounted on the windshield. A timer will control the time on how long the power grids and windshield wipers will be on depending on the information sent by the sensors to the micro controller. This will be power by a rechargeable battery.

The rechargeable battery will be connected to an alternator to power it back up by using an inverter. Although the designs worked, there are still improvements that can be made by incorporating a better power management, to maintain the performance of the circuit.

The final cost of implementation was lower than we expected. There are many ways the cost of production could be much cheaper but the actual cost is manageable.

2.ECE.22

Blind Eyes

Michael Erington, David Liu, Alexander Sanabria

Advisor: Vahe Caliskan, PhD
UIC Dept. of Electrical and Computer
Engineering

Some of the most common accidents on today's road are caused by drivers failing to check their blind spots, resulting in numerous fender benders every year. These accidents, while often relatively harmless for most vehicles, can be dire for cyclists. Thus it is imperative that a motorcyclist be continually aware of their surroundings. Blind Eyes will help the rider by advising them that there is a vehicle in their blind spot, facilitating the reduction of accidents. Although Blind Eyes is not meant to be a substitute for actually checking one's blind spot it will give users aid to monitoring their blind spots, increasing the rider's awareness and ultimately helping to save lives.

Our goal is to combine Ultrasonic sensory technology with a micro-controller in order to create a visual aid that will assist the rider by notifying them if a vehicle is in their blind spot.

Sensors, located behind the helmet, will sense the distance between a vehicle within a user's blind spot and report this to the micro-controller. The micro-controller will then turn on one or more corresponding LEDs. The LEDs will be color coded to represent distance between the motorcycle and the vehicle within the user's blind spot.

Ultimately our system will assist riders when they are on the road and help save lives. This device will be affordable and universal for all motorcycle and bicycle helmets.

7.ECE.52

Frozen Pipe Monitoring and Prevention System

Patricia Harris, Christopher Means, Marcus Weathersby

Advisor: Roland Priemer, PhD
UIC Dept. of Electrical and Computer
Engineering

Water pipe freezing can cause major problems. If left untreated, fluid freezing inside a pipe and expanding can cause the pipe to rupture. There are several methods to prevent this problem. The most common method is to insulate the pipe with Styrofoam. Another solution is to not allow the fluid to be sedentary by adjusting faucets to allow a constant fluid trickle. Both methods are effective, however they do not offer guaranteed protection. The goal of our project is to create a stand-alone and easily applied system that prohibits any occurrence or threat of frozen pipes. We propose to continuously monitor the pipe temperature with a sensor installed on the outside of the pipe, and if the sensed temperature is too low, then turn on a heating wire that is wound around the outside of the pipe. To perform this activity, a microcontroller will be used to receive temperature sensor output. This will provide a means to continuously observe and record current conditions and notify a user of any problems. When the microcontroller finds that the temperature is below a threshold, it executes several steps. These include warming the pipe by turning on the heating wire, notifying the user of this process, and possibly shutting off other associated water valves.

7.ECE.48

Greener Outdoor Lighting

Alex Benison, Benjamin Salvador

Advisor: Vitali Metlushko, PhD
UIC Dept. of Electrical and Computer
Engineering

Energy conservation is becoming a major issue in the United States due to the economy, environment, and international trade relations. It is imperative that solutions are found to reduce daily energy consumption in a significant way. Parking lots, parking structures, and public roadways have many lights that needlessly stay on throughout the night in the absence of vehicles. A cheap and effective loop detector can be used to manage the illumination needs of specific locations within a parking structure, or on a roadway, by providing vehicle presence awareness. Existing loop detector circuitry on the market for use in traffic signals is applicable but overly capable and expensive. Presented is a solution for roadway or parking structure illumination with a focus on energy use mitigation through the use of simple technologies at low cost.

7.ECE.49

Light Drive: An Application of L.E.D. Data Transmission

George W. Alvarez, Mauricio J. Gonzalez

Advisor: Vladimir Goncharoff, PhD
UIC Dept. of Electrical and Computer
Engineering

At a time when the job market is unstable and there is an increase in unemployment, there is also increased interest in attending career fairs or any environment where contact with many employers can be executed efficiently. As a consequence there are a lot of resumes that get exchanged in the process. Unfortunately a majority of these resumes get discarded quickly, which results in unnecessary waste of paper.

