

Armour College
of Engineering



ILLINOIS INSTITUTE OF TECHNOLOGY

2015 Engineering Undergraduate Summer Research Immersion Program



An aerial photograph of the Illinois Institute of Technology campus in Chicago. The foreground shows the green lawns and modern buildings of the campus, including the Lurie Tower. In the background, the dense city skyline of Chicago stretches across the horizon under a clear blue sky. The text 'engineering.iit.edu' is overlaid in the lower center of the image.

engineering.iit.edu



ILLINOIS INSTITUTE OF TECHNOLOGY

Armour College of Engineering
10 West 33 Street, Suite 224
Chicago, IL 60616

Natacha DePaola, Ph.D. Carol and Ed Kaplan Armour Dean of Engineering



2015 Engineering Undergraduate Summer Research Immersion Program



- 4 About**
- 5 Research Categories**
- 6 Lab Photos**
- 8 Events**
- 11 Research Expo**
- 12 Expo Photos**
- 14 Abstract Index**
- 18 Abstracts**
- 73 Posters**
- 110 Comments**
- 111 Credits**

2015 Armour College of Engineering Summer Research Immersion Program

Brazilian undergraduate students in the top two percent at their home institutions were selected and supported by their government to study and perform research in the United States as part of the Brazil Scientific Mobility Program (BSMP). This past summer, Illinois Institute of Technology (IIT) hosted the largest contingency of BSMP students of any university in the world. From a pool of 3,000 outstanding applicants, 424 BSMP engineering students were accepted into the IIT Armour College Summer Undergraduate Engineering Research Immersion Program alone. Over the course of 10 weeks, these students performed research under the guidance of over 70 engineering faculty and researchers.

The IIT Summer Engineering Research Immersion Program offered experiential learning through faculty mentored research and practical engineering training, as part of the distinctive and comprehensive Armour College of Engineering Research and Development program for undergraduates (Armour R&D). Research and development opportunities include biomedical engineering and health technology, engineering processes and product development, hardware, software, and communications, energy, water, transportation and sustainability, facilities, operations and project management, civil and construction engineering, engineering materials. Through these research opportunities, students have access to all facilities at the University including state-of-the-art engineering research laboratories, instructional laboratories and facilities, fabrication and design studios, and the campus at large.

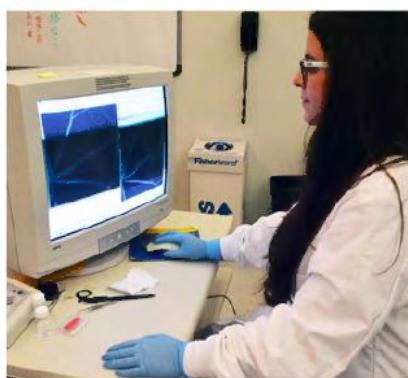
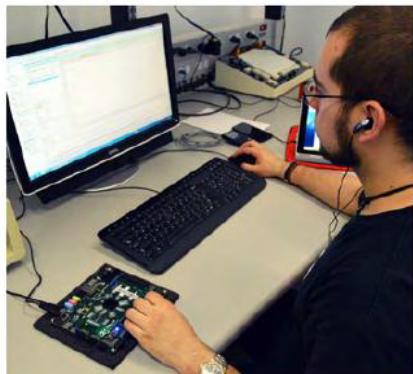
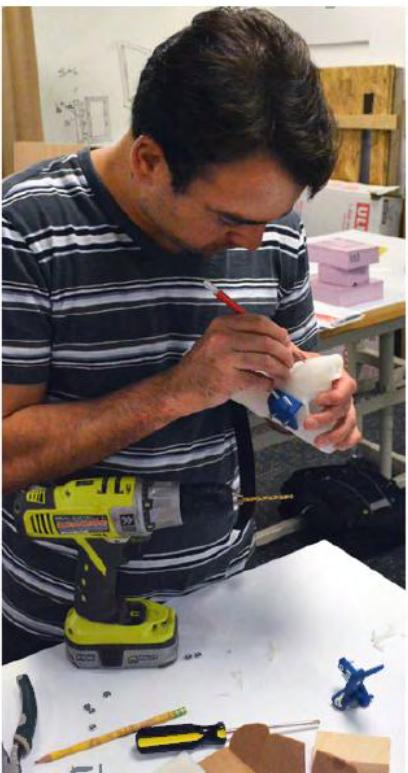
"It is gratifying to see how the BSMP students are benefiting from their academic training at IIT," said Consul General Paulo Camargo. "The Engineering Program has created meaningful research opportunities that will allow the students to go home to Brazil with an innovative perspective on engineering lab work".

"IIT attracts students from all over the world. In addition to educating students to be technically proficient, analytical thinkers, we also seek to inspire them to innovate. The Summer Engineering Research Immersion Program provides students with unique knowledge to make a positive and immediate impact on the continuation of their engineering studies, and subsequent contribution to Brazil," explained Natacha DePaola, Carol and Ed Kaplan Armour Dean of Engineering.

The program culminated at the Armour R&D Expo on Wednesday, July 8 in the IIT McCormick Tribune Campus Center. There, these exceptional students were able to showcase their research results to Armour Faculty and Alumni, IIT Administration, industry partners, and members of the Brazilian Consulate of Chicago.

- 18 Biomedical Engineering & Health Technology
- 26 Civil & Construction R&D
- 32 Energy, Water, Transportation & Sustainability
- 45 Facilities, Operations & Project Management
- 49 Hardware, Software & Communications R&D
- 59 Materials R&D
- 64 Product & Process R&D

Lab Photos



Lab Photos



Events

Group Activities

General Academic Orientation

Speaker: Bonnie Haferkamp - Senior Lecturer of Biomedical Engineering and Director of Student Success as a member of the ACE Distinctive Education Leadership Team

Lab Safety Lecture

Students were exposed to the health and safety procedures required to safely conduct research on campus. Participants learned how and when to use the proper safety equipment while in the lab. They also learned methods to reduce the hazards and risks associated with working in a research laboratory.

Speaker: Cindy Chaffee - IIT Director of Environmental Health and Safety

Ethics in Engineering Lecture

Discussion centered on the role professional ethics play in the daily practice of engineering, and how ethical and technical guidelines help define what occupations are considered a "profession." The main portion of the session was interactive, with participants practicing their ethical decision-making skills by discussing two ethics case studies.

Speaker: Kelly Laas - IIT Center for the Study of Ethics in the Professions

Next Steps: Graduate School Panel

Earning a graduate degree can lead to rewarding careers in research, academia, and industry. At this seminar, students learned about the value of graduate engineering degrees, how to select and apply for schools, and what to expect when you begin a graduate degree program.

Speakers:

- Jamshid Mohammadi - Professor of Civil and Architectural Engineering, Associate Dean of the Graduate College for Academic Affairs, Director of Architectural Engineering
- David Mogul - Professor of Biomedical Engineering
- Elizabeth Durango-Cohen - Associate Professor of Operations Management Stuart School of Business

Sustainable Energy Pathway Lecture

Students were presented with an assessment of the strategy required for continuing the pathway toward global sustainable energy. Participants were also presented with an overview of current and future research and education programs and activities at Wanger Institute for Sustainable Energy Research (WISER) that have been developed as a part of this strategy.

Speaker: Hamid Arastoopour - Henry R. Linden Professor of Engineering Director of the Wanger Institute for Sustainability and Energy Research (WISER)

Giving Back to Brazil Panel

In this seminar participants learned about hopes the Brazilian Consulate has for BSMP students as they return to Brazil, and from American citizens who had a similar opportunity to make a difference in Brazil, and how that experience impacted the rest of their lives.

Speakers:

- Lilian Colsant - Education Cooperation Coordinator for Brazilian Consulate Chicago
- Margaret Rohter - former Peace Corp volunteer in Brazil
- Nan Sullivan - former Peace Corp volunteer in Brazil

Robotics Lecture

This lecture described recent advances in the field of robotics and how these advances can lead to future applications in the medicine, transportation, maintenance and manufacturing. Students also learned about the opportunities available to them if they choose to pursue a career in robotics.

Speakers:

- Derek Kamper - Associate Professor of Biomedical Engineering
- Matt Spenko - Associate Professor of Mechanical Engineering



Giving Back Globally Panel

Members of IIT's MEDLIFE and Engineers Without Borders chapters participated in a panel discussion to share their experience serving communities in Peru, Ecuador and Nicaragua. The groups discussed their work and fielded questions from the audience.

Speakers:

IIT - MEDLIFE

- Gina Qualter - Biology
- Egle Malinauskaitė - Biomedical Engineering
- Irena Grauzinis - Biology
- Sany Nguyen - Biomedical Engineering
- Trevor Wasserzeichen - Biomedical Engineering

Engineers Without Borders - IIT

- Neal Patel - Biomedical Engineering
- Yusra Khalid - Chemical Engineering

Opportunities Offered by Healthcare Data to Solve Big Data Challenges Lecture

Students learned about the characteristics of big data and how electronic health records relate to these characteristics. They also learned about the challenges that arise when mining for and analysing data from large data sets, and the opportunities presented by electronic health records to address these challenges.

Speaker: Ashfaq A. Khokhar - Chair of the Department of Electrical and Computer Engineering and Professor of Electrical and Computer Engineering

Path to Technology Commercialization Lecture

Attendees learned about the path to commercializing technologies invented in the lab. Students were exposed to the process from invention and assessment to patenting and commercialization. The lean business model was introduced and students were shown how it can be applied to understanding the value of a technology.

Speaker: Raja Krishnan - Intellectual Property Manager for IIT Technology Commercialization Office

Communicating Your Research Findings: Expo Poster Guidelines Lecture

Discussion at this lecture centered on how to best communicate the findings from a student's research on a poster. Guidelines were given on how participants should prepare their posters for the research Expo and tips given on how to best present their work.

Speakers:

- Bonnie Haferkamp - Senior Lecturer of Biomedical Engineering and Director of Student Success as a member of the ACE Distinctive Education Leadership Team
- Eric Brey - Duchossois Leadership Professor and Professor of Biomedical Engineering

Achieving Function, Quality, & Performance in Vegetated Roofing Systems Lecture

During the lecture students learned about the complexities of vegetated roofing systems. They were exposed to the typical components of a functional green roof system and provided with the procedures on how to improve the quality of vegetated roofing system designed by focusing on detailing and performance.

Speaker: John L. Breidenbach - Market Development Manager - Architecture for Tremco Roofing and Building Maintenance

Communicating Your Research Findings: Final Paper Guidelines Lecture

Students learned how to best communicate their research findings through a research paper. They learned about the components needed to write an academic paper and how to best include their research finding through their data.

Speaker: Bonnie Haferkamp - Senior Lecturer of Biomedical Engineering and Director of Student Success as a member of the ACE Distinctive Education Leadership Team

Social & Networking Events

Biomedical Engineering Luncheon & Presentations

The Biomedical Engineering Department had a luncheon for students participating in the program. At the event, students shared the projects they were working on with their peers and department faculty.

Ice Cream Social: A Networking Opportunity for Engineering Undergraduate Researchers

As a short break from the lab and group activities, students were given the opportunity to relax at an ice cream social. There, students socialized and networked with their peers, Armour Faculty members and visiting speakers.

Engineering Undergraduate Summer Research Immersion Program Networking BBQ

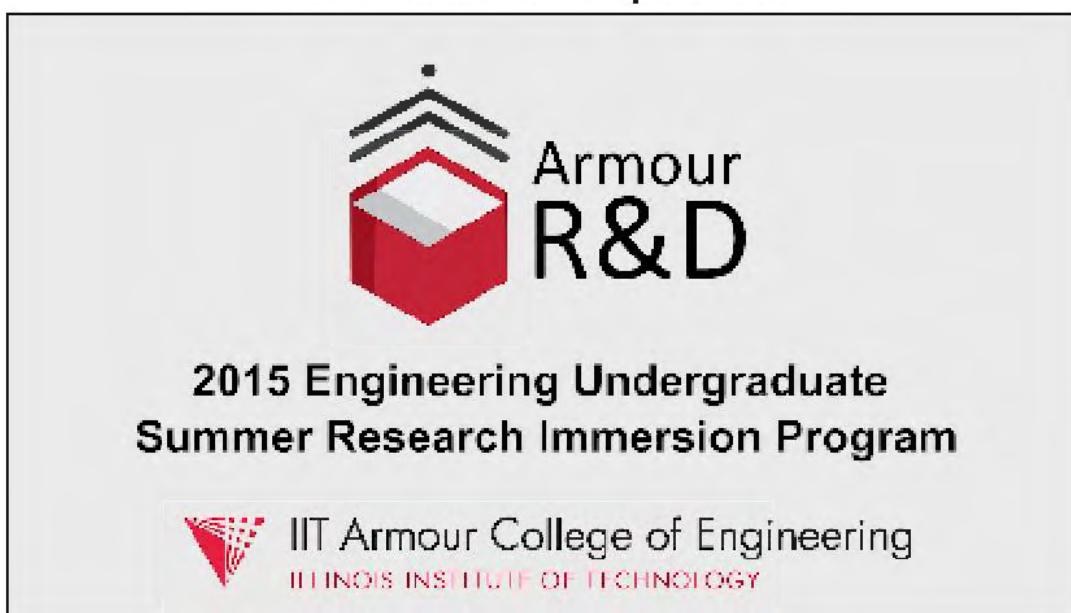
Students were given the opportunity to experience a traditional American barbecue. During the event, students ate, played games, and socialized and networked with their peers and Armour Faculty members.

Research Expo

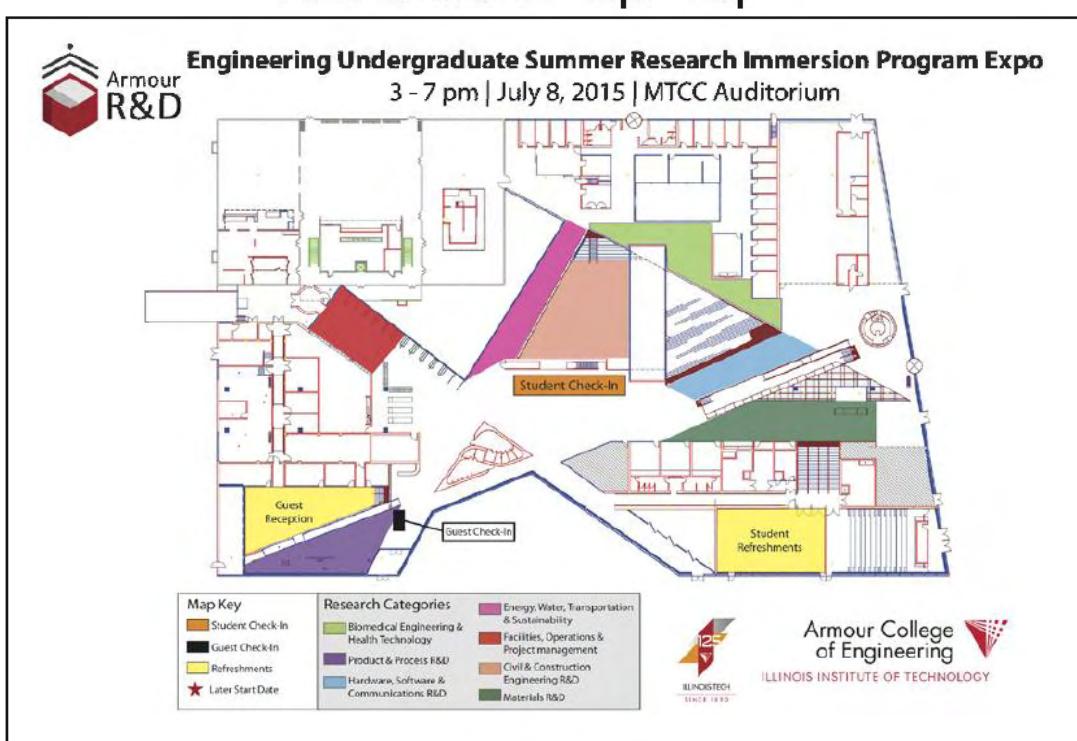
Armour R&D Expo for Engineering Undergraduate Summer Research Immersion Program

The program culminated at the Armour R&D Expo on Wednesday, July 8 in the IIT McCormick Tribune Campus Center. At the Expo, over 400 exceptional students showcased the results of the research they have been working on over the course of ten weeks in the lab of an Armour Faculty member. Each poster was presented to at least three judges and feedback was provided to the students. The team of distinguished judges was comprised of Armour Faculty and Alumni, IIT Administration, industry partners, and members of the Brazilian Consulate of Chicago.

2015 Research Expo Video



2015 Research Expo Map



(Click Image to view)

Expo Photos



Expo Photos



Abstract Index

16

Biomedical Engineering & Health Technology

Effects of Headphones Electromagnetic Radiation on Blood Rheological Properties Leading to Cerebrovascular Disorders (ENGR 498-06).....	18
Improving Molecular Imaging in Oncology (ENGR 498-21).....	18
Improving Molecular Imaging in Oncology (ENGR 498-21).....	19
Improving Molecular Imaging in Oncology (ENGR 498-21).....	19
Improving Molecular Imaging in Oncology (ENGR 498-21).....	19
Improving Molecular Imaging in Oncology (ENGR 498-21).....	19
Kinetic Modeling For Cancer Molecular Imaging - Improving Detection, Surgical Guidance, & Drug Development Post Processing (ENGR 498-21).....	20
BIIT Electrophysiology Teaching Device (ENGR 498-24)	20
Software Engineering for Cancer Research (ENGR 498-25).....	20
PEG Hydrogel Matrices for Studying the Role of Matrix on Breast Cancer Responsiveness (ENGR 499-02).....	21
Quantification of Pro-angiogenic Peptide Release from Hydrogel Nanoparticles (ENGR 499-03)	21
Sustained Co-delivery of Pro-angiogenic & Vessel Stabilizing Peptide Mimetic Sequences for Neovascularization of Hydrogel Nanocomposite Scaffolds (ENGR 499-03).....	22
Computer Model of a Specific Brain Circuit for Epileptic Seizures (ENGR 499-06)	22
Magnetic susceptibility in Gray Matter is Associated with Age-related Neuropathology: An ex-vivo QSM Study in a Community Cohort (ENGR 499-08)	22
Brain Magnetic Resonance Elastography Registration via Diffusion Tensor Imaging: Exploration & Quantification(ENGR 499-19).....	23
How Diet & Exercise Influence Fat Distribution in Elderly Women (ENGR 499-22)	23
Determining the Ideal Concentration of PEG-PLLA-DA in a Microspherehydrogel Drug Delivery System to Make it Fully Biodegradable (ENGR 499-23)	23
Determining the Ideal Concentration of PEG-PLLA-DA in a Microspherehydrogel Drug Delivery System to Make it Fully Biodegradable (ENGR 499-23)	24
Determining the Ideal Concentration of PEG-PLLA-DA in a Microspherehydrogel Drug Delivery System to Make it Fully Biodegradable (ENGR 499-23)	24
Ocular Drug Delivery System Produced by Combination of Different PLGA Formulations (ENGR 499-24)	24
Diabetic Retinopathy - Comparing Indocyanine Green (Retina +Choroid Flow) to Fluorescein (Retina Flow) (ENGR 499-27)	24
Advanced Molecular Imaging for Guiding Personalized Medicine in Cancer Therapy (ENGR 499-28)	25
Design of an Exoskeleton to Create Pinch for a Brain-Machine Interface (ENGR 499-30)	25
Influence of Oil on the Rheological Behavior of Peanut Butter (ENGR 499-46)	25

24

Civil & Construction R&D

Issues in Green Building Design, Construction, & Operation (ENGR 498-04)	26
A New Approach to the Pull Flow Based on a Controlled Inventory Method (ENGR 498-05).....	26
Enhancing Quality Control in Communication with Building Modeling Design (ENGR 498-05).....	27
UAVs on Construction Sites: Economic & Functional Study to Perform Sealing Masonry Quality Inspection (ENGR 498-05).....	27
Unmanned Aerial Vehicles as a Monitor of Brazilian Roadways Conditions & Help Keeping the Maintenance (ENGR 498-05)	28
Use of Augmented Reality & Text Based Representations as an Efficient Pedagogical Intervention in Construction Engineering (ENGR 498-05)	28
Use of Unmanned Aerial Systems for an Effective Monitoring of Personal Protective Equipment Utilization in Trenching or Excavation Activities (ENGR 498-05)	28
Multi-scale & Multi-physics Modeling of Concrete Durability in Service Conditions (ENGR 498-08).....	28
Multi-scale & Multi-physics Modeling of Concrete Durability in Service Conditions (ENGR 498-08).....	29
Multi-scale & Multi-physics Modeling of Concrete Durability in Service Conditions (ENGR 498-08).....	29
Multi-scale & Multi-Physics Modeling of Concrete Durability in Service Conditions (ENGR 498-08)	29
Multi-scale & Multi-Physics Modeling of Concrete Durability in Service Conditions (ENGR 498-08)	29
Collaboration with BIM: An Experiential Learning Case (ENGR 498-10)	30
Experimental Evaluation of Engineered Materials Arrestor System (ENGR 498-15)	30
New Technologies for Efficient Design & Construction of Emergency Shelters (ENGR 499-04)	30
Development of Importance Category Factor for Temporary Structures Subject to Seismic & Wind Loads (ENGR 499-05)	31
Development of Importance Category Factor for Temporary Structures Subject to Seismic & Wind Loads (ENGR 499-05)	31

Energy, Water, Transportation & Sustainability

Applying Finite Element Methods for Coupled Heat & Moisture Transport Processes in Porous Materials (ENGR 498-01) -----	32
Carbon Isotope Fractionation During Diffusion & Biodegradation of Petroleum Hydrocarbons in Unsaturated Zone-----	32
Field Experiment & Modeling Using Finite Element Methods (ENGR 498-10)-----	32
Finite Element Method Applied to the Fate & Transport of Petroleum Hydrocarbons in the Lower Mississippi River Delta (ENGR 498-01)-----	33
Finite Element Method for Environmental Transport Process (ENGR 498-01) -----	33
Finite Element Method for Environmental Transport Processes Case Study: Cadmium Biosorption Rate in Protonated Sargassum Biomass (ENGR 498-01) -----	33
Finite Element Method in Heat & Moisture Transport Through Hollow Porous Blocks (ENGR 498-01)-----	34
Finite Element Method: Modeling the Transport & Inactivation of E. coli in the Near-shore Region of Lake Michigan (ENGR 498-01)-----	34
Paleo-Roothole Facilitated Transport of Aromatic Hydrocarbons through a Holocene Clay Bed (ENGR 498-01)-----	34
Simulation of Groundwater Contaminated with Copper Ions Remediated by Waste Foundry Sand Permeable Barrier (ENGR 498-01)-----	34
Battery Thermal Management System (ENGR 498-09) -----	35
Comparing Interior Permanent Magnet (IPM) Machines used in Hybrid Electric Vehicle (ENGR 498-09) -----	35
Design & Thermal Analysis of DC/DC Converters on PHEVs (ENGR 498-09) -----	35
Electric-Hydraulic Hybrid (EH2) Vehicle Drive Train (ENGR 498-09) -----	35
HEVs, PHEVs and EVs: Identifying Opportunities and Predicting Future Trends (ENGR 498-09) -----	36
Coanda Airfoil in Compressible Subsonic Flow (ENGR 498-16) -----	36
Fan Performance in IIT Low Speed Wind Tunnel (ENGR 498-16) -----	36
Unsteady Lift Enhancement Using Active Flow Control (ENGR 498-16) -----	36
Smart Grid Analysis of Centralized Cooling for an Urban Community (ENGR 498-18) -----	37
Advanced Vehicles Research (ENGR 498-22) -----	37
Graphical Analysis and Simulation of the Brayton 6-Stroke Hybrid (ENGR 498-22) -----	37
Research on the Relationship between Cities and Water (ENGR 498-26) -----	37
Research on the Relationship between Cities and Water (ENGR 498-26) -----	38
Use of treated wastewater in building (ENGR 498-26) -----	38
Implementing Route Design Using GIS (ENGR 498-27) -----	38
Localization and Navigation Using Smartphones (ENGR 498-28) -----	39
Computational Aerodynamics of Vertical-Axis Wind Turbines (ENGR 498-30) -----	39
VAWT: 3-D Correction and Double Streamtube Model (ENGR 498-30) -----	39
Simulation of Active Blade Pitch Control for Vertical-Axis Wind (ENGR 498-30) -----	40
Timing Signal Optimization of Intersections in Chicago Loop (ENGR 498-45) -----	40
Timing Signal Optimization of Intersections in Chicago Loop (ENGR 498-45) -----	40
Study of Wind Turbines under Rainy Conditions (ENGR 499-12) -----	41
High Fidelity "Faster than Real-Time" Simulator for Predicting Power System (ENGR 499-34) -----	41
Faster Than Real-time Dynamics Simulator for Large-scale Power Systems (ENGR 499-34) -----	41
Faster Than Real-time Dynamics Simulator for Large-scale Power Systems (ENGR 499-34) -----	42
Faster Than Real-time Dynamics Simulator for Large-scale Power Systems (ENGR 499-34) -----	42
Faster Than Real-time Dynamics Simulator for Large-scale Power Systems (ENGR 499-34) -----	42
Automatic Event Detection and Data Compression Using Discrete Wavelet Transform Based on Synchrophasors (ENGR 499-35) -----	42
Data Compression and Event Detection Using Principal Component Analysis (ENGR 499-35) -----	43
Event Detection Using PCA Analysis Based on Synchrophasor Data (ENGR 499-35) -----	43
Stock Market Analysis for Event Detection in Power Grid using SMA (ENGR 499-35) -----	44
Resource Management in Green Hetnets Research (ENGR 499-38) -----	44
Green Commercial Construction (ENGR 499-42) -----	44
Green Commercial Construction, Green Ribbon/Summit Design (ENGR 499-42) -----	44

Abstract Index

22

Facilities, Operations & Project Management

Implementation of an Android App for the Campus Security (ENGR 498.07)-----	45
The Use of Software in the Construction Cost Estimating (ENGR 498.11)-----	45
High-Tech Ways to Change Orders in a Civil Construction (ENGR 498.11)-----	46
Uses of UAVs for Construction Estimate Tasks & Further Activities (ENGR 498.11)-----	46
The use of Building Information Modeling (BIM) In Cost Estimating (ENGR 498.11)-----	46
Delay Analysis in Construction Projects (ENGR 498.12)-----	47
The Evolution of Construction Scheduling Methods, Technologies, & Practices (498.13)-----	47
Quantitative Models for Operations Management (ENGR 498.33)-----	47
Utility Master Planning (ENGR 498.35/ 498.36)-----	47
Chilled Water System Optimization (ENGR 498.37)-----	48
Sustainability of Campus Utilities Production: Urban Green Loop Project (ENGR 498.41)-----	48
Life Science Proposed Security System (ENGR 498.43)-----	48

26

Hardware, Software & Communications R&D

Real-Time Automated Target Tracking System (ENGR 498.14)-----	49
Real-Time Automated Target Tracking System (ENGR 498.14)-----	49
Real-Time Automated Target Tracking System (ENGR 498.14)-----	50
Touch Screen Mini Calculator (ENGR 498.14)-----	50
Waypoint Tracking and Guiding System (ENGR 498.14)-----	50
Real-Time Embedded Audio Signal System (ENGR 498.14 / 499.17 Group 1)-----	50
Guitar Processor Effects (ENGR 498.14 / 499.17 Group 1)-----	51
Real-Time Embedded Audio Signal Processing System (ENGR 498.14 / 499.17 Group 1)-----	51
Automated Sorting Machine Using Video Processing & A Robotic Arm (ENGR 498.14 / 499.17 Group 2)-----	51
Digital Signal Processing & Its Applications: Discriminator of Objects Using Video Processing & A Robotics Arm (ENGR 498.14 / 499.17 Group 2)-----	51
Image Processing (ENGR 498.14 / 499.17 Group 2)-----	52
Digital Signal Processing & Applications: Image Processing (ENGR 498.14 / 499.17 Group 2)-----	52
Implementation of Software Defined Radio (ENGR 498.14 / 499.17 Group 3)-----	52
Implementation of Software Defined Radio (ENGR 498.14 / 499.17 Group 3)-----	52
Implementation of Software Defined Radio (ENGR 498.14 / 499.17 Group 3)-----	53
Reconfigurable Hardware Design for Ultrasonic Signal Processing (ENGR 498.17)-----	53
Traffic Lane Detection Using FPGAs (ENGR 498.17)-----	53
Gate Level Power Reduction in Deeply Scaled CMOS Technology (ENGR 498.19)-----	53
Gate Level Power Reduction in Deeply Scaled CMOS Technology (ENGR 498.19)-----	54
Gate Level Power Reduction in Deeply Scaled CMOS Technology (ENGR 498.19)-----	54
Leakage Power Reduction at Circuit Level (ENGR 498.19)-----	54
Leakage Power Reduction by Forced Stack & Power Gating at Circuit Level for Mobile Applications (ENGR 498.19)-----	54
Leakage Power Reduction by Forced Stack & Power Gating at Circuit Level for Mobile Applications (ENGR 498.19)-----	55
Leakage Power Reduction by Forced Stack & Power Gating at Circuit Level for Mobile Applications (ENGR 498.19)-----	55
Register Transfer Level Power Reduction by Advanced Clock Gating Scheme (ENGR 498.19)-----	55
Register Transfer Level Power Reduction by Advanced Clock Gating Scheme (ENGR 498.19)-----	55
Register Transfer Level Power Reduction by Advanced Clock Gating Scheme (ENGR 498.19)-----	56
Multiuser Coding with Multidimensional Coding (ENGR 498.23)-----	56
Portable Wireless Health Monitoring System (ENGR 499.17)-----	56
Remote Computer Networks Laboratory Design Tools (ENGR 499.17)-----	56
Real-Time Automated Target Tracking System (ENGR 499.17)-----	57
Energy-Efficient Techniques for Smartphone (ENGR 499.20)-----	57
Real-Time Traffic Sign Recognition for Advanced Driver Assistance Systems (ENGR 499.21)-----	57
Real-time 3D Reconstruction Using Depth Cameras for Augmented Teleoperation (ENGR 499.26)-----	57
Development of a Test Bed for Direct Current Microgrids (ENGR 499.36)-----	57
Virtual PYXIS Optimization (ENGR 499.43)-----	58
Software Engineering (ENGR 499.44)-----	58
Software Engineering: Web Development (ENGR 499.44)-----	58



30**Materials R&D**

Double Aging Effect on Corrosion Resistance & Mechanical Properties of Aluminum 7075 (ENGR 498.20)-----	59
Experimental Evaluation of Metallic Material Properties Al30Co40Ni30 – Sample 11 (ENGR 498.20)-----	59
Experimental Evaluation of Metallic Material Properties Ni40Co30Al30 (ENGR 498.20)-----	60
Experimental Evaluation of Metallic Material Properties Ni40Co50Al10 (ENGR 498.20)-----	60
Experimental Evaluation of Metallic Material Properties (ENGR 498.20)-----	60
Phase equilibria in the Ni-Co-Al system (ENGR 498.20)-----	60
Phase Equilibria in the Ni-Co-Al system (ENGR 498.20)-----	61
Phase Equilibria in the Ni-Co-Al system - As Cast Sample (ENGR 498.20)-----	61
Phase Equilibria in the Ni-Co-Al system - As Cast Sample (ENGR 498.20)-----	61
Investigation of Phase Equilibria in the Ni-Co-Al System Ni50Co40Al10 (ENGR 498.20)-----	61
Phase Equilibria of Ni-Co-Al System (ENGR 498.20)-----	62
Phase Equilibria in the Ni-Co-Al system (ENGR 498.20)-----	62
Phase Equilibria of Ni-Co-Al System at 1100 Degrees Celsius (ENGR 498.20)-----	62
Serrated Grain Boundaries via Discontinuous Precipitation in Ni-Co-Al Alloys (ENGR 498.20)-----	62
Design & Construction of an Instrumented Urban Model for Time-Resolved Pressure and Velocity Measurement (498.32)-----	63
Double Aging Effect on Corrosion Resistance & Mechanical Properties of Aluminum 7075 (499.13)-----	63
Microstructure & Mechanical Analysis of WC-Co Cerments (499.15)-----	63
Processing & Analysis of Nanostructured WC-Co Materials with Platelet Morphology (499.16)-----	63

33**Product & Process R&D**

Airport Runway Landing Analysis Using Finite Elements (ENGR 498-02)-----	64
Computational Analysis of a Fuselage Structure (ENGR 498-02)-----	64
Evaluation of Alternative Materials for Aircraft Structures During Emergency Landings (ENGR 498-02)-----	65
Evaluation of Baseball Bats During Impact With a Baseball (ENGR 498-02)-----	65
Evaluation of Helmet Protection During Impact of Head to Ground & Impact of an Object to Head (ENGR 498-02)-----	65
Evaluation of Hockey Sticks During Impact with Hockey Puck (ENGR 498-02)-----	66
Evaluation of Optimization Tools for Strong Mechanical Designs & Comparison to New Software (ENGR 498-02)-----	66
FEA of a Thermal-Stress Solar Panel with Hypermesh & Abaqus (ENGR 498-02)-----	66
Finite Element Analysis of an Aircraft Wing (ENGR 498-02)-----	66
Finite Element Analysis of the Asiana Airlines Flight 214 Crash (ENGR 498-02)-----	67
Bike Frame Analysis under Different Loads using Finite Element Method (ENGR 498-03)-----	67
Creation of a Simple Human Model to Evaluate Crash Performance (ENGR 498-03)-----	67
Scissor Car-Jack: A Finite Element Analysis (ENGR 498-03)-----	67
Static Analysis of Differential Behavior under Torque (ENGR 498-03)-----	68
Static Structural Analysis of Automotive Damper (ENGR 498-03)-----	68
Structural Analysis of a Racecar Chassis Using Finite Element Method (ENGR 498-03)-----	68
Structural Analysis of Nintendo Gameboy (ENGR 498-03)-----	68
Technical and Sustainable Evaluation of Short Span Bridge (ENGR 498-03)-----	69
Steady State & Dynamic Operation of a Catalytic Reaction in Two Coupled Reactors (ENGR 498.29)-----	69
Mobile Devices Antenna Simulation & Analysis (ENGR 498-31)-----	69
Analysis of Hyperelastic Material Models (ENGR 498-34)-----	69
Biomechanics: Finite Element Studies of Monkey Mandibles (ENGR 498-34)-----	70
Structural Analysis of a Gravity Dam Using Finite Elements (ENGR 498.34)-----	70
Design & Simulation for Bioenergy & Food (ENGR 499.01)-----	70
Engineering Solutions for Food & Nutrition (ENGR 499.01)-----	70
Study of Carbon Monoxide Oxidation in an Autothermal Catalytic Reactor (ENGR 499.33)-----	71
Idea to Product - The Prototyping Process for Entrepreneurial Engineers - 2 Ways Storage Report (ATR 498-06)-----	71
Idea to Product - The Prototyping Process for Entrepreneurial Engineers - Blackout Nap (ATR 498-06)-----	71
Idea to Product - The Prototyping Process for Entrepreneurial Engineers - Extendable Cube Outlet (ATR 498-06)-----	71
Idea to Product - The Prototyping Process for Entrepreneurial Engineers - Surgical Dental Articulator Edelthur (ATR 498-06)-----	72
Idea to Product - The Prototyping Process for Entrepreneurial Engineers - Umbrella Sharing (ATR 498-06)-----	72

Abstracts



Biomedical Engineering & Health Technology

Effects of Headphones Electromagnetic Radiation on Blood Rheological Properties Leading to Cerebrovascular Disorders (ENGR 498-06)

Arthur M. M. Gomes, Daniel R. Dessaune, Eroni F. De Almeida Jr, Thaisa R.C. Lima, Wolney M. Vasconcelos
Instructor: Promila Dhar, Ph.D.

According to World Health Organization (2012) stroke was the second most common cause of death in Brazil¹. Blood flow properties are one of the factors that are responsible to the occurrence of vascular diseases. Also with the growing technology the use of electronic devices, like headphones has become a significant part of the population. The use of electronic devices seems to be growing over time, and it is a font of electromagnetic radiation often located very close to the human brain. For this reason, the aim of this study is to assess the effects of the exposure to the headphones-like electromagnetic radiation on blood rheology. Assuming that long time exposure to headphones electromagnetic radiation can lead to blood rheological disorders, a blood flow chamber and a model of coil, which simulates the effect of the electromagnetic radiation generated by headphones were built. Analysis of whole blood viscosity, plasma viscosity and red blood cell aggregation were made to evaluate the features before and after the exposure of the blood to the radiation. These parameters were acquired after one, two and four hours of exposure. Some changes were found, mainly after the second hour of subjection to the electromagnetic waves, e.g. the aggregation was increased and the hemolysis was visibly higher after the exposure. It leads us to the need of deeper investigation to find out the harm that is caused in other crucial components of the vascular system.

Improving Molecular Imaging Oncology (ENGR 498-21)

Pedro Moraes Salgado
Instructor: Kenneth Tichauer, Ph.D.

This paper describes the results of a research project focused molecular imaging in oncology: tools for early cancer detection, personalized therapy, and guiding drug development. This research was divided into two main parts where we would have the first class of the key concepts for research, and the second part was the practical classes in the computer lab stirring in Matlab (used in the research program), where

this second part of the teacher divided eight shares in amounts of students involved in the project. After this division in which the teacher did I got the part of Simulation data when receiving data from another student I used Matlab program for Simulation and these simulations generated graphics.

Improving Molecular Imaging in Oncology (ENGR 498-21)

Julia De Oliveira Caliman
Instructor: Kenneth Tichauer, Ph.D.

Molecular imaging has growing and improving itself ion oncology applications. For this project we focused on the development of software analysis tools for improving the accuracy of molecular imaging and facilitate the analysis of the results. Also the use of molecular imaging represents a much less invasive method of cancer detection and/or staging.