Our project aims to create a device to transmit an electronic copy of a resume from a portable transmitting device to a receiver via data transmission using light emitting diodes (L.E.D.s). Because L.E.D.s can cycle at rates of millions of cycles per second, and appear naked to the human eye, they can be used to transmit binary data in a method that is very fast and efficient in ideal lighting conditions. Requirements include development of a transmitter utilizing a L.E.D. that can transmit the data efficiently and quickly in specific lighting conditions, a receiving module which can decode and reconstruct data to be transported to an employer's laptop as a document, and a user interface that can store all the collected resumes. Successful implementation can serve as a model for future applications of this form of data transmission. As we approach the conclusion of our project we hope to have successfully developed an application of an existent technology in a method that promotes eco-friendly technology and develops our engineering background.

2.ECE.20

Low Cost Function Generator

Adediran Adeleke, Rakeshkumar Patel, Stanley Syerov

Advisor: Roland Priemer, PhD
UIC Dept. of Electrical and Computer
Engineering

Looking at the current market of function generators, it is evident that there really is no model out there that is affordable to a student to use for the lab work, or for an average person to use for some tasks at home. The models that are available are usually very complicated and thus expensive, so the purpose of our project is to change that. Our plan is to allow the user to interface with a microcontroller using an LCD

and keypad combo, and the microcontroller to interact with a pre-developed function generating integrated circuit. The device will have only the basic functions implemented, but the advantage is that it will be much cheaper. A big advantage of our design is that the device will be portable, since it will be operable on batteries and the device will be small and light. This device will be ideal for students who study engineering-related fields, since it will allow them to prepare for laboratory work before doing the experiment, and for other people who like to work with electronics and need a function generator once in a while.

7.ECE.50

Ribbit Recorder

Anthony Biank, Daniel Dobrzynski, Aaron Jones

Advisor: Robert Becker, MSc
UIC Dept. of Electrical and Computer
Engineering

In remote parts of the world, many species of frog and toad are nearing endangerment or even extinction. Unfortunately, due to the remoteness of their habitat, nearly nothing is known about the behavior and survival of these species. It is impossible to make an effective effort towards preservation without a basic understanding of how they live and breed. As of now, biologists lack the technology to properly monitor and study these unique creatures. In the interest of saving a fascinating and important part of our natural world, we would like to propose an innovative solution to recording the calls of these frogs so that more information may be determined regarding their range, population, and breeding. Our solution provides a wireless interface through which the device can be accessed remotely from a laboratory. This allows data to be acquired more often and accessed much more efficiently. Utilizing an

audio filter, we have designed the device to “listen” for frogs and activate the recording mechanism only at times when calls are detected. In order for the audio data obtained from the recordings to be used scientifically, it is necessary to also monitor weather conditions so that the effect of climate on the frogs’ calling habits may be observed. Our design regularly checks and stores data detailing temperature, humidity, barometric pressure, and lighting levels. Furthermore, it is capable of sustaining itself indefinitely. Our solution is equipped with a solar panel, effectively maximizing sustainability and ease of operation.

8.ECE.54

Room Illuminator: The Smart LED Lighting Alternative

Daminabo Harry, Joshua Lawrence, Sameer Raheja

Advisor: Robert A. Becker, MSc
UIC Dept. of Electrical and Computer
Engineering

The push towards using energy-efficient light bulbs has received increased attention in recent years, with many countries passing legislation mandating the use of energy efficient lighting. With this in mind, our team has designed an indoor LED lighting system that can be controlled manually or automatically. We decided to use LEDs because they are much more energy-efficient than incandescent bulbs, and environmentally friendly than compact fluorescent bulbs which can contain mercury. LEDs also allow us to use a pulse-width modulation approach which also saves a significant amount of energy. In regards to our system itself, it should ideally be placed in a room where a significant amount of sunlight in order to get full usage of its features. The LED intensity decreases or increases depending on

whether there is more or less ambient light entering the room. The user also has the option of manually dimming the light intensity for convenience. Depending on the success of prototyping and testing phases of this project in the weeks preceding the Engineering Expo, we will also work on programming the device turn on or off as soon as the user enters or leaves the room. In the future, we may focus on voice-controlled dimming, which could not be added at this time due to the complexity of building and programming such a feature in itself! Adding this feature, along with the task of optimizing our project for possible production are two possible ensuing steps