Improving Molecular Imaging in Oncology (ENGR 498-21)

Ana Flavia Calado Pereira
Instructor: Kenneth Tichauer, Ph.D.

Molecular Imaging is a type of imaging that provides detailed pictures of what is happening inside the body at the molecular and cellular level. In cancer research and management it has been proposed impactful in a number of areas including early cancer screening and detection, cancer resection surgery and guiding personalized medicine. All the group work was done using matlab codes. These codes were previously developed by other researches that were, also, deeply involved with the experimental laboratory and analysis. Improvements and tests were done during research time.

Improving Molecular Imaging in Oncology (ENGR 498-21)

Henrique Lima
Instructor: Kenneth Tichauer, Ph.D.

This paper is based on the development process of a MatLab software motivated by the theme of our research program. Also, it contains about cancer cells, and explain some activities that I developed during the summer research at Illinois Institute of Technology.

Improving Molecular Imaging in Oncology (ENGR 498-21)

Tiago Rafael Giorgetti Landim
Instructor: Kenneth Tichauer, Ph.D.

Molecular Imaging presents what happens inside the body and understanding of cancer on the molecular level "in vivo". How to stop its growth, early detection and staging of a tumor mapping cancer biomarkers, finding if there are any targets for therapy, surgery guidance and developing drugs for specific types of cancer are the goals of molecular imaging. For this project it was to develop a Matlab software for molecular imaging using a Graphic User Interface, with some analysis tools to improve the accuracy of molecular imaging and a less invasive cancer detection method, these tools were: read and save data, preprocessing, manipulate data, simulation, run analysis and post processing. It is possible to select a region of interest from a white scan, this region will then be applied to all the other scans in 700nm and 80nm wavelength. After the region is applied, two average curves of the fluorescence are generated, one for each wavelength. Molecular imaging can be applied to detect the first lymph node to which cancer cells are starts to spread a tumor, staging cancer and developing a treatment plan. Also, another application is the epidermal growth factor receptor (EGFR) treatment that can be used in a patient who is EGFR positive, being a better solution than chemotherapy.

Abstracts

Kinetic Modeling For Cancer Molecular Imaging - Improving Detection, Surgical Guidance, & Drug Development Post Processing (ENGR 498-21)

Arthur Albuquerque

Instructor: Kenneth Tichauer, Ph.D.

The development of methods of detection makes the use of tools for post processing even more important to the research in molecular cancer. The impact of the digital imaging is a great solution based on visual inputs to provide a more accurate diagnostic of the results using a set of tools to manipulate, analyze, and better understanding what was reported. Based on a Graphic User Interface (GUI) created using the software MatLab to improve the methods of molecular imaging and cancer detection including all the stages of load and save data, preprocessing, data manipulation, simulation, test analysis, and post processing that bring a better solution for mapping, reporting, and understanding the cancer.

BIIT Electrophysiology Teaching Device (ENGR 498-24)

Eduardo Nunes Palmieri, Felipe Augusto Massari, Francisco Escher Guimaraes da Silva, Heres Arantes Junqueira, Hugo Giacomini, Josias Blos, Leandro Correia de Resende, Leandro Paiva, Luana Rodrigues, Lucas Moura Bastos, Lucas Salgado de Salles Oliveira, Mariane Regina Afonso Vieira, Matheus Takahashi, Rafael Vilela, Renan Arantes Bernardes, Tadeu Henrique da Silva Calheiros

Instructor: Bonnie Haferkamp, Ph.D.

Current electrophysiology systems for measuring electrocardiogram ("EKG" or "ECG"), electromyogram ("EMG"), and other physiological signals in laboratories generally provide good performance, but can be costly and lack flexibility. The most common platforms require wires between electrodes on the patient and the equipment and typically are black-box in that much of the signal processing is not available to the user. This limits student learning and more widespread use of such systems in physiology laboratories. Here we present a system developed that overcomes these deficiencies. It provides an "open box" in which the students can see and adjust the hardware signal processing and therefore learn how the components affect the final signal. The system is wireless and therefore can be worn while the patient is moving at a distance from the rest of the system components, and therefore allows signals to be captured under a variety of physiological states, such as walking and other movements. Finally, the patient or students can view signals on smartphones and capture and analyze the signals through a software system designed from open-source software.

Software Engineering for Cancer Research (ENGR 498-25)

Alerson Costa, Alisson Sales, Arthur Sena, Caio Diniz, Eduardo Gomes, Henrique Nascimento, Judá Santos, Lucas Costa, Marcel Santee, Michel Silva, Neemias Freitas, Vinícius Maia

Instructor: Bonnie Haferkamp, Ph.D.

In the United States, it is estimated that 1,658,370 people will develop cancer in 2015. The medicines used for cancer treatment sometimes may cause side effects and the development of resistance to those drugs. This research highlights the importance of a personalized medicine that may be the key for cancer treatment and prevention. Some types of cancer are caused by Lynch Syndrome, in which tumors present microsatellite instability (MSI) a change in the DNA sequence that makes the gene lose normal expression and contributes to tumor growth. Fortunately, scientists at IIT have discovered that the use of unusual splicing may restore a mutated gene to have functionality again. However, there are more than 700 genes mutated with MSI tumors and each gene can produce thousands of isoforms. It would take years to analyze all these isoforms in the lab. The purpose of this project is to develop a software that will narrow down the number of isoforms to be analyzed in the lab based on how likely the isoform is functional. Toward this end, we show here a software application that leverages existing biological databases and prediction engines and captures user defined biological splicing rules to identify top alternatively spliced isoforms for each mutated gene out of the hundreds of thousands of possibilities.

PEG Hydrogel Matrices for Studying the Role of Matrix on Breast Cancer Responsiveness (ENGR 499-02)

Joao Paulo Da Luz Silva

Instructor: Georgia Papavasiliou, Ph.D.

It is estimated that over 200,000 new cases of invasive and 60,000 non-invasive (*in situ*) breast cancer will be diagnosed in women in the U.S. alone in 2015 with 12% being diagnosed with invasive breast cancer throughout their lifetime.[1] While *in vitro* cell culture has been extensively investigated to develop therapeutic treatments for this disease, the majority of studies have focused on 2D cell culture which is not representative of tumor cell response with their 3D microenvironment (the extracellular matrix (ECM)). Thus, 3D cell culture has become increasingly important in studying aspects of cancer cell behavior *ex vivo*. Synthetic hydrogels of poly(ethylene glycol), PEG, have been extensively used as ECM mimetic scaffolds for 3D culture. While PEG hydrogels have been utilized for studying tumor cell growth in 3D culture, to our knowledge, the ability of these materials to prevent tumor invasion has not been exploited. *In situ* hydrogel polymerization can be used to locally confine tumors that are easily accessible prior to surgical removal, chemotherapy, or radiation in order to increase the effectiveness of these treatments. The goal of this project was to determine the role of PEG matrix biochemical composition and matrix stiffness on the responsiveness (cell morphology and proliferation) of an invasive breast cancer cell (BCC) line (MDA-MB-231) in 3D culture. BCCs (at different concentrations) were encapsulated in PEG hydrogels biochemically modified with (1) tethered cell adhesive (RGD) as well as crosslinked matrix metalloproteinase (MMP)-sensitive peptides and (2) tethered RGD alone. In each case the compressive modulus of the hydrogels was also quantified. These studies allowed us to explore the effects of matrix biochemical composition and stiffness on BCC response in 3D culture.

Quantification of Pro-angiogenic Peptide Release from Hydrogel Nanoparticles (ENGR 499-03)

Marja Bittencourt Pimentel

Instructor: Georgia Papavasiliou, Ph.D.

A critical criterion for the clinical success of implantable tissue engineered scaffolds is their ability to promote rapid and stable neovascularization to provide oxygen and nutrient delivery for support of cell and tissue viability and function. Controlled and sustained release of neovascularization factors within scaffolds is critical to this process. While growth factor delivery from particle carriers embedded in scaffolds has been previously exploited for the promotion of neovascularization, the clinical efficacy of growth factors is limited by their short half-lives, structural instability and immunogenicity. A promising alternative is the use of peptide mimetic sequences that recapitulate the biological functions of growth factors. A VEGF mimetic peptide sequence, QK, has been previously identified to bind and activate the same extracellular receptors as vascular endothelial growth factor (VEGF, one of the most potent regulators of neovascularization. While the use of soluble or immobilized forms of QK in scaffolds has been previously exploited, studies indicate that sustained release of this factor is necessary to its biological function and for formation of persistent vasculature. Therefore, the goal of this study was to utilize crosslinked, hydrogel nanoparticles (NPs) of poly(ethylene glycol) (PEG) as delivery vehicles for sustained and controlled release of QK. QK-loaded PEG hydrogel nanoparticles were synthesized using inverse phase miniemulsion polymerization. [1] In this work we quantified the loading efficiency of QK in the nanoparticles, NP size distribution and swelling ratio, QK release kinetics over a period of 35 days, and characterized the mechanism of release by fitting the release data to a semi-empirical model of Fick's second law. Data indicate that the nanoparticles allow for sustained release of QK up to 40% of the loaded peptide by 14 days, for a total amount of 16.8 µg QK/mg NP. The mechanism of release was found to be non-Fickian, as the average of the exponential release coefficient from two batches of nanoparticles with the same formulation was estimated to be 0.355. Using nanoparticle tracking analysis the NP diameter was estimated to be 225.2 ± 75.4 nm for QK loaded and 202.5 ± 61.9 nm for blank NPs. This study demonstrates the potential of PEG hydrogel nanoparticles to provide sustained release of angiogenic peptides over time.

Abstracts

Sustained Co-delivery of Pro-angiogenic & Vessel Stabilizing Peptide Mimetic Sequences for Neovascularization of Hydrogel Nanocomposite Scaffolds (ENGR 499-03)

Luana Dias

Instructor: Daniel Young and Georgia Papavasiliou, Ph.D.

Therapeutic neovascularization (new blood vessel formation) involving delivery of growth factors has shown promise for ischemic tissue repair. Injection of growth factors directly into ischemic tissues has been used in clinical models to stimulate growth of new vasculature to provide oxygen and nutrients to ischemic tissue. This approach has been limited due to the short half-lives of growth factors *in vivo*. Polymer matrices have been extensively used as scaffolds to protect growth factors from degradation while enabling their controlled release. Specifically, Neovascularization factors have been incorporated within biocompatible, synthetic hydrogels, such as poly(ethylene) glycol (PEG) acrylate (PEGDA), which have been used as scaffolds or as drug delivery systems for promotion of neovascularization within ischemic tissues. The ability to promote stable neovascularization requires sustained and prolonged delivery of neovascularization factors and is highly dependent on the context in which these factors are presented within the 3D matrix. While growth factors have been extensively used for stimulating neovascularization, their clinical efficacy has been limited by their structural instability as well as immunogenicity. Peptide sequences that mimic the functions growth factors use to regulate neovascularization pathways are promising alternatives due to their ease in synthesis, low toxicity and enhanced stability. The goal of this study was estimate the diffusion coefficient of a pro-angiogenic peptide, QK, from PEG hydrogel nanoparticles (NPs) which have been previously shown by our lab to allow for prolonged and sustained QK release. The diffusion coefficient of the QK peptide from PEG hydrogel (NPs) was estimated using an experimental diffusion chamber and a transport model of one-dimensional diffusion. The PEG hydrogels were formed via bulk polymerization and with the same polymerization chemistry used to create the hydrogel NPs. The effect of network swelling ratio on the QK diffusion coefficient was quantified. Alterations in the molecular weight of the PEGDA crosslinker and the mole ratio of the crosslinker, PEGDA, to the accelerator, NVP, resulted in variations in swelling ratio. The data indicates that increases in the ratio of PEGDA:NVP (from 1:1 to 9:1) result in decreases in peptide diffusion coefficient and hydrogel swelling ratio, whereas. Variations in PEG crosslinker molecular weight did not lead to significant changes in peptide diffusion or hydrogel swelling. Current studies are being conducted to determine the QK diffusion coefficient in biochemically modified PEG hydrogel scaffolds.

Computer Model of a Specific Brain Circuit for Epileptic Seizures (ENGR 499-06)

Barbara Martins

Instructor: David Mogul, Ph.D.

Neuronal population in the brain achieve levels of synchronous electrophysiological activity as a consequence of both normal brain function and pathological states such as epileptic seizures. Understanding this synchronous in the brain is a critical component toward decoding such complex behavior. In this paper, a model is presented to simulates spiking behavior of known types of cortical neurons, with the objective of explore how this seizures are generate and transmitted across brain regions.

Magnetic susceptibility in Gray Matter is Associated with Age-related Neuropathology: An ex-vivo QSM Study in a Community Cohort (ENGR 499-08)

Luis F. C. Cardoso, Lucas F. Lopes, Diego V. Pereira

Instructor: Konstantinos Arfanakis, Ph.D.

Iron accumulation in the brain has been linked to aging and various neuropathologies [1,2]. Measurement of iron in gray matter structures may aid in the development of biomarkers for these pathologies. Quantitative susceptibility mapping (QSM) can allow for the quantification of iron levels [3,4]. The purpose of this study was to investigate the neuropathologic correlates of magnetic susceptibility in gray matter throughout the brain for TDP43 pathology, hippocampal sclerosis, Alzheimer's Disease (AD).

Brain Magnetic Resonance Elastography Registration via Diffusion Tensor Imaging: Exploration & Quantification (ENGR 499-19)

Authors: Marcos Yoiti Takeno

Instructor: John G. Georgiadis, Ph.D.

The noninvasive measurement of the mechanical properties of brain tissue using magnetic resonance elastography (MRE) has emerged as a promising method for investigating neurological disorders. The quantification of the stiffness of specific structures in the white matter architecture may be valuable in assessing the localized effects of disease. Though the most common technique for investigating white matter microstructure is diffusion tensor imaging (DTI). DTI probes restricted diffusion of water in tissue, and can reflect axonal organization, integrity, and myelination. For this study, we focused only the corpus callosum (CC) to analyze, using MRE via DTI to characterize and quantify the success of image registration by Matlab, and use two different methods to see how much the 3D images are similar to make future changes in the MRE registration method.

How Diet & Exercise Influence Fat Distribution in Elderly Women (ENGR 499-22)

Mariana Costa Mendes

Instructor: John G. Georgiadis, Ph.D.

This project consists in test a non-invasively technique that assess the fat composition of the thigh in elderly women (67 + 6 years). Three different groups, varying in physical activity levels and adiposity was selected for this study. The first objective was develop a Magnetic Resonance Imaging (MRI) technique to quantify adipose tissue and measure muscle quality. Another objective was to quantify the difference between the three groups obese, lean active and lean sedentary. In another portion of the study, the objective was qualify and evaluate the effect of two interventions, diet and exercise which the obese group was submitted. In the first part, no differences were found between the obese group and lean sedentary group, showing that the fat distribution is very similar in those two groups. In the second part, exercise was found to be beneficial for redistribution of intramuscular lipids. The conclusion of this project is that MRI is very useful and could be a good technique to help in diagnosing and treating diseases and physical activity is one big determinant of health status.

Determining the Ideal Concentration of PEG-PLLA-DA in a Microspherehydrogel Drug Delivery System to Make it Fully Biodegradable (ENGR 499-23)

Rafael Antônio Moschem

Instructor: Jennifer Kang-Mieler, Ph.D.

This project consists in test a non-invasively technique that assess the fat composition of the thigh in elderly women (67 + 6 years). Three different groups, varying in physical activity levels and adiposity was selected for this study. The first objective was develop a Magnetic Resonance Imaging (MRI) technique to quantify adipose tissue and measure muscle quality. Another objective was to quantify the difference between the three groups obese, lean active and lean sedentary. In another portion of the study, the objective was qualify and evaluate the effect of two interventions, diet and exercise which the obese group was submitted. In the first part, no differences were found between the obese group and lean sedentary group, showing that the fat distribution is very similar in those two groups. In the second part, exercise was found to be beneficial for redistribution of intramuscular lipids. The conclusion of this project is that MRI is very useful and could be a good technique to help in diagnosing and treating diseases and physical activity is one big determinant of health status.

Abstracts

Determining the Ideal Concentration of PEG-PLLA-DA in a Microspherehydrogel Drug Delivery System to Make it Fully Biodegradable (ENGR 499-23)

Joao Menezes

Instructor: Jennifer Kang-Mieler, Ph.D.

Intravitreal injections have great efficiency in the treatment of posterior segment eye diseases. However, this kind of treatment often require monthly injection and potential complications may be caused by those injections, for example: endophthalmitis, retinal detachment, intravitreal hemorrhage, and cataract. The use of drug delivery system that combine microspheres and hydrogel has shown great results in extended the drug release in the eye. This study aims to determine the ideal concentration of PEG-PLLA-DA in a microspherehydrogel drug delivery system that would be fully biodegradable.

Determining the Ideal Concentration of PEG-PLLA-DA in a Microspherehydrogel Drug Delivery System to Make it Fully Biodegradable (ENGR 499-23)

Rodrigo Profeta

Instructor: Jennifer Kang-Mieler, Ph.D.

Diseases that affects the posterior segments of the eye (vitreous body, retina, and choroids) are responsible for the most cases of irreversible blindness in the world. This scenario therefore stimulates the development of new forms of treatment for retinal degeneration and diseases of the posterior tissues of the eye. The successful treatment is primarily aimed at the delivery of effective doses of pharmacological agents directly to the locations to be treated. Intravitreal injection presents a great delivery efficiency, but there are potentially serious complications associated with it, such as endophthalmitis, intravitreal hemorrhage and cataract. In this manner, there is a need to develop ocular delivery systems that allow delivery of therapeutic concentrations of drugs for an extended period. Previous studies showed that poly (lactic-co-glycolic acid) (PLGA) 75:25 is a more ideal polymer formulation based on its apparent release time and a more complete and consistent release profile. Alternatively, PLGA 50:50 yielded a higher encapsulation efficiency. Thus, the goal of this research is to determine if the combination of PLGA 50:50 and PLGA 75:25 can yield nanoparticles with the properties that represent the advantages of each polymer.

Ocular Drug Delivery System Produced by Combination of Different PLGA Formulations (ENGR 499-24)

Filipe Bueno Vilela, Rodrigo Profeta

Instructor: Jennifer Kang-Mieler, Ph.D.

This research aims to combine two different poly(lactic-co-glycolic acid) (PLGA) in order to produce nanoparticles that will encapsulate vancomycin for prevention of infection in post operative treatment. The PLGA was used in different ratios (PLGA 50:50 and PLGA 75:25) for assessing changes in parameters such as initial burst of the drug, surface area of nanoparticles and encapsulation efficiency.

Diabetic Retinopathy - Comparing Indocyanine Green (Retina +Choroid Flow) to Fluorescein (Retina Flow) (ENGR 499-27)

Talita Belandino Bordon

Instructor: Kenneth Tichauer, Ph.D.

Diabetic retinopathy is a disease that only shows symptoms when it is in an advanced stage, which difficults the chances of successful treatment. Therefore, it was idealized perform experiments that could make an early diagnosis of the disease, involving the use of Indocyanine Green to analyze the choroid, a layer of deeper tissue and sensitive eye, located below the retina. Using videos of ICG and Fluorescein injected into mice, we wanted to find out the choroid vascular mapping and thus provide an early detection method of the disease. Videos of experiments conducted on rats, injection of ICG dye, were analyzed in Matlab using codes, but no conclusive result was obtained due to lack of quality of videos.

Advanced Molecular Imaging for Guiding Personalized Medicine in Cancer Therapy (ENGR 499-28)

Priscila da Silva Soares

Instructor: Kenneth Tichauer, Ph.D.

This report aims to describe a research project focused on the optimization of kinetic modeling applied to cancer molecular imaging. Kinetic Modeling together with Cancer Imaging can provide an earlier detection of this disease and enhance Cancer treatment. Also, it can be helpful in the development of new drugs, since molecular imaging provides the visualization of normal and pathologic process in living organisms. In this study, mice were used to determine the capacity of the tracer to detect markers present in tumor cells. Programming tools, such as MATLAB were also used to evaluate the data obtained. The results showed that the tracer is a useful tool in quantifying tumor markers, despite some limitations that will be overcome in the future.

Design of an Exoskeleton to Create Pinch for a Brain-Machine Interface (ENGR 499-30)

Luiz Anjos

Instructor: Derek Kamper, Ph.D.

A brain-machine interface (BMI) has the capability to allow severely disabled individuals to control external devices through recorded signals from the motor cortex. The current BMIs, however, lack critical somatosensory feedback, essential to avoid slow, unstable movements of controlled devices. Exoskeletons can be used to take advantage of spared tactile sensation of the hand while providing actuation directly on the impaired limb. This report describes the design, prototyping and testing of an exoskeleton to investigate BMI-controlled pinch force generation.

Influence of Oil on the Rheological Behavior of Peanut Butter (ENGR 499-46)

Francielle Dias Eifler

Instructor: David Venerus, Ph.D.

Peanut Butter is a very interesting Yield Stress Fluid. The Natural Peanut Butters are unstabilized suspensions that consists of solid peanut particles in peanut oil. To make it stabilized and more creamy were created the artificial peanut butters that are a "smooth" that consists of the same suspension stabilized with a vegetable oil, molasses or diglycerides and contains other additives such as salt, sugar, sweeteners and others in very small quantities. Those oils are unhealthy because they contain saturated fats that causes a lot of heart diseases. Three store-bought commercial brands of peanut butter were used. One of them was natural: Smucker's Natural Peanut Butter Creamy (The J.M. Smucker Company Orrville, OH), and two of them were artificial: Jif Creamy Peanut Butter (The J.M. Smucker Company Orrville, OH) and Skippy Creamy Peanut Butter (Hormel Foods Sales, Austin, MN). The Smucker's Natural Peanut Butter was used to prepare 5 samples with different concentrations of Palm Oil. Concentrations were 1%, 2%, 3% and 5% (% m/m). All samples were tested on Shear Flow, uniform strain rate and stress. They were submitted to constant $\dot{\gamma}$ and constant τ_{yx} measurements. The natural peanut butter had a higher Yield Stress Magnitude and was less consistent than the artificial ones. As we increase the palm oil content in the samples, the experimental results suggest a trend that the Yield stress decreases, the consistency coefficient doesn't vary much and the flow behavior index increases. Increasing the oil content on natural peanut butters, they get closer to the rheological behavior of the artificial ones than 1 suggesting shear thinning behavior.

Abstracts



Civil & Construction Engineering

Issues in Green Building Design, Construction, & Operation (ENGR 498-04)

Amanda De Melo Trindade, Luiz Gustavo De Souza Jesus
Jessica Pereira De Oliveira, Jessika Queiroz Severino, Gelly Whesley Silva Neves
Instructor: David Arditi, Ph.D.

Leadership in Energy and Environmental Design (LEED) is a green building certification program that recognizes best-in-class building strategies and practices. To receive LEED certification, building projects must satisfy prerequisites and must earn points to achieve different levels of certification. LEED certification applies to different types of buildings and is composed of eight categories. The category of "Energy and Atmosphere" was the one considered in this project because it represents 30% of the total points for certification. The research team evaluated the conformance of Alumni Memorial Hall to the requirements of the Energy and Atmosphere category of LEED. Alumni Memorial Hall was designed by Ludwig Mies van der Rohe and constructed in 1945. It originally served as the Navy Building but was converted in 1974 to house the Department of Civil Engineering at IIT. It is currently used by the Department of Civil, Architectural and Environmental Engineering. The state of Alumni Memorial Hall relative to the Energy and Atmosphere category of LEED is deficient. The evaluation of the research team indicated that only one of the three perquisites was satisfied while none of the seven required credits were met. Overall, Alumni Memorial Hall received zero points in this very important category. If the objective is to have an energy-efficient building, Alumni Memorial Hall has to be radically renovated. Some requisites like using smart electric meters and participation in a demand response program are met and constitute good starting points. However, in order to score as many points as possible in the Energy and Atmosphere category, the heating-ventilating-air conditioning systems, the windows, the insulation of the building need to be replaced, energy-saving measures such as motion-activated electric switches and automatic temperature controls need to be installed, alternatives for using renewable energy need to be explored.

A New Approach to the Pull Flow Based on a Controlled Inventory Method (ENGR 498-05)

Matheus Martins Gonzalez
Instructor: Ivan Mutis, Ph.D.

Lean Production, introduced by Toyota Motor Company, has been an object of study by researchers from various fields of knowledge. Its philosophy has been applied and grown in a scope that covers the entire industrial sector and confirms its consolidation as a tool for the end-

consumer satisfaction guarantee. In the construction industry, the term, widespread as Lean Construction, has played an important role in the simplification of activities, reducing the variability derived from the uncertainties assigned to construction, reducing costs linked to the misuse of resources and a significant increase in quality of the final product. Allied to this, the growing use of building information modeling platform (BIM) as an analytic, representative and integrative tool for projects is making the sector more productive and concise. Based on and aiming at a possible combination of these two tools and the subsequent benefits, this research developed an inventory control method to optimize the production process for construction activities.

Enhancing Quality Control in Communication with Building Modeling Design (ENGR 498-05)

Gilmara Viana Rosa

Instructor: Ivan Mutis, Ph.D.

Building Information Modeling (BIM) is a methodology that provides better coordination and efficiency in construction projects. The benefits associated with BIM are cost and time reduction, and more coordination and control. In addition, BIM enables issues to be recognized early in projects, such as design uncertainty and how design changes will impact on the project. Nevertheless, BIM cannot assist in the problem solving process. BIM works better in the exchanging process of explicit knowledge rather than tacit knowledge. Recently, informal communication has been seen as an example for exchanging tacit knowledge, as we know explicit knowledge is the kind of knowledge that is documented and easily exchanged. An example of informal communication is messy talks, talks that are not about topics present on BIM session agenda, neither on specified problems. Consequently, having messy talks in BIM sessions is essential; however, managing all information present in these messy talks can be a difficult task. In this paper, methods for ensuring quality control of the information presented on messy talks will be discussed, as the methods that are used for ensuring coordination during meetings. Moreover, characteristics for ensuring efficiency and effectiveness of messy talks are present establishing improvements in productivity during BIM sessions. The paper addresses issues on the transformation of messy talk to enhance quality of exchanged information.

UAVs on Construction Sites: Economic & Functional Study to Perform Sealing Masonry Quality Inspection (ENGR 498-05)

Jose Roberto Souza

Instructor: Ivan Mutis, Ph.D.

Largely used during wars, the utilization of UAVs (Unmanned Aerial Vehicle) has begun in the most different economic sectors. Their features, such as capturing of HD pictures, small size and weight, significant time of flight, possibility of making live video streaming etc., have allowed to expand their operating area to distinct economic segments. This implies the optimization processes of other activities such as quality inspection. Having noticed the positive influences of UAVs in oil pipeline, gas pipeline, power line, solar installation, critical infrastructure, bridge inspection etc., this research proposes to study the benefits of UAV implementation on a determined construction activity, which is sealing masonry quality inspection. According to Sitter (1984), "If no maintenance is carried out, the later repair will be five times the saved maintenance costs. If no repair is carried out, the cost of renovation will be five times the money saved by not repairing." Besides, Matos (2010), a Brazilian engineer, states, "The sooner the manager can intervene, it is better." He also calls the first phases of a building construction as "A constructive opportunity, which is the time when you can alter the course of a service or of the planning at a relatively low cost. Over time, this intervention becomes less effective and its implementation, most expensive - it is the destructive opportunity." Thus, it is possible to comprehend that the more time a company takes to intervene in an activity, the more expensive the repair will be if it is necessary. For those reasons, the inspection activity makes a huge difference on a company profit, becoming an essential procedure to assure the quality of other activities and an indicator that signalizes whether a consequent activity can or not to be started. Observing the effectiveness of the use of UAVs in different activities, this research proposes the following aim: verifying the economic and functional viability of using UAVs to perform sealing masonry quality inspection. To do so, the chosen methodology for this project has the following steps: (1) literature review, (2) observation of the activity to be optimized, (3) delimitation and characterization of the activity in question, (4) development of hypotheses around the context, (5) collection and analysis of data from job sites and, finally, (6) verification of the hypotheses' consistency. We expect that the use of UAVs will be significantly beneficial for the activity studied, but there are not concrete results so far.

Abstracts

Unmanned Aerial Vehicles as a Monitor of Brazilian Roadways Conditions & Help Keeping the Maintenance (ENGR 498-05)

Matheus Ovidio Siqueira
Instructor: Ivan Mutis, Ph.D.

UAVs (Unmanned Aerial Vehicles) is a new kind of technology that is more and more been used by gownsman. They have many applications, it starts in the military field, going though delivery field, until monitoring systems. One filed that they are find each time more applications is in the civil engineering. A drone can be used as a tool to help traffic control, monitoring roadways and helping in the construction field. On the other hand, Brazil has a tropical weather, and the roadways are affected at least once a year for a big storms that can until be destroyed. As Brazil has the roadways as the main tool to delivery its purchase, they should be ready to use as much time as possible. In this point UAVs are so important, because they are a fast tool that can scan the roadways after the storm and see how much damaged is the road and the Brazilian government can do some actions to fix the road. So this work will reveal some points that are important in this method and how its importance.

Use of Augmented Reality & Text Based Representations as an Efficient Pedagogical Intervention in Construction Engineering (ENGR 498-05)

Melo L.H.
Instructor: Ivan Mutis, Ph.D.

Devices that use Augmented Reality (AR) are gaining ground as virtual interaction tool and entertainment. In pedagogical aspects, this technology allows interactions with interesting virtual environments. These interactions can be tactile, olfactory, auditory and visual, changing the perception of the real environment from the configurations in virtual environments. The visual aspect of AR has proved a vast educational potential tool and visualization of three-dimensional structures. The pedagogical premise of AR is based on the Situated Learning Theory, which states that individuals broaden the knowledge and acquire professional competencies when work with the focus on learning in a investigative way; as active participants in the cognitive formation of their mental structures. This article also describes how this learning can be structured efficiently. For this, the principles of Cognitive Theory of Multimedia Learning are relevant, which in turn demonstrates, based on several cognitive studies, what is the best way to dispose text-based representations and images. This theory aligns the entire information in order that user does not feel overloaded with information or have access to incomplete and overly simplistic concepts.

Use of Unmanned Aerial Systems for an Effective Monitoring of Personal Protective Equipment Utilization in Trenching or Excavation Activities (ENGR 498-05)

Renato H. B.
Instructor: Ivan Mutis, Ph.D.

The diversified use for Unmanned Aerial Systems (UASs) is becoming more common at Construction Jobsites in different activities. Small and fast, UASs are already been used to traffic monitoring on highways, capture aerials pictures, and even to deliver pizzas. This study introduces one of the advantages from their, to help construction companies survey and monitor their employers, providing a view, and dealing with restricted or complicated safety management issues. This paper treats the use of UAVs to guarantee a proper use of Personal Protective Equipment (PPE) at construction jobsites in an outside perspective. The results of this study could lead to further research on design, development, and field-testing of UAVs for applications identified as beneficial to the Construction Industry.

Multi-scale & Multi-Physics Modeling of Concrete Durability in Service Conditions (ENGR 498-08)

Andre Ferreira de Barros Correa, Luan Lisbo Silva
Instructor: Tongyan Pan, Ph.D.

Reinforced concrete (RC) is one of the most commonly used material of construction. The deterioration of RC structures is a problem affecting many old structures built with small concrete cover to protect the rebar from corrosion. Ingress of chlorides is the main cause of rebar corrosion. In this work, a finite element method was developed using the program COMSOL multi physics to prevent rebar corrosion by chlorides.

Multi-scale & Multi-Physics Modeling of Concrete Durability in Service Conditions (ENGR 498-08)

Caio Cesar Moreira De Souza
Instructor: Tongyan Pan, Ph.D.

Reinforced concrete design takes care, on its majority, of aspects as bending, shear, and torsion strength, serviceability, which controls deflection and concrete cracking, the combination of various types of loads, etc. Nevertheless, there is one aspect that is not considered as important as those stated above: the environmental loads. The environment that surrounds a construction can severely change its integrity. One of the major problems experienced by reinforced concrete constructions near marine environments or highly chloride concentrated centers is the corrosion of its reinforcement (rebars). The damage done by rebar corrosion decreases the lifetime of the structure and can lead to a catastrophic failure.

Multi-scale & Multi-Physics Modeling of Concrete Durability in Service Conditions (ENGR 498-08)

Braga Junior, Edmar de Sousa; Covalenco Junior, Helio Jeferson; Lima, Taina
Instructor: Tongyan Pan, Ph.D.

Concrete durability is a concerning topic in civil engineering, since the reinforced concrete is the most used material in this field and commonly used as a structural element and exposed to the environment, it is totally desirable to maintain the designed properties, such as the mechanical and the physicochemical properties during its service life. In addition, the concrete degradation is generally caused by the chloride action presented in the environment, which is responsible for the rebar corrosion causing cracking and structural degradation. The focus of this project was to develop a multi scale and multi physics finite element model simulating the ingress and removal of chloride in the concrete utilizing the COMSOL Multiphysics software, working in three primary examples based in a specific finite element model, simulating successfully diverse environment conditions, such as nature diffusion, electrical migration, moisture and also temperature, and their effects in the concrete service life.

Multi-scale & Multi-Physics Modeling of Concrete Durability in Service Conditions (ENGR 498-08)

Andrey Araujo dos Santos, Luiz Baccarini, Murilo Borges Pires
Instructor: Tongyan Pan, Ph.D.

This paper consists in a brief introduction of concrete, as well as the mechanism of degradation by corrosion within reinforced concrete, leading into cracks and loss of the bond between concrete and steel. A transversal cut of Reinforced Concrete was applied under the COMSOL Multi physics program into different conditions considering nature diffusion, temperature, and moisture and nature diffusion.

Multi-scale & Multi-Physics Modeling of Concrete Durability in Service Conditions (ENGR 498-08)

Emiliani Castro, Guilherme Carmo, Túlio Trentini
Instructor: Tongyan Pan, Ph.D.

Reinforced concrete is one of the most used materials in our current society, therefore it is necessary that the mechanical, physical and chemical properties do not get compromised during its service life. It is known that chlorides are one of the most aggressive enemies of reinforced concrete structures. The chemical ingress of chlorides affects the resistance of the concrete due to the corrosion of reinforcement and generates internal cracks, causing serious damages to the material. This report and the research, equally done for all researches, shows three different situations that the reinforced concrete will be evaluated considering the presence of chloride: the first model considers only natural diffusion with the application of electrical field. The second one, includes the first example and the effects of moisture field, applying the Richard's equation. Finally, for the last model, the temperature field is included in the second model allowing us to analyze how the variation of the temperature influences the material and the transport of the chloride inside the concrete. The software COMSOL is used to design the 2D Multi-physics models and evaluate the transportation of the chloride inside the reinforced concrete. The factors considered as variable are time, concentration of chloride and temperature.

Abstracts

Collaboration with BIM: An Experiential Learning Case (ENGR 498-10)

Amanda Dos Santos Aires, Dimas Crescencio, Verissimo Santos, Fernando Caldeira Brant, Borem Dias Nivaldo, Stefani Junior Ronney, Petyk Manicoba Wadham, Entringer Bottacin
Instructor: Julide Demirdoven, PhD

Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life cycle from inception onward. It is clear that Building Information Modeling (BIM) is the trend of the future, with increased use documented in the construction industry in the last few years. To sustain the momentum of BIM, effective workforce development that aims to balance the supply-demand equation in the labor market is essential. This paper presents an experiential approach adopted to BIM-enabled learning to investigate collaboration with Building Information Models. Around many uses of BIM, the researchers selected their primary roles creating a BIM team and explored the interoperability of selected tools to operate their tasks. In this creative and collaborative process the researchers gained some skills for BIM capabilities of the integrated design project by using various course materials and software licenses provided for their use in a limited time frame. This methodology allowed the researchers to experience integrated design process in a realistic way and helped them to learn how different tools and methods integrate with each other. Experiences in integrating BIM in terms of learning by doing into the undergraduate immersive research program at IIT are presented and discussed through sample assignments and specific research sessions including lectures, seminars, researchers' oral and poster presentations, industry partnerships, workshops and activities. The objective of this study is to educate the engineers/architects of the future who will be actively using BIM routinely.

Experimental Evaluation of Engineered Materials Arrestor System (ENGR 498-15)

Fernanda Yumi Serenario Tadano, José Bruno Primo do Nascimento, Matheus Cavalcante do Couto, Thauann Pinheiro Santiago, Arthur Marostica Alves Silva, Bruno Baracho Lyra, Lucas Almeida Tejada, Gabriel Pereira Magalhães de Novaes Santos
Instructor: Jeffrey Budiman, Ph.D., P.E.

Engineered Materials Arrestor Systems (EMAS) are a growing tendency in airports worldwide, due to their capability of absorbing the aircraft's kinetic energy, greatly reducing human injury and airplane damage. Therefore, it is of extreme importance to inquire and experiment to find the best possible material to fulfill this purpose. Taking this into account, the research purpose was to try different material compositions, searching for the ideal lightweight concrete mix capable of dampening the plane motion. With this in mind, the ideal characteristic attempted to achieve was an ideal fragility, providing resistance altogether with crushability. In spite of these aimed results, the approach method used was to tilt the runway 90 degrees, using a plastic wheel attached to a metal plate that would drop from a certain height, sliding down a wooden structure, and simulating the plane landing gear impact on the sample. After several crash tests, and analyzing the results obtained, it was found that the most effective sample contains less amounts of cement, and a bigger proportion of perlite, a cheap and lightweight material responsible for the dampening properties of the cement made. This sample, rationed approximately, volume concerned, one part of cement, one of joint compound, four of water and eight of perlite.

New Technologies for Efficient Design & Construction of Emergency Shelters (ENGR 499-04)

Lucas Maia Marques Guerra Cardoso, Uiatan Aguiar Nogueira
Instructor: Mehdi Modares, Ph.D.