8.ECE.53

Smart Seatz

Russ Gladchenko, Lian Guan, Fernando Gutierrez, Minh Ngoc Nguyen

Advisor: Vitali Metlushko, PhD
UIC Dept. of Electrical and Computer Engineering

Finding seats in crowded places can be a hassle. The goal of our project, Smart Seatz, is to solve this problem by designing a device that will allow users to find the best available seat in an event where the seats are not pre-assigned. Users will be able to find a seat faster, safer, and more efficiently.

The desired final design consists of custom made cushions that will attach to any existing seats and will communicate to a display board wirelessly. Infrared technology will be implemented for the realization of this task. The display board will be color coded and will also be strategically placed inside the facility to make it easier for the users to see and find the desired seat. It will display which seats are taken and which seats are available. The device will also include a reserve button feature. This feature will

allow users to save the seat for a certain amount of time. For the purpose of reducing power consumption, a stand-by mode might be added to the device.

This device is necessary because no such device exists. Unless the seats are pre-assigned, it is up to the user to find a seat. Our project will not only eliminate disruptions, but will also prevent users from taking up more than one seat and will also reduce traffic flow in the facility. Our product is envisioned for facilities while providing a service to its users.

8.ECE.57

Sound Security

Emmanuel Adufah, Kevin Green, Michael Walsh

Advisor: Roland Priemer, PhD
UIC Dept. of Electrical and Computer Engineering

With the proliferation of video monitoring cameras, it becomes increasingly difficult to monitor every video feed by a human operator. We aim to replace the active monitoring of humans with the interrupt-based monitoring of an audio solution. We are developing a system that makes the user feel safe and sound. Sound Security uses a keychain alarm that emits a 120db signal to alert nearby audio sensor nodes of a user in distress. Audio sensor nodes then notify via wireless the central security office that a patron is in need of help. The keychain alarm emits an audio signal of a varying frequency versus time. This creates a specific fingerprint of the sound. The audio sensor nodes then wait to receive this fingerprint. The use of audio fingerprinting allows accurate identification even in noisy environments. Wireless communications is achieved using the ZigBee protocol arranged in a mesh network. This allows the network to be easily extensible and

resilient. When the node recognizes that an alarm is triggered, a wireless signal is sent to a base station located in the security office. At the base station, a user interface would then display on which node an alarm has been signaled, alerting security personnel that a patron is in need of help. This projects aims to be an easily-installed infrastructure upgrade supplementing existing security systems.

2.ECE.18

Sump Pump Monitoring System

Zeshun Cai, Syed Fouzan Hussaini, Irfan Khan

Advisor: Yingwei Yao, PhD
UIC Dept of. Electrical and Computer Engineering

Many houses have a sump in the basement where rain water gathers. When it rains, the rain water around the house drains into the sump. At the bottom of the sump there is a pump, which pumps the water in sump outside the house. If there is a problem with the sump pump, this can lead to water gathering in the sump. If the pump fails during heavy rainfall, the sump will overflow and flood the basement. The goal of this project is to design a device which will be able to monitor the state of the sump as well as the sump pump. If it is determined that the sump pump has stopped working or power to the pump has been lost the user will be immediately notified. The current draw of the pump will also be monitored in order to identify pump failure before catastrophic failure occurs. To accomplish this goal, a level sensor, a power sensor, and a current sensor will gather data on various aspects of the sump pump system. If the level sensor or power sensor trip, the user will be notified using an SMS text that the sump may be in danger of overflowing and flooding may occur. The current sensor will continuously send the current draw of the pump to a computer. The current draw will then be stored and periodically

analyzed. If the current draw shows a trend similar to that of a failing pump, the user will be informed that the sump pump may experience a catastrophic failure in the near future.