In order to provide housing for people who are displaced due to natural disasters and armed conflicts, many relief organizations use tent structures, which do not provide proper insulation from outdoor events, creating an unsanitary environment. To overcome those issues, new and economical solutions must replace the state-of-the-art shelter technologies. In this work, we designed a dome-shaped shelter utilizing aluminum frames for structure and Fiber Reinforced Polymer (FRP) composite panels as cladding. The panel is composed of E-glass FRP, a hydrophobic polymer layer for moisture insulation and a UV-blocker to protect the polymer's integrity, since it degrades faster when exposed to sunlight. Additionally, the shelter is elevated to keep the inside isolated from outside on the ground. Structural Analysis was performed considering dead load and a 128 mph wind load and it was checked for stability. The design was found structurally sound, capable of easily resisting the imposed loads. Moreover manufacturing costs were estimated. Construction of a single shelter costs \$9,649.44, with the possibility of reducing the costs if mass-produced. We suggest the future work of this study to build an actual prototype for experimental purposes. Upon successful completion of this project, a new generation of emergency shelters will be built that can be assembled onsite.

Development of Importance Category Factor for Temporary Structures Subject to Seismic & Wind Loads (ENGR 499-05)

Barbara Maio da Costa, Isabela Beatriz Macedo dos Santos, Joao Alfredo de Lasari, Lucas Daniel Souza de Oliveira, Marina Fernandes Soier
Instructor: Jamshid Mohammadi, Ph.D.

Temporary structures are described as all structures with short service lives. They are intended for a temporary function, such as maintenance, repair or retrofit of a structure, for temporary housing, or for staged performances. Currently, design code coverage of guidelines or design procedures specific to temporary structures when exposed to wind and seismic loads is not comprehensive. Specifically, there is no prescribed importance category designation for temporary structures when subject to wind and earthquake. This paper proposes a method for importance category designation of temporary structures based on such parameters as usage, risk level category, and duration. The report starts by providing a review of literature on temporary structures. This is followed by a proposed method for importance category determination similar to those suggested by codes for permanent structures. The risk level category proposed for temporary structures follows ASCE 7-10 (published by the American Society of Civil Engineers) and concerns the potential for loss of lives. The proposed Category I is intended for temporary structures that have low risk to human life in case of failure. This includes isolated areas and places that will not affect the functionality of services and/or with a few people involved directly or indirectly with the structure or with no human occupancy. Category II is intended for all temporary structures other than those listed in Category I, III and IV. Category III is intended for temporary structures that represent a substantial risk to human life in case of failure. This includes systems located in metropolitan areas, places that will affect the functionality of services and/or have many people involved directly or indirectly with the structure. Category IV is intended for temporary structure that represents a high risk to human life in case of failure. This includes temporary structures located nearby essential facilities or used as essential facilities such as hospitals, police stations, and fire and rescue stations. In addition, it includes temporary structures used in nuclear industry and temporary structures used in association with historic buildings. The risk category based on the occupancy, usage and location is reflected in the importance factor that is used throughout the load calculations. It is important that as the category changes from low to high, the importance factor increases as well to provide an adequate factor of safety for temporary structures listed on III and IV. In addition, design temporary structure as permanent structures may be very conservative, so it is important to use a reduced factor applied to the loads. Due to the lack of information about procedures to determine a reduced factor to apply in temporary structures, a linear regression method was used to find wind and seismic importance factors. This method is based on duration and factors found in different codes for permanent structures. Accordingly, the risk category I, II, III and IV are correlated to the service duration of the temporary structures in order to provide estimates for reduction factors for temporary structures.

Development of Importance Category Factor for Temporary Structures Subject to Seismic & Wind Loads (ENGR 499-05)

Eduardo de Faria, Igor Silva, Pedro Paranhos, Ulana Medino, Vitor Hugo Tresoldi
Instructor: Jamshid Mohammadi, Ph.D.

The main purpose of this study is to develop an importance category for temporary structures for their design against wind and earthquake loads. The importance category, along with the usage of a temporary structure, is then used in determining design loads for seismic and wind design of the structure. This study suggests using five factors to classify temporary structures. These are (1) Duration; (2) Occupancy; (3) Purpose (i.e., application type); (4) Accepted risk of failure; and (5) Location. Using these factors, the study suggests 4 importance categories for temporary structures. A procedure is proposed on how to arrive at the importance category for a given temporary structure. Utilizing the importance category prescribed in this study, it is possible to determinate a design load level that is compatible with the expected level of risk, usage, location, and the application type of the temporary structure.

Abstracts



Energy, Water, Transportation, & Sustainability

Applying Finite Element Methods for Coupled Heat & Moisture Transport Processes in Porous Materials (ENGR 498-01)

Caio Potenza Sampaio

Instructor: Paul Anderson, Ph.D.

The use Finite Element Method (FEM) for solving the problem of coupled transport of heat and mass (in this case water) is worth considering because FEM can deal with complex geometries and its numerical method, once given the initial and boundary conditions, can predict the transport with accuracy and with the right tool (in this case I am using the software Mathematica 10.0.2 by WolframAlpha) may be simpler than the several analytical solutions already proposed for solving the problem. This study will apply the equations formulated by Qin et al. (2006), which describes the transport of heat and moisture in porous building materials and try to solve them by the FEM approach, looking for the agreement of the both methods.

Carbon Isotope Fractionation During Diffusion & Biodegradation of Petroleum Hydrocarbons in Unsaturated Zone: Field Experiment & Modeling Using Finite Element Methods (ENGR 498-01)

Marcos Luan Rosa Fonseca

Instructor: Paul Anderson, Ph.D

Bouchard et al. (2008) talk about a natural attenuation process that could be used to manage contamination of a petroleum-hydrocarbon-contaminated site. Contamination by petroleum is an important environmental problem, and it is beneficial to seek new ways to handle this sort of contamination. The authors describe the need to demonstrate the utility of natural attenuation. Specifically, it is important to demonstrate that biodegradation of hydrocarbons is actually occurring at the site. Due to this, field experiments and simulations were carried out. In my research I was responsible to use mathematical models to simulate the fate of volatile organic compounds in groundwater. I incorporated finite elements methods to the Advection-Dispersion-Equation(the equation responsible for the fade of the volatile organic compounds) using the software Mathematica. Through the simulation I was able to plot the graphic concentration per distance from the source in function of time. Still the results are incomplete, the plotted graphic is showing some type of fluctuation. Nevertheless, the research was able to demonstrate the model predicted for the field experiment.

Finite Element Method Applied to the Fate & Transport of Petroleum Hydrocarbons in the Lower Mississippi River Delta (ENGR 498-01)

Hian Clisman De Medeiros Costa
Instructor: Paul Anderson, Ph.D.

Environmental issues are always themes for debates in these recent times of sustainability. The petroleum industry is a likely source of environmental problems, a single spill can cause concerning danger for animal life and human intakes around it. This research will analyze the behavior of an oil spill in a marine environmental, the Lower Mississippi River Delta. The area of study is surrounded by drinking water intakes and different biomes. The purpose is to create a model that describes all the singularities of this area simulating the variation of oil concentration through finite element methods in Mathematica Software.

Finite Element Method for Environmental Transport Process (ENGR 498-01)

Driely Celestino da Costa
Instructor: Paul Anderson, Ph.D.

Zinc (Zn) and Manganese (Mn) are divalent metals that are not removed satisfactorily in conventional calcite (or organic matter-based) passive treatment systems. Adding caustic magnesia (MgO) mixed with wood chips to the system the metals can be alternatively removed from water. During one year were used two columns to measure profiles of chemical parameters and hydraulic conductivity to treat the metals in the water, one column containing 25% (v/v) of MgO with median particle size (~3mm) that show low reactivity and poor metal retention, and the other column containing only 12.5% (v/v) of MgO with median particle size (~0.15mm) took the metals below detection limit and had a good hydraulic performance. This method applied consumed the metals in 95%. The Zn and Mn could be dissolved completely before they precipitate, and the wood chips help to prevent clogging. The MgO dissolution achieved the pH near by 10, which did the Zn²⁺ solubility become lower and also did the Mn²⁺ oxidized quickly. The environmental transport processes that are occurring in the columns were modeled on Mathematica software using finite element methods to get simulated changes of concentration during the time, and to evaluate each column is the most efficient. In the end was proved that the small size of particles is the key factor to achieve a faster dissolution of the reagent and a most efficient system with larger surface area of reaction.

Finite Element Method for Environmental Transport Processes Case Study: Cadmium Biosorption Rate in Protonated Sargassum Biomass (ENGR 498-01)

Otavio Foresto da Silva Cardozo
Instructor: Paul Anderson, Ph.D.

This project looks at the work of Jinbai Yang and Bohumil Volesky on Cadmium Biosorption Rate in Protonated Sargassum Biomass, which studies the adsorption and diffusion processes of cadmium, one of the most threatening heavy metals, in a biomass particle from a brown alga that is very effective in binding metal ions. The purpose of this research was to use the equations described on the article and try to implement a numerical method called Finite Element Method (FEM) to solve them. Since it is a relatively new package on software Mathematica, this research was conducted in a group so that each student could have a different case study and work separately on it, but communicate their findings to the group so that everyone could discuss and help each other in the task of exploring this numerical method. All the case studies were related to environmental transport processes and had equations that described advection, diffusion or reaction processes. After working with the expressions from the article, it was found that solving the equations using Mathematica could be quite challenging if you are not familiar with the code. Although, we concluded that it is possible to solve these kind of equations in Mathematica successfully for someone with previous knowledge of the programming language, and it is much easier and faster than solving analytically.

Abstracts

Finite Element Method in Heat & Moisture Transport Through Hollow Porous Blocks (ENGR 498-01)

Joao Augusto Silva Bottrel
Instructor: Paul Anderson, Ph.D.

The finite Element Method can be used in a wide variety of partial differential equations and many different regions as well. The study presented below uses this method to obtain a profile of temperature and humidity transport through a hollow porous block, it can be useful to develop new construction, insulating materials and developing new equipment for industry. To generate the graph two equations, heat transfer and moisture transfer, were solved, determining a region and initial and boundary conditions, with the aid of the software Mathematica. The results were consistent and satisfactory.

Finite Element Method: Modeling the Transport & Inactivation of E. coli in the Near-shore Region of Lake Michigan (ENGR 498-01)

Ananda Antenor
Instructor: Paul Anderson, Ph.D.

Water management programs are an important issue in the environmental area. New techniques can help to measure water quality, and to understand sources of pollution in the water cycle. (Liu et al., 2006) investigated the transport and fate of fecal pollution at Great Lakes beaches and the health risks associated with swimming, the near-shore waters of Lake Michigan, and two tributaries discharging into it were examined for bacterial indicators of human fecal pollution. The purpose of this study was to learn how to use the FEM (finite element model) package in Mathematica applied for an environmental transport process. To achieve it, the environmental transport process chosen was the work made by (Liu et al., 2006) - modeling the transport and inactivation of E. coli and Enterococci in the near-shore region of Lake Michigan. The notebook of Mathematica has five sections: the delimitation of the Lake Michigan near-shore, solving by FEM package; using different values to k (overall first-order inactivation rate); the formulation of k depending on temperature, light and settling; and comparison of the k values. The model had problems and because of them was not possible to have concrete results to E. coli concentration. The main problem was the definition of two distinctive regions to be able to use different values of concentration in the boundary conditions. Even though with these problems, the model is a reasonable example of how to use FEM package in Mathematica applied to environmental transport process.

Paleo-Roothole Facilitated Transport of Aromatic Hydrocarbons through a Holocene Clay Bed (ENGR 498-01)

Luisa Miranda Mendes
Instructor: Paul Anderson, Ph.D.

Since the rise of industry chemical use, the contamination of soil and water has become an ever more prevalent problem. Moreover, this problem started to become a concerning issue few decades ago. One contributing contaminant group, the non-aqueous phase liquids, is an extremely toxic and a very common waste product. The case analyzed, based on the article of White et al. (2008) analyses the contamination of a clay bed by NAPLs in an area previously occupied by an industrial facility. This work tried to simulate the real contamination process using the data found in the article, finite element methods and the software Mathematica. A 3D contamination graph was generated and, while not being perfectly suitable, it can be used as a startup for further simulations.

Simulation of Groundwater Contaminated with Copper Ions Remediated by Waste Foundry Sand Permeable Barrier (ENGR 498-01)

Maria Fernanda Cardoso Gonzaga
Instructor: Paul Anderson, Ph.D.

The treatment of contaminated groundwater is difficult and expensive, is also one primary factor to limit closure of contaminated sites. One viable option is to use permeable reactive barriers (PRBs), because past experiments confirmed that they have been used successfully to remove an extensive range of organic and inorganic contaminants from groundwater. The focus of the research is use the software Mathematica to simulate the potential of waste foundry sand as an inexpensive material in PRBs for the removal of copper (Cu^{2+}) from contaminated groundwater. The Finite Element Analysis (FEA) is the tool used for the evaluation, because it can provide an accurate prediction of it.

Battery Thermal Management System (ENGR 498-09)

Natalya Emmanuely, Mohr Kublik
Instructor: Mahesh Krishnamurthy, Ph.D.

Batteries of Hybrid Electric Vehicles (HEVs) and Electric Vehicles (EVs) present great performance at an optimum range of temperature, they also require an effective thermal management due to safety concerns and because it ages considerably at high temperatures. Because temperature is a concern, the objective of this paper is determine the minimum measurements of temperature and their locations in order to obtain the temperature of any point of the battery pack, where phase change material is the proposed cooling system. Furthermore, the heat generation of each cell is one input required, hence an electro-thermal model is created simulating the electrical-thermal behavior of the cells. The pulse relaxation test was performed and the errors between experiment and the test were satisfactory, thus the electrical-thermal model was validated. After validating it, all inputs can be estimated. Finally by using state estimation and observability we determined two as a minimum of measurements for of a staggered seven cells pack.

Comparing Interior Permanent Magnet (IPM) Machines used in Hybrid Electric Vehicle (ENGR 498-09)

Renato Galdino
Instructor: Mahesh Krishnamurthy, Ph.D.

This paper aims the evaluation and comparison of two permanent magnet synchronous motors (PMSM) used in a hybrid electric vehicle. The machines to be compared are Interior Permanent Magnet (IPM) motors that are used in the Toyota Prius 2004 and 2010. The software Info-lytca Magnet, a Finite Element Analysis based simulation program, will be used to perform the virtual evaluation. The main conclusion states that the 2010 model can provide equivalent performance with a better efficiency and slightly lower cost, which is mainly due to improvements on the rotor design, reduced magnets dimensions, and reduced stack length. The software achieved success performing a precise simulation of the models.

Design & Thermal Analysis of DC/DC Converters on PHEVs (ENGR 498-09)

Everton Cocco Cancian, Pedro Henrique Brossi Ligere
Instructor: Mahesh Krishnamurthy, Ph.D.

The focus of this project is to design and thermal analysis of a DC/DC converter applied to plug-in hybrid electric vehicles (PHEVs). First, it is designed a buck converter based on given parameters of operation, and simulated on PSIM® software. From that, it is possible to estimate the power losses generated by the semiconductors of the converter, which generate heat in the system, and based on these results we further apply them into a multilayer thermal structure flow simulation on different software, Solidworks®. This structure modeled represents the heat sink, layers of different materials, and power semiconductor devices. As a result of this flow simulation, we have to analyze the behavior of the power electronic devices regarding the heat dissipation. After, we can verify the best configuration of the multilayer thermal model as well as the best design of the heat sink. Hence, performing the thermal analysis of the power electronic devices we can estimate and choose the most efficient model to use on the PHEV. In the end, results are shown in order to demonstrate that the developed procedure is valid.

Electric-Hydraulic Hybrid (EH2) Vehicle Drive Train (ENGR 498-09)

Gustavo Campos, Christophe Emerich Costa
Instructor: Mahesh Krishnamurthy, Ph.D.

This paper presents the current status of the Electric-Hydraulic Hybrid (EH2) vehicles. Seeking higher efficiencies in energy usage and environmentally friendlier transportation systems, the EH2 vehicle have been shown a good option, because the hydraulic system is added to an standard electric drivetrain. It can provide a better performance to the vehicle, reduce the use of the battery, and, consequently, solve the main issues of an Electric Vehicle, the low power density and reduced life of the batteries. A modeled version is presented to simulate the forces acting in the hydraulic system using Solidworks software. It will provide a good understand of the packing and size/weight of the components to be improved and to be optimized.

Abstracts

HEVs, PHEVs and EVs: Identifying Opportunities and Predicting Future Trends (ENGR 498-09)

Cassiano Ferri, Caroline Silverio Rosa, Fernando Wosniak
Instructor: Mahesh Krishnamurthy, Ph.D.

Nowadays, the society has started facing problems related with the environment, most of those problems caused by the human activities and pollutant emissions. The pollution rate is rising every year. The burn of oil in internal combustion engines causes most of this pollution. Each year the fleet of internal combustion vehicles increases substantially. In order to decrease the actual and future environmental threats affecting the human life in Earth, governments and companies are trying to develop more environmental friendly solutions to reduce these problems. One of the solutions, which is discussed in this paper, is the adoption of electric vehicles as an alternative to decrease the greenhouse gases emissions. For determining the viability of electric vehicles around the world, this paper discusses the standards and policies, the fuel market and its trends for the future, the available infrastructure, and environment issues focusing in Brazil, United States, Europe and China.

Coanda Airfoil in Compressible Subsonic Flow (ENGR 498-16)

Jessika Julia Veronese Goncalves, Rafael Silva Reghin
Instructor: David R. Williams, Ph.D.

This paper is about a research that studies the effectiveness of a Coanda type airfoil that uses active circulation control to increase lift coefficient in compressible subsonic flow. The analysis was made on a supersonic wind tunnel equipped with a force balance, pressure sensors and air supply for the airfoil circulation control. The results showed that an increase in momentum coefficient (blowing intensity) increased the lift coefficient, but this effect would decrease with increasing Mach number for the same blowing intensity.

Fan Performance in IIT Low Speed Wind Tunnel (ENGR 498-16)

Rafael Cavalcanti Amado, Denini Santini Fernandes
Instructor: David R. Williams, Ph.D.

This research was done over a two-month period by two Brazilian students during summer in Illinois Institute of Technology (IIT). The main objective was to obtain the fan performance map of the IIT low speed wind tunnel, show how it works with the louver system and see the response of the wind tunnel to louver motions. The data acquisition was made by wireless connection via Arduino Yún, transmitting directly from digital pressure sensors located right after the fan and one before it. The Arduino was connected to the wireless network created by the Arduino's linux, so that it could be accessed by any computer in the same network with the system Putty. Measuring the pressure and the velocities for several angles of the louver system, graphs were made in order to see how the system works and the fan performance map can be done correctly.

Unsteady Lift Enhancement Using Active Flow Control (ENGR 498-16)

Diego Soares Gonçalves
Instructor: David R. Williams, Ph.D.

The improvement on the performance of aircrafts for flight situations such as gusts and high-G maneuvers can be achieved by understanding better the application of active flow control. Actuators are installed on the leading edge of a wing to evaluate the lift response to pulse actuation. Using particle image velocimetry (PIV) data, time-resolved velocity field and vorticity measurements are obtained.