7.ECE.51

Wireless Power Transfer

Shivraj Bhosale, Bijay Pokharel, Michael Samaniego, Pravin Sridhar

Advisor: H.Y. David Yang, PhD
UIC Dept. of Electrical and Computer Engineering

In today's technology, absolutely everything is going wireless. Consumers demand these types of products from the market place, and companies are doing everything they can to eliminate wires from anything that they can. Besides the obvious cosmetic reasons for going wireless, there are a lot of benefits from furthering the study of wireless technology. Our group specifically decided to deal with the wireless power transfer. The primary goal of our group was to create a system that can receive an AC signal, sent wirelessly, and convert it to a useable DC output. The specific requirement include developing a system that is easily built so that it can be reproduced cheaply, but complex enough to handle the wireless transmitting signal and voltage conversion from AC to DC. It must also be able to be versatile, in that we can use the same system for many different applications, such as charging a device or battery. First, we designed the system and simulated it in a PSpice circuit. We then created an actual prototype of our design before we finalized it to test our system. Finally our system was able to wirelessly receive an AC output and convert it to DC. Our ideas started out as very ambitious, but once narrowed down, we were able to accomplish what we set out to do. This product allows for various updates, like extending the distance between the transmitter

and receiver, or getting more power from the output to use for other applications.

DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING

2.MIE.19

Dual Levered Sink Handle

Chris Dahl, Sanjin Hodzic, Tracie Walker

Advisor: Carmen Lilly, PhD
UIC Dept. of Mechanical and
Industrial Engineering

As common as the act of hand washing is, a standard sink handle lever is a rather unsanitary system. For the usual lever system on a sink, the user will touch the single handle to turn the faucet to a desired temperature. Next, the user will once again touch the same surface, which has now been contaminated while turning the system on, in an attempt to turn the faucet system off and essentially result in recontamination of their hands with those same germs. Our project is a dual levered sink handle with a design that would allow the user to touch alternating levers for an on and off position as to allow minimal recontamination of the users hands before and after washing. To do this, there were some obstacles we were going to consider. Though the idea was established by our client, we were to optimize lever orientation that would best suit the desired results, as stated above. Our first objective prior to any real design was to have clear labeling. We concluded that a simple on/off instruction was to be implemented as formal labeling. Next, we

wanted optimal angle and orientation of the two levers, and began consideration as to whether they would be stacked, staggered, at different heights, consist of different lengths and different angles. After considering these options and researching germ studies and user behavior, our mock up constructions have led us to a single plane, same length handle system with a set degree offset with clear labeling was the ideal, simple solution to this problem of recontamination. We aim to alter the current design for the client company to keep within their design parameters, but simply add the additional arm with the desired arm orientation. This is a lower cost alternative to current sanitary faucet design in the market such as costly sensor faucets and would be ideal for aftermarket purchase in public homes and may be used in commercial settings in restrooms as well. With this low cost alternative to replace a single lever sink handle, we can achieve our alternate goal of minimizing recontamination and provide a more sanitary hand washing system.

1.MIE.5

Easter Seals Bicycle Project

Patryk Pieta, Uday Sangar, Tarndeeep Singh

Client: Kathy McGuire
Easter Seals

The primary goal of our project is to design a bicycle for a disabled 10 year-old boy. The boy has an amputated left leg and limited strength in his right hand. The parents want the boy to ride the bicycle independently with no assistance from them. Independence is not our only goal for the bike; safety is our number one priority. Our main focus is to make the boy feel like any other 10 year-old riding his bicycle.

When physical disability prevents a child from achieving their full range of independence, any measure of restoring and helping to develop this sense of independence is essential. The driving

force behind our bicycle project is the desire to help a young kid ride a bicycle by himself, and whose family requested someone to design a bike for him. While this bike will not be able to perform any medical miracles, we are hoping it will help him to become more independent as he ages.

1.MIE.4

The Foot Strengthener

Adriana Artiga, Laura Ruiz-Santamaria, Marcelo Sahagun

Advisor: Ryan Kole
RK Inventions

In today's gym, there is an exercise machine for every part of the body except one: the foot. What many people do not realize is that there are over twenty muscles in the foot and around ten in the shin that connects to the foot. Therefore, a foot exercise device is ideal and necessary for people looking to improve their performance, stability and balance. With this in mind, the goal of the project is to create a prototype that exercises the appropriate foot muscles. This working prototype must safely target the appropriate muscles while sustaining wear and tear in a daily use. The Foot Strengthener incorporates adequate material and measurements that are susceptible to various foot sizes. While being light weight and easy to store, this product also features varying levels of resistance and an adjustable heel counter. Two prototypes with different operational mechanisms of resistance were tested to insure compliance of the desired functional features. Feedback of both designs was received by occupational therapists, rehabilitation doctors, and a biomechanics expert from the UIC College of Engineering. This allowed us to modify and finalize our design to meet the needs of prospective users. Through our design process, our team was able to accomplish the production of a fully functional

foot strengthener which is not only attractive and safe for consumers but also economical.

2.MIE.21

Improved Speed Freight Bogie Suspension

Martin Hamper, Pratik Shah, Ulysses Contreras

Advisor: Ahmed Shabana, PhD
UIC Dept. of Mechanical and Industrial Engineering

The principle goal of this project is to develop a suspension system that can effectively increase the critical speed of a freight railroad vehicle. There are many factors that can affect the maximum or critical speed of a railroad vehicle; i.e. the wheel and rail profile, the primary, secondary & tertiary suspensions, the quality of the rail etc. However, this project will focus on modifying the secondary suspension (i.e. the spring package) with the intention of increasing its critical speed to at least 110 MPH.

To do this, first a 3D model of the bogie will be constructed. Although there are many programs available to construct a 3D model, ProE will be selected because it is readily available to students at UIC. Important information such as the body mass and mass moments of inertia can be extracted easily from the ProE model for use in the engineering analysis.

In SAMS/2000, a single railroad car will be modeled under ideal circumstances. A tangent track with no irregularities will be used to mimic the performance of the vehicle under optimum conditions. Since ideal circumstances will be observed, all rigid bodies will be assumed as non-deformable. Under these conditions, SAMS/2000 can be used to determine the critical speed of the vehicle.

In order to determine the critical speed of the vehicle, a stability analysis will be performed. The stability analysis will require SAMS/2000 to run the full vehicle model at a constant speed over a specific time interval. As a result, information regarding the lateral position of the vehicle will be available for analysis. Stability will be defined as a relatively constant sinusoidal plot of the lateral position of the vehicle with respect to time. The vehicle speed will be increased until the plot is sinusoidal with an amplitude that is increasing without bounds—thus displaying instability.

During the analysis, animations will be created to help visualize the stability of the vehicle at the newly determined critical speed. For this, the program 3D Studio Max will be used to create the animations using the output data from SAMS/2000. 3D Studio Max was chosen because of the powerful animation tools which it provides.

12.MIE.26

Manufacturing Process Optimization for Radioactive Implants

Mays Almasri, Jennifer Flight, Dave Urda

Advisors: Andrew Reuter
Bard Brachytherapy

Located in Carol Stream, Illinois, Bard Brachytherapy is a division of C. R. Bard, Inc specializing in the diagnosis and treatment of prostate cancer. Bard produces approximately 50,000 to 80,000 radioactive implants each month with intensities ranging between 0.19MCL to 0.96MCL, because their product is radioactive, special consideration needs to be made for decay. By performing a time study on the manufacturing and packaging processes, we will analyze the cycle times for each batch of implants and develop a simulation model which accurately represents the process to determine

the optimal batch size to maintain inventory while eliminating the bottleneck within their process. To accomplish our goals we intend to utilize the cycle times obtained through our time study to verify the company's cycle times and determine whether the standards in place are realistic through the use of simulation software. Arena will be used to analyze the time study and cycle data to generate accurate models of the production processes. Because Arena has built in optimization software, our model can be manipulated to find the optimal batch size or another constraint, allowing the Bard to utilize our solution far into the future. We will provide two simulation models which represent the production of seeds and the packaging operations using the cycle times derived from our time study.