Smart Grid Analysis of Centralized Cooling for an Urban Community (ENGR 498-18)

Jessica Madruga De Miranda Henriques, Moises Soares Martins, Raimundo de Melo Neto, Leandro Lima de Rezende, Larissa Soares
Instructor: Donald J. Chmielewski, Ph.D.

This project will investigate three different methods to provide energy to operate the cooling system for a new community that will have about 10,000 residents in an area formed only by residential buildings. First case we will study a decentralized system, each home has its own residential electric chiller to provide cooling. Centralized systems will be analyzed, the first one we will have a big chiller for cooling. An absorption chiller will be used to produce the cooling and it will use a natural gas combined cycle (NGCC) power plant to produce the waste heat that it needs and to generate energy. In addition, by using smart grid analysis and technology it will be decided when it will be profitable to produce energy or turn the power plant off while the energy production does not provide revenue. Finally, another centralized system case, a similar analysis will be implemented, however a thermal energy storage (TES) will be added to the first centralized system case.

Advanced Vehicles Research (ENGR 498-22)

Daniel Rocha
Instructor: Francisco Ruiz, Ph.D.

The goal of this project is to build a Hovercar capable of levitating by electromagnetic forces. An alternating current is applied to a coil. If the coil is placed near a conductive non-ferromagnetic surface, the currents induced below the surface produce a magnetic field of opposite polarity. As a result, coil and surface repel each other so that the coil may levitate. An experiment using a transformer was made to measure the repulsion force between an electromagnetic field created by a transformer and an aluminum plate. Graphs of current versus force, and distance versus force were plotted. A similar technology has been used in maglev trains in Japan, but this principle may apply in theme parks attractions and industry heavy lifting as well.

Graphical Analysis and Simulation of the Brayton 6-Stroke Hybrid (ENGR 498-22)

Michel Martins, Gabriel Maffia, Filipe Martins
Instructor: Francisco Ruiz, Ph.D.

This paper was developed in order to analyze a hybrid engine proposed and designed by Professor Francisco Ruiz. This engine is based on the Brayton Cycle and works by using two different types of source: compressed air and Gasoline. There will be air compression and storage using the movement and work performed by the piston of each cylinder of the engine. The engine also will comprise alternative ways in which one may experience increased performance or greater economy. The goal of this activity was to simulate and get graphical data from the proposed engine in a software and compare this results with a standard 4-stroke engine simulation. Important results were obtained through simulations which brought confirmation of practical results already expected in theory and allowed analysis and correction of other data that were not expected. Therefore, this activity has met the expectations and contributed satisfactorily to the project itself.

Research on the Relationship between Cities and Water (ENGR 498-26)

Gabriela Santos Alves, Lucas Nunes Ambrosio, Isabella Bambirra, Flávia Mendonça, Lucas Calfa Vilhena
Instructor: Corradi Dell' Acqua, M.S.

The objective of this report is to introduce a project that uses water as a source of the refrigeration system in a building. The Water Research Center comprised by a series of buildings is the proposed project which is located nearby the Chicago River in Chicago, Illinois. The idea is to create a water cooling system, which is able to collect cold water from a waterfront near the site, used to cool down the building during the summer, and discharge it back to the waterfront without the use of a cooling tower. Normally, in conventional Air Conditioning systems, there are condensers which extract the heat from the building and release it to the surrounding area. It is a system that basically works with the same principle as an air source heat pump, but extracts the heat from a body of water rather than the air. This type of system is more efficient and appropriate to the design of this project. The reasons to choose this system are explained in this report as well as the amount of energy savings and how this system works.

Abstracts

Research on the Relationship between Cities and Water (ENGR 498-26)

Andre Mafra, Elayne Figueiredo, Thiago Tomassine
Instructor: Corradi Dell' Acqua, M.S.

This paper describes the design of a masterplan for a water research campus located on Chicago's river front. The architectural proposal is part of a broader research project, which aims to explore the relationship between cities and water. Only a small fraction, approximately 3%, of the world's water is fresh water and the Great Lakes hold nearly 20% of the world's fresh surface water. This research explores how to best use, treat, and preserve this precious resource in a city located next to a big body of water. The project masterplan is the result of an iterative process and of the collaboration in between three different disciplines: architects, civil engineers, and environmental engineers. While the architectural project focuses on the design of a water research campus on Chicago's river front, the civil engineering team has researched on a water-to-water cooling system, which uses the river as an energy source exploiting the water temperature. Concurrently, the research conducted by the environmental engineering team focusing on storm water management and wetland design has greatly influenced the landscape and site design. The architectural project has been developed in three main steps: (1) The research started with the analysis of urban waterfronts at a global scale; (2) during the second phase, it zoomed into Chicago and the analysis of the project site; (3) the third phase is the design of the masterplan. This paper focuses on the development of the architectural proposal.

Use of treated wastewater in building (ENGR 498-26)

Costa, N. L. S., Franco, H. G., Gervazoni, M. E. M., Silva, F. A. A., Souza, C..
Instructor: Corradi Dell' Acqua, M.S.

The purpose of this project is to design a stormwater management system integrated with a water treatment system for a water research complex proposed for Downtown Chicago, Illinois. The stormwater management system includes a series of Low Impact Development (LID) controls in order to treat the impervious surfaces of the analyzed site. Those management strategies include infiltration basins, green roofs and rain gardens, for instance. Each one is mainly responsible for making the current surface areas more permeable, besides improving the current environment by supporting great biodiversity. The water treatment system consist of 3 wetlands where the water flows continuously through the system removing pollutants and improving water quality in terms of Biochemical Oxygen Demand (BOD), nitrogen, phosphorus, total suspended solids and other important parameters. The main plants responsible for the treatment processes are Cattails, Bulrushes and Reeds. The system is composed by three zones where the first and the third wetlands are a fully vegetated system with less presence of sunlight and containing a denser and emergent vegetation and the second one is an open-water surface system, containing submerged plants and receiving the sunlight as an active and very important resource for the biological treatment. All the wetlands have a retention time of 3 days each and the average flow of approximately 350 cubic meters a day. Wetlands 1 and 3 are 2 feet deep, having an area of approximately 22,222 square feet each and average velocities of approximately 0.059 foot per second. Wetland 2 has depth of 4 feet, area of approximately 11,111 square feet and average velocities of approximately 0.125 foot per second. In order to attend the water quality improvement desired, Wetland 1 is mostly in charge of flocculation and sedimentation processes, wetland 2 deals mainly with disinfection and wetland 3 is responsible for removing a great portion of the remaining Nitrogen.

Implementing Route Design Using GIS (ENGR 498-27)

Andressa Domingues Penteado, Felipe Bonatto de Lima, Gabriela Bernardes, Giselle Araujo Pimenta dos Reis, Ingrid Dourado de Lima Caires, Lucas Luz, Luis Carlos Soares da Silva Junior, Matheus Lisboa Aguilar, Mirele Pereira Paulo, Samuel Fonseca, Tatyanne Cybelle Coutinho
Instructor: Laurence Rohter, M.S., P.E.

Current consumer Navigation Systems are inadequate for more advanced users who want to follow a predetermined route. GIS allows the easy creation of routes but integrating these with the US' Global Positioning System requires a more sophisticated map and realtime display capability. Applications for this include Automated Machine Control such as practiced in construction or agriculture; Inspection Recons to check utilities; and Tourism. The objective of this research was to test tools available for custom route design and real time following at various scales of implementation. A wide variety of platforms are available for creating the desired routes. The goal was to integrate these into different levels of flexibility, usability, and accuracy. The team worked together to research the various methods available, make sample data sets, and test them in actual conditions; 10 routes were produced. The IIT Campus Admissions Tour and IIT Mies Architecture Tour were the first documented and proofed for concept and consistency. Comparables of various gps and gis platforms were evaluated. Additional routes

included four regional to the Chicago area, one was North American in scope and three were International. The various levels and applications available in current GIS were easily accessible and performed well. The 'pocket' applications such as available with android and iphone were a good place to start. Various interactions to other parts of the GPS and GIS universe increased scope and scale and added substantial context to the route following. These included topics of orienteering, geo tagging, geo fencing, crowd sourcing, affinity groups , public facing, and QR Coding, among others. The higher end commercial (ESRI, Autodesk) and semi commercial (open source qGIS) applications can add more robust context and data collection capabilities at costs including additional learning time.

Localization and Navigation Using Smartphones (ENGR 498-28)

Alexandre Lara, Danielle Guedes, Lucas Neubert, Luiz da Silva Jr., Otavio Mota, Rafael Ferraz, Tales Dantas, Vinicius Stock, Wesley Passos
Instructor: Samer Khanafseh, Ph.D.

Global Positioning System (GPS) is nowadays a fundamental and very useful tool for applications that includes localization and navigation concepts. Such applications can be cited as civil for navigation in roads and highways, military for precisely navigation and localization, for aviation to increase the safety and efficiency of flight, and for marine to improve search and rescue. However, the GPS signal can be easily degraded or even completely lost when blocked by buildings and tree canopies. As a result, its accuracy is compromised in indoor environments, urban canyons and deep forests. Furthermore, interference, jamming and spoofing can be used to block or hack GPS communication. This work describes the integration between a GPS module and an Inertial Measurement Unit (IMU) in a low cost embedded system in order to provide a robust localization system with a submeter level position estimate accuracy. The whole system comprises of a reference station, GPS and IMU connected to a Raspberry Pi 2. The inputs of the system are the GPS and IMU measurements, which are processed and filtered to provide an estimated position of the user as an output. Through this project, it was determined that tightly coupled GPS and INS integration algorithms are feasible on low cost embedded systems such as a Raspberry Pi 2. In summary, a low cost GPS/INS navigation system that can provide a good accuracy even in indoor environments was created. Bear in mind that the GPS/INS navigation system is more robust than GPS or INS standalone and that the performance is submeter accuracy for GPS/INS and tens of meters for GPS or INS.

Computational Aerodynamics of Vertical-Axis Wind Turbines (ENGR 498-30)

Eduardo De Souza Nascimento
Instructor: Dietmar Rempfer, Ph.D.

Even though vertical-axis wind turbines (VAWTs) may provide several advantages such as noise reduction and easier maintenance and construction, their development still faces a few obstacles, as its difficult aerodynamics and a lower power generation when compared to their counterparts (horizontal-axis wind turbines). This paper presents results from a simulation program developed in MATLAB using streamtube methods that greatly simplify the aerodynamics without significantly compromising the accuracy of the results. The code also included important aspects for the phenomenon, such as dynamics stall and wake corrections. The data generated was then compared to previous works from other authors that used different approaches. In addition, an arrangement for a multiple turbines wind farm was also simulated in order to verify the possibility of increasing the overall power generation when compared to the single turbine case.

VAWT: 3-D Correction and Double Streamtube Model (ENGR 498-30)

Karina Brumatti, Victor Hugo Alves Borges, Guilherme Franco Monteiro
Instructor: Dietmar Rempfer, Ph.D.

The vertical axis wind turbines has lots of benefits that highlights them in the nowadays, though they are less efficient and more difficult to be aerodynamically studied than the horizontal ones. The benefits include less noise because they work in a smaller rotation than vertical ones, and the blades are always at the same distance from the shaft. This Turbine also allows have the generator next to the ground due the vertical axis, what makes easy and cheaper the maintenance. As the Finite method is too hard to model and process, requiring a lot of computational work and a lot of time to run the process, the DMST model is utilized as an easier alternative to simulate the VAWT. The 3-D correction is applied to the data of the finite wing in order to obtain results closer to the reality next to the ground due the vertical axis, what makes easy and cheaper the maintenance. As the Finite method is too hard to model and process, requiring a lot of computational work and a lot of time to run the process, the DMST model is utilized as an easier alternative to simulate the VAWT. The 3-D correction is applied to the data of the finite wing in order to obtain results closer to the reality.

Abstracts

Simulation of Active Blade Pitch Control for Vertical-Axis Wind (ENGR 498-30)

Guilherme Almeida, Jader Beck, Luiz Felipe Santana Dos Santos
Instructor: Dietmar Rempfer, Ph.D.

In this project, we developed a computer code to simulate the aerodynamics of a vertical-axis wind turbine with a stall model and wake correction and output its performance parameters. In addition to that, we implemented a control system for active blade pitch and demonstrated that this system can significantly increase the power efficiency of such a turbine.

Timing Signal Optimization of Intersections in Chicago Loop (ENGR 498-45)

Alan Felipe Do Vale Souza, Andre Barrosa Rocha, Elton Lima Maximiano
Instructor: Zongzhi Li, Ph.D.

The research was divided in two projects, the first related to the optimization of traffic signals in fifteen intersections of Chicago, and the other considering the crash data from the city of Chicago. The number of vehicles has been increased through these past years in the big city of Chicago, resulting in the increasing of the delay for traffic motion. Since the amount of vehicles increased, something must be done to try accommodate all the demand, to try reduce as much as possible the time that these vehicles spend on the streets. The time became an aspect very important in our lives, being considered as money. People do not want to spend too much time to get around, and here we can see the importance of signal optimization. Besides that, with the increase of vehicles, the amount of crashes also has been increased. The project 1 was made taking fifteen intersections from Chicago Loop area, and optimizing those time signals through two software: Synchro 7 and Excel Solver. And the second one had ArcMap, a Geographic Information System (GIS) software and Excel Solver as main tools. The main objectives for the project 1 was decrease the delay of those vehicles taking the chosen intersections, creating a network in Synchro 7 of the intersection and importing the data collected from Chicago Department of Transportation (CDOT) into the same software. We used Excel Solver to calculate the volume of vehicles for each approach and apply these values into Synchro 7.

For the second project, we used Excel Solver to create the files in the right format, and applying into ArcMap. After that, we created several layers showing the crash data spread in Chicago, and then using those maps, we made analysis based in each aspect, the day of week, the time of the day, and the crash severity. The final results showed that for the project of optimizations, we got an improvement of all the intersections, even with some disturbances with the volumes and the timing distribution. In the second project, we got several possible reasons for the total amount of crashes happening in different locations of Chicago. According with each aspect, a reasonable reason was founded out, and well explained in the description of each layer, containing the crash data by location. The optimization of those intersections in project 1 faced a big problem with lack of information for those volumes, since the amount of data collected from CDOT was not enough to make a more accurate optimization. The improvement percentage for each approach, in each intersection was also calculated, but for some approaches, the improvement was negative, because the volumes in those movements were too big, so a greater amount of time was needed for other movements. At last, for project 2, the reasons why so many crashes happened in those locations was directly related with comparisons in each year, 2004, 2005 and 2006.

Finally, the optimization and all the reasons came as a possible solution for the problem of high amount of traffic and high crash rate happening in the city. The process of optimization depends of others parameters that were all assumed in our research, for example, the collection of volumes of vehicles passing in each approach for each movement, and the assumption of how much volumes are going in each movement, (through, left or right). In the project 2, the data used was taken from the CDOT, and represents the real conditions of Chicago. The reasons used for that locations was also based in the crash data, and geographic design of those intersections where the crashes happened more frequently. We could check the design of the intersections using the tool Google Maps.

Timing Signal Optimization of Intersections in Chicago Loop (ENGR 498-45)

Debora M. Pacheco
Instructor: Zongzhi Li, Ph.D.

Chicago Loop is one of the 77 community areas and the central business of Chicago. The population in this area has been increasing, and one of the results is a larger number of cars in the streets. Therefore, to try to improve the traffic, this project has the objective to optimize the traffic signal plan of a part of the Chicago Loop Area using the software Synchro. It was chosen nine intersections in the area and information

such as traffic direction, movements, traffic volume and timing plan were collected and input in the software. Then, the network was created in the Synchro, and the intersections were optimized. From all nine intersections, the optimization worked on just three of them, which were improved. However, due to this action, others intersections were affected, having some of them upgrading as well as having other worsening. In the overall, the network had an enhancement.

Study of Wind Turbines under Rainy Conditions (ENGR 499-12)

Caroline Alves

Instructor: Hamid Arastoopour, Ph.D.

The aim of this work is the study of the aerodynamic behavior of a wind turbine airfoil after affected by environmental conditions such as heavy rain. It is based on the data of an experimental procedure made by NASA, using the NACA 64-210 aerospace airfoil and a rain simulation system. In order to make this study possible, CFD simulation is being used and single phase analysis are being previously made. This will make possible not only the validation of this experiment but also the use of the results as a baseline to the development of a multiphase model in ANSYS FLUENT, where the modeling approaches Discrete Phase Model, based on the Eulerian-Lagrangian approach, and the Volume of Fluid Model, that uses the Eulerian-eulerian approach will be applied. After the development of a 2D simulation to increase the knowledge about the problem, a 3D simulation is in process. Unfortunately, some errors about the geometry were found during the meshing procedure and are still being solved. The next steps in the research are the review of the meshing to solve the error and verify its accuracy, and the realization of the simulation for the single phase problem considering different angles of attack to the airfoil.

High Fidelity “Faster than Real-Time” Simulator for Predicting Power System (ENGR 499-34)

Rafael Fernandes

Instructor: Alex Flueck, Ph.D.

The purpose of this research project is to develop a high fidelity “faster than real-time” dynamics simulator capable of predicting the behavior of complex, large-scale power systems. This tool will help control center operators avoid major economic losses caused by widespread blackouts.

Faster Than Real-time Dynamics Simulator for Large-scale Power Systems (ENGR 499-34)

Leonardo Alves Moreira de Melo

Instructor: Alex Flueck, Ph.D.

During the last century, electrical usage has intensified and expanded. The electrical power grid technology has been stagnant for a long time. Therefore, with this new demand is necessary to improve the quality of this service. In this field, there is a new technology called smart grid that can be defined as the modern electric power grid. Looking forward to develop a smart grid, the “faster than real-time” dynamics simulation project uses state-of-the-art high performance parallel computing to simulate large-scale power system dynamics. The goal is to simulate the effects of a disturbance, such as a lightning strike, or an equipment failure before the entire post-disturbance transient has settled down through smart grid infrastructure system. For instance, if the initiating event can be detected, maybe with real-time synchrophasor data, then the operator could launch a detailed simulation on a powerful parallel computer cluster (i.e., small supercomputer) and try to complete the entire simulation before the actual transient behavior has finished. If possible, then the system will be able to see into the future and help operators avoid widespread blackouts. The “faster than real-time” dynamics simulation project consists to develop a C simulator using Linux (gcc, gbd, git); therefore, the team is building prototype models using Matlab/Simulink and PSSE benchmark (from Siemens PTI) to be able to implement the C program.

Abstracts

Faster Than Real-time Dynamics Simulator for Large-scale Power Systems (ENGR 499-34)

Jozias Rufino Leite Neto
Instructor: Alex Flueck, Ph.D.

There is a lot of concerns about energy conservation, how to avoid high costs, and also to help operators avoid widespread blackouts in electrical projects. For this reason, engineers have been searching for solutions to develop power systems ever more efficiently and ever more reliably. In the project "Faster than Real-Time Dynamics Simulation for Large-scale Power Systems", state-of-the-art high performance parallel computing is used to simulate large-scale power system dynamically. The first step is using MATLAB/Simulink to build the prototype models before implementing in C. Next, the commercial program PSSE (from Siemens PTI) is used for benchmarking. The implementation in C language is made in residual functions, and using the numerical Newton-Raphson method. Then, the main purpose for the "faster than real-time" dynamics simulation project is to develop a simulator in C using Linux, the TS3ph simulator.