12.MIE.23

NALCO Truck Unloading Safety Upgrade

Vincent Bullen, Daniel Garcia, Asim Prses

Advisor: Jon Boo
Research Scientist, NALCO Water
and Core Technologies

Nalco Company is the world's leading water treatment and process improvement company. Their 66th Place Water Services Campus in Chicago has a chemical loading and unloading process (LUP) in which safety is one of the primary considerations. Nalco desired safety evaluations of the workers and cistern-truck drivers for this chemical handling process to increase the immediate safety of the worker while keeping cost and procedural time in mind. Design safety requirements were utilized in accordance to current industry standards set by Nalco. Additionally, all design is compliant to Occupational Safety and Health Administration (OSHA) standards for chemical handling, and fall under the guidelines and requirements set by the Department of Transportation (DOT), and

Federal Motor Carrier Safety Administration (FMCSA). The proposed design decreases potential physical and chemical hazards to the worker. Using worker interviews, observations, literary research, and concept generation, it was possible to formulate revised drawings of Nalco's current layout and identify areas of improvement for the worker's completion of the LUP. Based on the findings, the plan would increase the immediate safety of the worker, and efficient maneuvering of the cistern truck into the loading dock. The plan provides Nalco with revised drawings of their current loading dock layout, and job safety analysis of the workers and truck drivers.

6.MIE.34

NALCO Water Softener Improvement Project

Tim Pollard, Jason Zhang, Henry Zhao

Advisor: Keith Schutt
NALCO Chemical Company

The current water softener system for Nalco is deteriorating and is in need of a replacement to keep the water quality at Nalco manufacturing standards. The primary goal of our project is to investigate the possible replacement of the current softener tanks with fiberglass and/or carbon steel tanks with white lining. The piping of the system would need to be replaced as well with fiberglass or stainless steel. Nalco wishes to determine the feasibility of the replacement based on material and cost. A secondary goal from Nalco, starting from the pump, is to design a whole new water softener system that would fit in the current allotted area but would allow greater flow and redundancy for the company to run more efficiently. Our first priority was to do market research on the cost of the materials that would be required to replace the tanks and piping. Upon finalizing on the material, design of a strategy to eliminate water hammering for the

system would have to be done. Lastly, certain components required for efficiency, such as bag house systems for the salt tank would be investigated.

12.MIE.24

Nitric Acid Distribution System

Paul Chojecki, Ryan Porzel, Mike Zigulich

Advisor: Keith A. Schutt
Process Engineer

NALCO Holdings is a company that specializes in, but does not limit itself to, water treatment and the production of chemicals. NALCO is interested in producing a system for the distribution of nitric acid of 70% concentration. The nitric acid would originate from a tote capable of housing 300-400 gallons of the acid. From this tote the acid should be capable of being delivered to 3 or 4 tanks in specified quantities via pipes. It is necessary to construct a diagram showing the path locations of the pipes and the valves and pump that will be used. The layout of the system should take into account such considerations as the cost of the system and safety of the employees who will operate the system.

The nitric acid and distribution system would be required to deliver 150 pounds of nitric acid of 70% concentration into a tank that would be chosen by the operator. The delivery of these 150 pounds of acid should be accomplished in no more than 15 minutes. The nitric acid distribution system should also be able to deliver nitric acid into containers ranging from half a gallon to five gallons in a reasonable amount of time.

4.MIE.28

SEN Payback

Brian Clark, Jim Gibson, Dan Hollenbach, Dylan Matthews

Advisor: William Ryan, PhD
UIC Dept. of Mechanical and Electrical Engineering

Ecological responsibility is a dynamic concept. Today an unprecedented awareness of the true economical and environmental costs of modern living have demanded a reassessment of how energy is produced, where it comes from, and, more to the point, how it is used.

Currently, the residential and commercial sector, consuming an average 40% of the nation's power compared to 32% for the industrial arena, remains largely in the dark on how specifically to reduce the energy usage of their home or business, however, and thus accountability has taken a counterintuitive turn. Individuals may recognize the importance of conservation efforts, but typical suggestions generalize the energy-efficiency movement with little mention of capital expenditure, government rebates, or practical payback. Only by empowering citizens to quantify their own personal savings opportunities can environmental engineering to have any substantial impact.

Going forward with this idea has necessitated the creation of an interactive online setting capable of calculating payback on several specific energy-saving home and office improvement projects based on specific user input, associated implementation costs, and programmed cost savings equations that have served the industrial sector for years. Knowledge of thermodynamics, financial engineering, heat transfer, programming, fluid mechanics, energy auditing, and marketing, among other things, has been applied to ensure an accurate analysis of energy usage and the proper presentation of engineering solutions. Ease of navigation and usability were applied as secondary goals to ensure a sleek web format and help pave the way for a heightened

awareness of consumer solutions to energy mismanagement in a climate of economic freeze and environmental concern.

12.MIE.25

Turntable Manufacturing Line Layout

Mateuz Bujalski, Selham Kazokoglu, Kamil Luto

Advisor: Michael Brown, PhD
UIC Dept. of Mechanical and Industrial Engineering

Miller Welding and Machine Co., provides machining and assembly services. In 40 years it has grown from a 3-person business in a garage to a nationally recognized, ISO certified, and award winning business today. Our project for Mr. David Miller, the President of the company, is to design a manufacturing line for a turntable assembly. The objective of this project is to come up with 2 different layouts, each having slightly different assumptions and space constraints. The first layout will be based on the space that is currently available to the company at the facilities location, whereas the second will include additional space currently unavailable for the project. The former will account for two machines which already have their location, and the latter which includes their relocation. There is a designated area which we can utilize. The most efficient layout includes a decrease in the usage of space, parts traveling distance, and parts handling time. Also, we need to keep in mind that the assembly parts will be handled with use of cranes and these cranes have limited movement capabilities. A potential safety hazard results from the facts that the parts are heavy to move.

In addition to space constraints, another critical design aspect is the parts flow. The entire assembly process needs to be performed in a specific sequence. Some work stations in the sequence are already in place and their location is permanent – they cannot be moved. Two machines, KBN135 and Toshiba, as well as the entire paint line already have their locations. It is assumed that all machines have proper hook ups and are able to be moved to any designated area that is feasible (considering the constraints). Risks include crane usage, space requirement for handling parts, and human/other parts traffic on a mutual path in the facility. We will account for these risks minimizing the possibility of accidents.

12.MIE.27

Warehouse Heating

Patrick Hageman, Jeff Janicki, Vishal Shah

Advisor: Chad Brajercik,
Staff Engineer, NALCO
Company

NALCO Chemical Company presented us with a 74,000 square foot warehouse that is currently being heated by a very inefficient steam system. Our job was to completely scrap their design and redesign a brand new system employing the most efficient heating alternative possible. By utilizing a product with the capability of over 99% efficiency we were able to overhaul their entire layout and drastically reduce the carbon footprint of Nalco Company building 24.