Faster Than Real-time Dynamics Simulator for Large-scale Power Systems (ENGR 499-34)

Diego Henrique Duarte Bezerra
Instructor: Alex Flueck, Ph.D.

The "Faster than real-time Dynamics Simulator for Large-scale Power Systems" research focuses on power system operation and power system dynamics. The "faster than real-time" dynamics simulation project uses state-of-the-art high performance parallel computing to simulate large-scale power system dynamics. Our goal is to simulate the effects of a disturbance, such as a lightning strike, or an equipment failure before the entire post-disturbance transient has settled down. The tools will allow power system engineers to operate large-scale power systems more reliably and more efficiently. For example, if we can detect the initiating event, perhaps with real-time synchrophasor data, then we could launch a detailed simulation on a powerful parallel computer cluster (i.e., small supercomputer) and try to complete the entire simulation before the actual transient behavior has finished. If possible, then we will be able to see into the future and help operators avoid widespread blackouts. For the "faster than real-time" dynamics simulation project, we are developing our simulator in C using Linux and PETSc library, the TS3ph. We also use the commercial program PSSE® (from Siemens PTI) for benchmarking. In our initial model development work, we use Matlab/Simulink to build our prototype models before implementing in C.

Faster Than Real-time Dynamics Simulator for Large-scale Power Systems (ENGR 499-34)

Eduardo Steffens
Instructor: Alex Flueck, Ph.D.

Nowadays, when the subject is power systems operation and dynamics, one of the best ways to understand the effects of a disturbance, e.g., a lightning strike or an equipment failure is analyzing simulations. The main concept of Faster than Real-Time Dynamics Simulator (TS3ph) is to develop those simulations faster than real-time in order to predict blackouts in the power systems. To achieve the goal and make TS3ph able to be applied in large-scale power systems, it is being written in C programming based on PETSc Library, a high-performance computing library developed by Argonne National Laboratory. Because mathematical resources are applied (Newton-Raphson Method) to solve Partial Differential Equations, each model has four different C codes to work. In order to guarantee reliability, some comparisons between MatLab/Simulink and Siemens PSSE graphs are being made, the difference (error) between the plots and also the 1-norm, 2-norm and Infinite-norm are being analyzed, and improvements are implemented.

Automatic Event Detection and Data Compression Using Discrete Wavelet Transform Based on Synchrophasors (ENGR 499-35)

Frederico Jose De Oliveira
Instructor: Alex Flueck, Ph.D.

The objective of this paper is to present a signal processing technique for automatic event detection and data compression. The whole algorithm is created using Discrete Wavelet Transform, and structured with Daubechies 4 as the wavelet base function. A method to compress steady state data and keep original data around anomalies is proposed, achieving successful results using voltage synchrophasor data from

a microgrid installed at Illinois Institute of Technology. After detecting an event, the anomaly is classified, and a PDF format report is generated automatically. The methodology can be used in real-time control and protection systems as integrated part of Smart Grid applications. The complexity of the algorithm is considered low, and the processing speed is faster than others methods employed for the same purpose.

Data Compression and Event Detection Using Principal Component Analysis (ENGR 499-35)

Flavio Oliveira
Instructor: Alex Flueck, Ph.D.

The goal of this paper is to explain methods of event detection. Synchrophasor data produced by phasor measurement unit (PMU) is used to get data from buildings and substations. This work shows an efficient way to detect events in power systems using an mathematical procedure. This work explain how this procedure works step by step and the results acquired when the algorithm is tested with some data that we have. This work will show how much PCA is capable to help in the development of reliable systems. This technique, if optimized, is strong and reliable to detect an abnormal behavior of the system and as a consequence warn the controllers that something is going wrong. So, the main idea is to present a tool that is able to improve the distribution and it does not matter how big the system is, it will work properly every time that we apply it.

Event Detection Using PCA Analysis Based on Synchrophasor Data (ENGR 499-35)

Jeymyson Alves
Instructor: Alex Flueck, Ph.D.

The aim of this report is to present the work developed during summer research at IIT. The following report will present the description of the use of Principal Component Analysis (PCA) for the detection of power events based on synchrophasor data. The report presents the mathematical approach for the algorithm. Event detection algorithm was implemented through the comparison between the real power data versus the predicted PCA data. The software utilized for this process was MATLAB. The data used for this report was collected from the synchrophasor installed in the Local Area Monitoring System (LAMS) for Illinois Institute of Technology's (IIT) microgrid. Due to the evolution of power grid, and the addition of renewable sources such as solar and wind power, it is extremely important the development of event detection algorithms. These algorithms will be useful to identify disturbances and effectively prevent setbacks.

Event-Oriented Method for Load Modeling and Estimation Based on Synchrophasor Data (ENGR 499-35)

Jose Felipe C.F. de Lima
Instructor: Alex Flueck, Ph.D.

The objective of this paper is to present the work in the Smart grids synchrophasors - Analysis of power grid field measurements from PMUs research. The chosen focus for these studies were the event detection and model validation based on the synchrophasor data. This paper presents a method that uses a set of synchrophasor data to perform a voltage and power event-detection and then estimate the parameters for four types of load models. The model that presents the best fit is then selected, and the information is stored for further analysis. For the rest of the data where no events are observed, a static load estimation is applied for each window. Both algorithms are capable of generating text files containing the events and models information and save figures in a way that can be converted into a PDF report. The test data for the presented method are from the Illinois Institute of Technology (IIT) Microgrid based on synchrophasor data, which are given by the installed phasor measurement units (PMU's). This paper also presents a study that aims to determine the amount of current and power that a motor load is draining in a load bus using the PSSE CIM5- single cage induction motor load model based on the PMU data. In order to perform the load modeling for this more complex induction motor load model a set of data given by PSS®E were utilized.

Abstracts

Stock Market Analysis for Event Detection in Power Grid using SMA (ENGR 499-35)

Willian Luiz

Instructor: Alex Flueck, Ph.D.

This paper is focused on reporting an individual eight weeks Internship Summer Research Project about Synchrophasor data analysis for event detection in power grids. The objective was to develop an algorithm to efficiently detect voltage abnormal behavior, known as "events". This work achieved the previous described goal using a Stock Market Graphical Analysis method, the Simple Moving Average (SMA) with threshold and sliding window. This method showed to be very powerful for the event detection, a great tool to protect the safety of transmission lines and prevent blackouts.

Resource Management in Green Hetnets Research (ENGR 499-38)

Ciro Peter Janos Lobo Mora, Daniel Levy Lima da Silva

Instructor: Lin Cai, Ph.D.

This paper focuses on the new technologies in the next generation multi-channel wireless communication networks. Specifically, we investigate a protocol design in an energy efficient Heterogeneous Network (HetNet) [1] operating over multiple unlicensed spectrum bands. As a first step, we study the multi-channel bonding protocol in a single small cell [2]. To evaluate the throughput performance of a small cell in a HetNet, we use a simulation tool, namely, network simulator-3 (NS-3) to study the relationship of the network throughput and the number of mobile users associated with a small cell base station (BS) or an Access Point (AP), using the channel bonding protocol.

Green Commercial Construction (ENGR 499-42)

Dulio Helfenstens, Penques da Silva

Instructor: Amber Autumn

During the eight-week period from May 18 to July 11 of 2015, activities related to green commercial construction were developed at the Green Ribbon Foundation, a partner of the Illinois Institute of Technology, through the Armour College of Engineering. This paper references 3 project participation experiences during the 2015 summer immersion program. Baja Foods LLC, is a food company looking for a greener path, which will provide money savings during their food production. Outdoor Classrooms, is project that drives the engineering mindset to think outside the regular classrooms, looking for new structures that provide enough atmosphere for teach sustainability in a practical way to young children. The construction site visits are related here, showing thoughts on what had been seen.

Green Commercial Construction, Green Ribbon/Summit Design (ENGR 499-42)

Karen Silva

Instructor: Amber Autumn

The main goal of this research was to learn more about general Green Construction and Business and as well to develop and improve the following attributes: sustainability, project management, meetings conduction, civil construction, Lean Methodology, LEED. In order to do that, during those 8 weeks, we worked in several projects and places, getting deeper into each subject and having real life experiences.



Facilities, Operations & Project Management

Implementation of an Android App for the Campus Security (ENGR 498-07)

Mariane Borges, Felipe Paiva, David Silva, Marcello Souza
Instructor: Anitol Longinow, Ph.D., P.E.

This paper is based on the development process of an Android App motivated by the theme of our research program, Campus Security. The Illinois Institute of Technology is settled onto a dangerous neighborhood which brought us the idea. The work was done by Industrial and Computer Engineers and Computer Science undergraduate students and executed throughout the Summer Undergraduate Engineering Research Immersion Program at Illinois Institute of Technology, 2015. In order to enhance the security of the campus and trying to make the students feel more safe around the university facilities. This app was developed and tested by the software Android Studio. In association with ARMOUR College of Engineering, we will provide the management, release, and supervision of the Android App called IIT Hawks Defender. This software takes pride in providing a friendly interface for the user, no cost, and a real time connection to the IIT Police.

The Use of Software in the Construction Cost Estimating (ENGR 498-11)

William Rios
Instructor: Ray Lemming, M.B.A., J.D., P.E.

Construction engineers are concerned with primarily two things on a project, time and costs. Estimating is a function that is obviously related to costs but it is also a function that oftentimes can impact time on the project. Therefore any technological improvements to construction cost estimating, including estimating software as a major technological component, can improve the construction project. This research centers on the quality and use of the top construction estimating software programs. During this research, it was explored better ways to work with this type of technology, and to reach a consensus about it, how this affected during the years and how works. To be more accurate about how these software programs operate it was necessary a better study of how the cost estimating is done in different places as to types of construction and location (United States and Brazil), and with this, how to select and best use these software programs. After examining a variety of software programs, choose the best for cost estimating software for various uses.

Abstracts

High-Tech Ways to Change Orders in a Civil Construction (ENGR 498-11)

Lucas Ferreira Ramos
Instructor: Ray Lemming, M.B.A., J.D., P.E.

This report describes the results of a research project focused on change orders for civil construction related with cost estimating. Three different analyses were considered to identify "Best Practices" methods to improve the process of change orders. Face-to-face communication and paper negotiation were related as simple and inefficient ways to change order because the first one is fast, but not reliable and the second one is detailed, but slow. After the review of the results were considered that software is the best way to change orders for civil construction because it provides express communication between engineers, a huge list of materials available, easy ways to change order, and instantaneous decision making. It is also highly recommended by engineers that have used it. The software has many options to cover the whole system and change any kind of order in a construction. And also, it can be installed in a tablet and be used at any time or any place.

Uses of UAVs for Construction Estimate Tasks & Further Activities (ENGR 498-11)

Diego Willian De Witte
Instructor: Ray Lemming, M.B.A., J.D., P.E.

Over the years many technologies have been shown up to facilitate the construction estimator's work by making it faster, and improving the accuracy of estimates, such as new software solutions, new measurements tools, photogrammetry, and laser scanners. Unmanned aerial vehicles (UAVs) are an emerging tool, which have been studied to perform elementary tasks into the construction field. Previously, those tasks were being performed by human work or heavy machinery with higher costs, in longer time, and less efficiency. The Building Integration Modeling (BIM), unified with UAVs, might be a new innovating tool which can optimize the way how tasks have been executed by integrating 3D models with photogrammetry solution. The scope of the presented work is to analyze and present the areas which UAVs can act into the construction field focusing on estimate tasks such as surveying, volume take off, data acquisition for analysis of work progress, as well as further activities such as bridges inspections, safety management, traffic monitoring. The research clarified that UAVs are a promising tool to improve the civil engineering field optimizing the execution of task in cost, time, and quality.

The use of Building Information Modeling (BIM) In Cost Estimating (ENGR 498-11)

Mikael Nathan Macaneiro, Marcos Vinicius Da Costa Tornim
Instructor: Ray Lemming, M.B.A., J.D., P.E.

Cost Estimating involves the time consuming activities of quantifying and costing each element of the project. The skill level involved demands experienced cost engineers particularly when there are unforeseen events that occur throughout a construction project. Re-estimating consumes excessive time when making changes in a project. While unforeseen events are hard to avoid, it's possible to employ a technological tool, the Building Information Model (BIM), to facilitate and speed up the cost estimators' work of quantifying and readily make changes in the project. Despite BIM being able to accelerate these tasks, BIM for estimating is not yet widely used in the construction industry. This software needs to overcome some barriers such as the mistrust of employing a new tool and the lack of standard regarding its use. To clarify some facts about BIM, this paper is going to present topics such as: the three means of making the data exchange to acquire the quantity takeoff, when BIM is a good alternative to be employed by a company, its challenges required to overcome to reach success and how it is going to change the role of the cost estimators. It was found that there are three means of making the data exchange between the model and the cost estimating tools, and there is not a unanimous alternative, so all the alternatives should be analyzed and chosen accordingly to the company's interest. The role of the cost estimators is going to be improved since they are going to be able to spend more time on more valuable activities. BIM's adoption is still in progress but it has shown signs that it is going to be effective in the near future.

Delay Analysis in Construction Projects (ENGR 498-12)

Claudinei Diniz, Guilherme Brugger, Josifran Moreira, Lucas A. F. Fiore, Vitor Orsini
Instructor: Attila Damci

Delay is one of the most common problems in the construction industry. Delays may result in severe consequences on most project goals. In order to prevent delays, the major causes of delay must be carefully analyzed. The main objectives of this study are to identify the major causes of delay in construction projects, and to identify the shortcomings frequently encountered in the implementation of delay analysis methods. A total of 85 papers were reviewed and analyzed, from which 51 regarded to causes of delay and 34 were related to delay analysis methods. The findings show that 50 out of the 51 studies on causes of delay were performed in developing countries. In such countries, financial problems caused by the owner and contractor's poor site management and poor scheduling and controlling techniques are the most frequent causes of delay. For the delay analysis methods, it was found that none of them presented a set of procedures capable of covering all the different situations involved in a construction project delay. Thus, it is essential to understand the approach and the shortcomings of each method.

The Evolution of Construction Scheduling Methods, Technologies, & Practices (498-13)

Carolina dos Santos Martins, Danielle Rosa Batista Lima, Gabriela Sayuri Mizushima Nakagawa, Guilherme Peixe de Moura, Lethicia Borba Roldao, Lourenco Luiz Gustavo Lima Galvao de Souza, Marcos Rafael Silva Rodrigues
Instructor: Lee Welsh, M.S.

The construction schedule has always been a cornerstone for successful projects. Origins to some of the same methods still in use today date back to before 1900. However, despite many similarities to the past, the methods, technologies, and practices have had to adapt in response to ever growing, fast paced construction projects. The purpose of this study is to analyze the evolution of the main scheduling methods over time, and the relationship with the development of computer technology and capacity. This has been done by a timeline analysis between the main methods and technologies and a comparison of the leading scheduling software available. Upon these investigations, it is possible to identify trends in technologies and practices to predict how emerging technologies may influence the future of scheduling methods and practices.

Quantitative Models for Operations Management (ENGR 498-33)

Bruna Roma, Caique Gomes Filadelpho Belo, Isabela Pompeu Tavares, Lana Silva, Mariana Casaçoli Ribas, Paula Carneiro Martins, Regis Fernandes Silva, Thiago Indalécio Santos
Instructor: Elizabeth Durango-Cohen, Ph.D.

This study involves both theoretical and practical analytical models used to study inventory systems, production planning and supply chain management issues, as well as models at the interface of marketing and operations. In addition, it identifies the solution of problems involving risk analysis (uncertainty in problem parameters), decision analysis (sequential decisions under uncertainty with information) and data analysis (synthesize the available data into useful information) by using Microsoft Excel and other software to analyze, solve and interpret solutions to business decision problems.

Utility Master Planning (ENGR 498-35/ 498-36)

Bruna Lourenco Ferrari, Juliana da Silva Ferreira
Instructor: Jeffrey Barrie

A utilities master plan is a deep study of the actual campus' conditions and its growth. This study allows a better understanding of the Illinois Institute of Technology (IIT) campus systems utilizing the available resources at an optimal point and the acquisition of new technology for the campus' best purposes. The final goal of this research is to provide and organize the information about campus' equipment such as boilers, turbines, chillers, etc. that would help the campus utilities and energy department, and develop a plan for the short, medium, and long term.

Abstracts

Chilled Water System Optimization (ENGR 498-37)

Ana C. O. Souza, Lucas D. S. Silva
Instructor: Bruce Watts

Chilled water is often utilized to cool air in commercial buildings. A chilled water system is mainly composed of chillers, cooling towers, chilled water pumps, condensing water pumps, and air handling units. Chilled water gains heat from the air of the buildings, then gets rejects into the atmosphere. In this project, we studied the Engineering 1 (E1) chiller plant. Since this plant supplies chilled water to cool many buildings at IIT campus, it represents a large consumption of energy. This research allowed us to formulate potential options to optimize the system and increase its efficiency. The research was performed by visiting the E1 chiller plant and collecting data about its operation for the months of May and June 2015 in order to evaluate the current conditions. The results show that there is a lack of insulation in some parts of the piping network that has been causing corrosion on the pipe surfaces. Our findings also show that the chiller sequence and piping configuration of the E1 plant have been causing a high number of starts for the chillers in a short period of time, resulting in a high chilled water supply temperature in the buildings. Both effects represent a low efficiency of the chilled water system. Suggestions to optimize the system, based on the literature and meetings with engineers and area mechanics, are gathered and discussed at the end of this paper.