6.MIE.33

Water Distribution System for the Community of Cerro Alto

Sam Choi, Jason Maciejewski, Michael Pappalardo

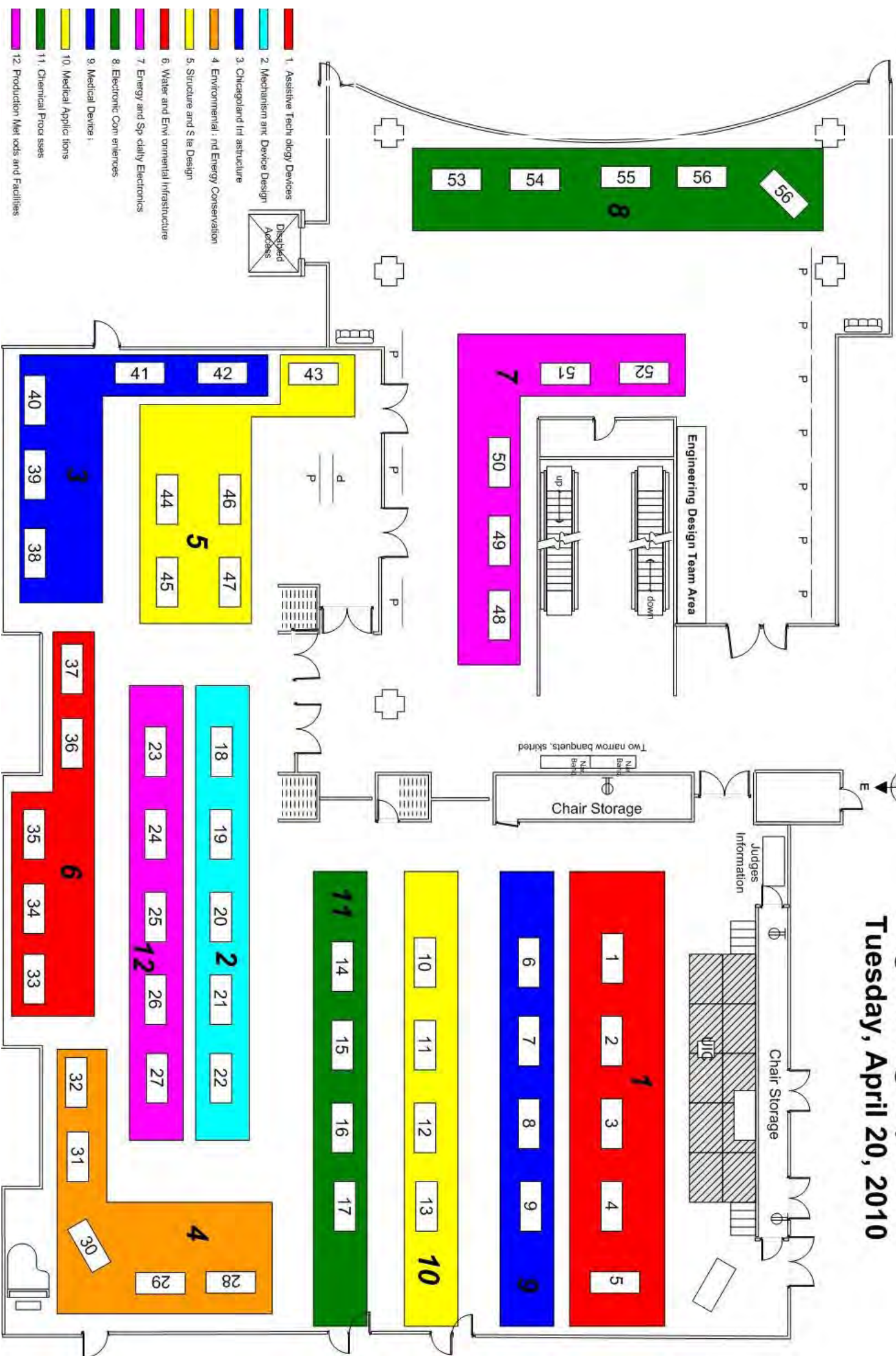
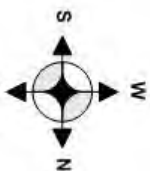
Advisor: Carmen Lilly, PhD
UIC Dept. of Mechanical and
Industrial Engineering

The UIC chapter of Engineers Without Borders (EWB-UIC) is partnered with Cerro Alto, Guatemala. Originally partnered with this community in 2006, EWB-UIC conducted an initial health assessment report that revealed a number of health concerns mostly attributed to the buildup of bacteria from infrequent water delivery. EWB-UIC made water quality improvement their primary goal. In the past this was attempted through a combination of a chlorine system, ceramic filters, and health education to the community; however their work has yielded marginal results.

The objective of our project is to improve Cerro Alto's water quality by implementing the design of a water system, in conjunction with their current system, to deliver water at a more frequent and predictable rate. Based on the failure of previous projects, Cerro Alto's water conditions will hardly improve with their current system that only allows for fresh water every three to four days. By increasing this rate with our design, water will not need to be stored for days like before, thus decreasing bacterial growth and improving water quality. Our design is created with a low residual cost for the community along with sizing for population growth. By working alongside EWB-UIC and implementing our design, we hope to improve the health of the community of Cerro Alto for many years.

Illinois Rooms with Fort Dearborn

Engineering Expo 2010
Tuesday, April 20, 2010



- 1. Assistive Technology Devices
- 2. Mechanism and Device Design
- 3. Chicago and Intl Architecture
- 4. Environmental and Energy Conservation
- 5. Structure and Site Design
- 6. Water and Environmental Infrastructure
- 7. Energy and Specialty Electronics
- 8. Electronic Components
- 9. Medical Devices
- 10. Medical Applications
- 11. Chemical Processes
- 12. Production Methods and Facilities