Sustainability of Campus Utilities Production: Urban Green Loop Project (ENGR 498-41)

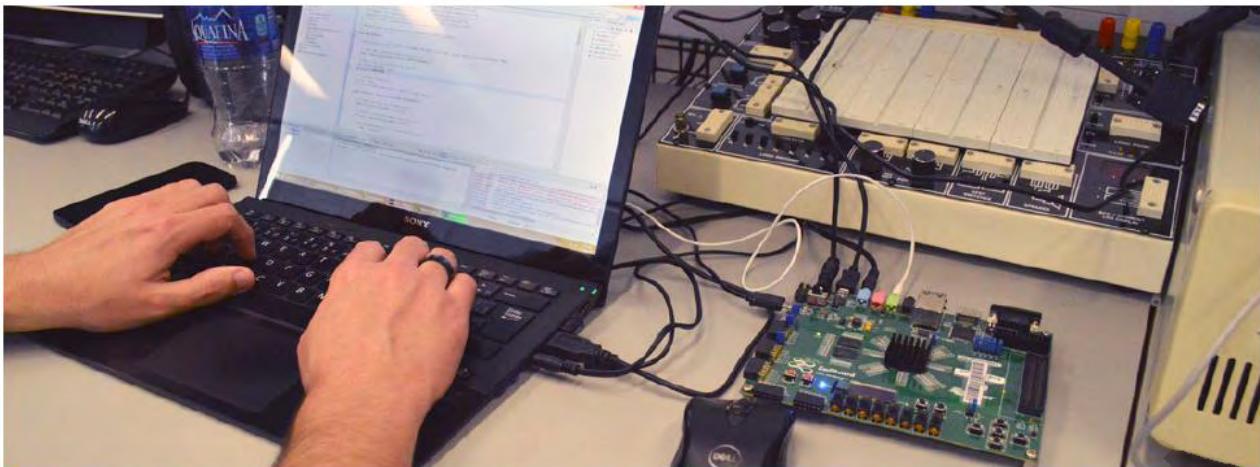
Hyan Alvarenga De Moraes, Rebeca Priscila Oliveira Marinho
Instructor: Bruce Watts

Many Universities have been trying to minimize the impacts in the environment adopting sustainable ideas on their campus. At the same time that they are avoiding those impacts, they also obtain benefits on their campus, such as energy savings and others. Based on this, IIT have been developed the Urban Green Loop project that have been studied by students from IIT's Stuart School of Business during the past semesters. The project proposes the implementation of a sustainable closed loop in the IIT neighborhood provided by the generation of biogas and compost from recycling organic waste. It has been developed since 2013 and consists of the installation of an anaerobic digester (AD) and a Combined Heat and Power system (CHP) at IIT location. To proceed with the project, we had to estimate how much food waste we have around IIT and evaluate the costs for the project. The results showed that the neighborhood near IIT has the capacity to supply the anaerobic digester with many tons of organic waste, and the costs for the investment showed high but this was expected.

Life Science Proposed Security System (ENGR 498-43)

Luiz Felipe Moriondo Alves Filho
Instructor: Greg Makowski

Nowadays, in the Life Science Building, there are a very poor security system because of that I have analyzed the entire system and surveyed faculty and staff of Life Science Building, after that I studied the Life Science proposed renovation plan and on that I made some standardization in some aspects of the security equipment, so I could be able to come up with a final ideal security system.



Hardware, Software & Communications R&D

Real-Time Automated Target Tracking System (ENGR 498.14)

Yan Curvina

Instructor: Jafar Saniie, Ph.D.

A target system is something that had been very used with radars as sensors or by cameras, which is the main point of this project. Using cameras could give a very well feedback when applicable for short distance and of course depending on the camera used on the project could catch even longer. The military application for this research showed up to be the main focus since a gun was used for shooting the target tracked, but it still able to implement this project in some other field such as sports, as could be checked by a video tracking system (IMAGO) already on the market that is capable to support some matches, or even for surveillance systems that could track some suspect on an environment or any other applications that comes to mind.

Real-Time Automated Target Tracking System (ENGR 498.14)

Cleberton de Santana Oliveira

Instructor: Jafar Saniie, Ph.D.

Nowadays the acquisition of high quality cameras and video processing has become faster and capable of real-time image data processing. As a trending topic on actual technology market, the Image Processing area has some challenges about the identification of objects, image filtering, and trajectory prediction of object position. There are some powerful methods to solve these problems. Some of those are explored on this project such as image segmentation, Haar cascade Classifier, and camShift. As for real-time applications, the velocity of processing is the key factor for good results, it was explored ways to implement such algorithms as fast as possible. Then, it was chosen to use the OpenCV library for C++ programming, and Visual Studio IDE to give the expected results. In other hand, it is necessary to have a reliable interface between the software development and the hardware actuators. The utilization of the Nucleo STM32F401RE fits on the necessities of the project because it is based on ARM processor, a widely utilized system for mobile systems with an online IDE and the mbed library, and discussion forums to help the developer.

Abstracts

Real-Time Automated Target Tracking System (ENGR 498.14)

Matheus dos Anjos Inoue
Instructor: Jafar Saniie, Ph.D.

The Real-time Automated Target Tracking System system presents a tracking system that performs several algorithms to complete one final task: Shoot an incoming helicopter. The system is an integration of several areas within the Electrical Engineering field: Image Processing, Control and Communications, because it requires several mini-tasks to complete the final objective. To be able to perform the shooting reasonably the system have several hardware parts: The camera (captures a video stream and sends it to the computer), the computer (which performs the algorithms), The micro-controller (makes the communication between computer and other components), the rotating base (which have all the components together, and also is able to rotate in 360 degrees), the stepper motor (to make the rotation of the base possible), the gun (that performs the shooting) and the servo-motors (to slightly move the gun in the x and y axis). The detection of the target is made by using the camera, that sends the video stream to a computer that does Image Processing to find the target from the frames. It was used an open source library made especially for Image Processing called OpenCV, that provides several built-in functions to process images, and the programming used the C++ language.

Touch Screen Mini Calculator (ENGR 498.14)

Eduardo Massayuki Iwasaki
Instructor: Jafar Saniie, Ph.D.

The purpose of this project is understand better the ARM Micro controller, the TFT TouchScreen and how this two devices can work together. When these devices are connected is possible to create many others devices that can help us in our daily activities like devices for home automation and many machines for the industries or devices just for fun like games. So for begin my project I decided to make a calculator, because it is something that have an easy concept and is known by almost everyone, making the final objective clear and the work easiest to be understood by lay people. And maybe encourage future works using these devices because as I already said is possible create many products using micro controllers and a touchscreen.

Waypoint Tracking and Guiding System (ENGR 498.14)

Leandro José Bieseck
Instructor: Jafar Saniie, Ph.D.

Mobile devices as smartphones nowadays has immense options in mobile applications with several objectives. Some of this apps are focused on tracking and recording user's mobile position. Due to the multi-application purpose of mobile devices the power consumption can be a differential in some situations. This project presents as alternative an embedded system implemented in a micro controller running a Real Time Operating System (RTOS) that collect and record position points (Waypoints) from a sensor module composed by an Accelerometer, a Gyroscope and a Magnetometer and a GPS module. The system uses the collected data to generate useful guiding information allowing the user to track his way back to the first recorded position. The collected data and the guiding information stored and provided to the user by a LCD Touchscreen display with an integrated SD Card module.

Real-Time Embedded Audio Signal System (ENGR 498.14 / 499.17 Group 1)

William Jamir Silva
Instructor: Jafar Saniie, Ph.D.

Audio digital signal processing is the intentional modification of the digital signals. With this processing method we can store, compress, transmit and enhance any digital signal. In this project I am going to enhance an audio signal by using an Adaptive Digital Filter with the Least Mean Squares (LMS) algorithm to improve the desired sound and reducing the noise coming from the environment. The LMS filter can be applied in situations where it is necessary to cancel a noise that is not originally from the source.

Guitar Processor Effects (ENGR 498.14 / 499.17 Group 1)

Joao Jose Monteiro De Barros Fidalgo
Instructor: Jafar Sanie, Ph.D.

The present work documents the use of a field programmable gate array (FPGA) in the implementation of a guitar effects processor. Guitar effects processor is a real-time digital audio signal processor used by guitarists in live concerts and/or in studio recording. The motivation of this work is the development of a non-expensive, highly configurable and portable device. The use of a general processor, such as Intel Core combined with software to process digital signals introduces an undesired delay in the data path. Real-time applications require low system latency and high reliability, and an FPGA design allows the algorithms of digital signal processing to be implemented on hardware platforms which is faster than software processing. It were used software tools from Xilinx and Mathworks to develop and simulate models of the effects and to implement a prototype design on a platform named Zedboard. This board uses a Zynq-7000 AP Soc XC7Z020 chip which is composed by a dual-core ARM9 processor and a Series 7 field programmable gate array (FPGA). Four different audio effects were explored. Three of them are filters. The other one is a delay effect. The filters are: low pass, band pass and high pass, which are used to implement an equalizer. The delay effect is a simple signal repeater similar to the echo effect. This work is a beginning of a major work. Projects like this are just limited by the creativity of the designer. The future work is to develop more effects and implement a user-friendly touch screen interface.

Real-Time Embedded Audio Signal Processing System (ENGR 498.14 / 499.17 Group 1)

Thales De Lima Beraldo
Instructor: Jafar Sanie, Ph.D.

Audio digital signal processing is the intentional modification of the digital signals. Advanced digital signal processing systems require a high performance embedded computing. This process require a power efficiency once everything is happening in real time and audio applications cannot have a delay. With this processing method we can store, compress, transmit and enhance any digital signal. Knowing about this I could implement a Digital Equalizer with different bands of frequency. It consists of digital filters which will be followed by a gain controller to change the input signal depending what operation the user needs. This kind of equalizer can be applied to enhance the tones of musical instruments such as electric guitar, drums, flute, or either a human voice. Consequently, it could reduce some background noises which were interfering the music.

Automated Sorting Machine Using Video Processing & A Robotic Arm (ENGR 498.14 / 499.17 Group 2)

Luigy Bertaglia Bortolo
Instructor: Jafar Sanie, Ph.D.

Automation is quickly becoming a key to decrease production cost and manufacturing time in the industrial world. To contribute to this cause, this project proposes the use of a robotic arm and computer vision (CV) techniques to automate the sorting of two different classes of objects.

Digital Signal Processing & Its Applications: Discriminator of Objects Using Video Processing & A Robotics Arm (ENGR 498.14 / 499.17 Group 2)

Vitor Gaboardi dos Santos.
Instructor: Jafar Sanie, Ph.D.

Most manufacturing firms nowadays are looking for the automation of their systems, in other words, they want to develop machines and robots that will replace people in doing some tasks, making their system more efficient and economic. The purpose of this research is to develop a system that is capable of discriminate between bolts and nuts using real-time video processing and utilize a robotic arm to separate these two objects.

Abstracts

Image Processing (ENGR 498.14 / 499.17 Group 2)

Lais Domingues Leonel
Instructor: Jafar Saniie, Ph.D.

This project presents a robotic arm that is able to distinguish between different objects and respond according to specific commands. The project involves using image processing to enable the arm to identify the specific object that should be retrieved. The OpenCV library on image processing and the Arduino board was used to control the arm.

Digital Signal Processing & Applications: Image Processing (ENGR 498.14 / 499.17 Group 2)

Ivan Guilherme Pagani Fernandes
Instructor: Jafar Saniie, Ph.D.

This project is composed by a set of integrated algorithms in order to make the Robot Arm identifies and separates objects based on video stream from a camera above the Arm.

Implementation of Software Defined Radio (ENGR 498.14 / 499.17 Group 3)

Ana Lopes
Instructor: Jafar Saniie, Ph.D.

Software Defined Radio is the software representation of a system that is typically implemented on hardware. The main task of the project was to implement some physical layer applications blocks using SDR through the Matlab programming language. The implemented blocks were the following: Scrambler (error prevention), Hamming Encoder (error prevention, detection and correction), Interleaver (error handling) and Constellation Mapper (modulation). All the blocks were implemented on Matlab and joined at the end to obtain the desired output. As future work, it is desired to convert the Matlab codes to Simulink and then to Verilog, that is the programming language accepted by the FPGA board.

Implementation of Software Defined Radio (ENGR 498.14 / 499.17 Group 3)

Raquel Beatriz Silva Do Nascimento
Instructor: Jafar Saniie, Ph.D.

Radio communication is defined as the reception and transmission of signals in the radio frequency. The implementation of a software based radio communication instead of the traditionally hardware based application, eases the changes and upgrades that might be done. To project a Software Defined Radio (SDR), a design of blocks was created: each of the blocks either protect, identify and recover from errors, modulate or transmit the signal. The blocks were implemented using Matlab with the purpose of simulation. The blocks implemented were: Scrambler/Descrambler (error avoidance), Hamming Encoder/Hamming Decoder (error detection), Interleaver/Deinterleaver (error handling) and Constellation Mapper/Demapper (signal modulation).

If one of the blocks does not work properly during the physical implementation, the identification of the problem should be easy and the replacement by another block without affecting the rest of the project is more accessible. The decision of the blocked design implemented should allow changes more flexibly because each block works independently. The obtained results and improvements are discussed, as well as the next steps for the project.

Implementation of Software Defined Radio (ENGR 498.14 / 499.17 Group 3)

Alana Torres Vidal
Instructor: Jafar Saniie, Ph.D.

The Information Age has begun several years ago and it continues to evolve due to new devices and technologies developed by industries, companies and laboratories that make advances in the Digital Era every day. Digital communications are no exception to this timeline of progresses. The Software Defined Radio project refines this concept, improving the wireless transmission of data in radio frequency.

This project is composed by implementations of radio's operating functions in software instead of hardware, which enhances the flexibility and the reduction of time needed to switch between network protocols to another. The design of SDR project is divided in blocks, each of them worked on and developed separately. The functions vary between error detection, prevention, handling and treatment. There were eight designed blocks: Scrambler, Descrambler, Hamming Encoder, Hamming Decoder, Interleaver, De-interleaver, Constellation Mapper and the Constellation De-mapper. They all programmed on Matlab so that in future they can be translated to Verilog and then to a Field Programmable Gate array (FPGA).

Reconfigurable Hardware Design for Ultrasonic Signal Processing (ENGR 498.17)

Eric Barroca, Luiz Antonio Kuhnen Ronsani
Instructor: Erdal Oruklu, Ph.D.

This paper presents an application for target detection and classification of ultrasonic data. Ultrasonic Imaging processing has been a very important method for nondestructive evaluation of materials and flaw detection. Due to the large amount of data to be processed, and the necessity of real-time applications, the algorithm must be fast and optimized. In this project, we used a Field-programmable Gate Array (FPGA) to design a customizable application that uses a Fast Fourier Transform (FFT) and minimization method for target detection of ultrasonic data. In addition, we designed a MATLAB interface where the user can modify some parameters, such as number of windows, window size, and offset, that affects directly the results. All the data processed come from a steel block, which is analyzed by an ultrasonic pulse-echo measurement setup.

Traffic Lane Detection Using FPGAs (ENGR 498.17)

Gustavo Jordão, Marco Dall'Agnese,
Instructor: Erdal Oruklu, Ph.D.

In this paper, a Computer Vision application is used to support the comprehension of the FPGA (Field-Programmable Gate Array) and its resources. Based on the article Real Time Detection of Lane Markers in Urban Streets¹ and other articles, a lane detection algorithm was coded, combining available sources and own code, in order to obtain a hands-on experience using an AtlysTM board on the Xilinx platform. The project consists in five major steps: IPM, Filtering and Thresholding, Line Detection, RANSAC (Random Sample Consensus) and Post-processing. It was initially implemented in MATLAB and then the code was converted in C, since it was intended to manipulate embedded systems. The conversion was partially successful.

Gate Level Power Reduction in Deeply Scaled CMOS Technology (ENGR 498.19)

David Freitas
Instructor: Kyuwon Ken Choi, Ph.D.

The first thought that comes when we think about small devices in small levels (micrometers, for instance) is how to make it works faster, however, there are situations that is better when they work slowly, but with a minimum power consumption. The recent advances on electronic devices have made necessary the power consumption to be decreased, since power storage solutions tend to be more expensive. This research uses some techniques to simulate such levels and show the results with the cost/benefits of doing this manipulation. The results are about the power consumption and the delay that may be caused.

Abstracts

Gate Level Power Reduction in Deeply Scaled CMOS Technology (ENGR 498.19)

Henrique Ribeiro Flores

Instructor: Kyuwon Ken Choi, Ph.D.

The recent advances on electronic devices have made necessary the power consumption to be decreased, since power storage solutions tend to be more expensive. Then the objective of this project is to minimize the total power of CMOS (Complementary Metal-Oxide Semiconductor Circuits). This is done through the search for the optimum value for the following parameters of the transistor: Power Supply (V_{dd}), Threshold Voltage (V_{th}) and Transistor Width (W), for each gate that meets the maximum delay condition while achieving minimum power dissipation. This strategy is based on the observation that power consumption and delay are monotonic functions of V_{dd} , V_{th} and W individually, other parameters being fixed.

Gate Level Power Reduction in Deeply Scaled CMOS Technology (ENGR 498.19)

Karlson Tellicio Bezerra

Instructor: Kyuwon Ken Choi, Ph.D.

The objective of this project is to minimize the total power consumption of CMOS (Complementary Metal-Oxide Semiconductor Circuits). This is done through the search for the optimum value for the following parameters of the transistor: Power Supply, Threshold Voltage and Transistor Width. We have applied an algorithm in some circuits to analyze its delays within the many signal paths. The result was an average decrease of around 30% in the total power. Also we could notice a small increase in the final delay.

Leakage Power Reduction at Circuit Level (ENGR 498.19)

Gustavo Jose Bernardes Dos Santos

Instructor: Kyuwon Ken Choi, Ph.D.

This project is part of the Design Issues in Mobile Applications research as a way to apply the knowledge acquired during the term and the lab sections previously studied. With this knowledge, this project goal is to evaluate two ways to reduce power consumption at circuit level. The development of new technologies is challenged to advance in fast pace. Each new generation of microprocessor requires better performance, higher clock speeds, and smaller process technologies. However, it comes with a high cost in power consumption, turning it into a primary concern for new microprocessor designs. In order to reduce power consumption, there are techniques that can be implemented in the system, register-transfer, gate, circuit, and technology levels of the VLSI design. In the circuit level, one can apply techniques to reduce both the dynamic and static power. The dynamic power is consumed when the system is in operation, switching the signal. On the other hand, static power is consumed when the system is in steady state. This last one occurs due to the leakage current through the transistor in idle mode and it is the object of study of this work that compare some techniques to reduce the leakage power consumption at circuit level.

Leakage Power Reduction by Forced Stack & Power Gating at Circuit Level for Mobile Applications (ENGR 498.19)

Diego Henrique Carvalho Andrade

Instructor: Kyuwon Ken Choi, Ph.D.

The development of new technology is required to advance. However, advances in performance, speed, and size come with a high power consumption. Scaling down demands to decrease threshold voltage and results in an exponential increase in leakage power consumption. One alternative for achieving lower power consumption is to apply techniques for reducing static power consumption at the circuit level. We analyze the Forced Stack method and MTMOS Power Gating method for diminishing the sub threshold leakage current and the leakage power. The techniques evaluated achieve the goal, however, there is a trade-off between power consumption and delay to be considered.

Leakage Power Reduction by Forced Stack & Power Gating at Circuit Level for Mobile Applications (ENGR 498.19)

George Lucas Dias

Instructor: Kyuwon Ken Choi, Ph.D.

Power consumption has become a serious problem in nanometer CMOS technologies. In the past, the dynamic power has dominated the total power dissipation of CMOS devices. However, with the continuous need of the scaling reduction of the transistors, leakage power is becoming a main contributor to power consumption. Many methods had been proposed for leakage power reduction like forced stack, power gating, sleepy keeper, dual sleep approach etc. In this paper, two existing methods, Forced Stack Method and MTCMOS Power Gating Method, have been analyzed for the leakage power reduction in 45nm technology. The methods will be compared with the basic case. The result is simulated using Cadence Virtuoso, and the waveforms are plotted using CSCAPE in 45nm CMOS technology at room temperature.

Leakage Power Reduction by Forced Stack & Power Gating at Circuit Level for Mobile Applications (ENGR 498.19)

Lucas dos Santos Silva

Instructor: Kyuwon Ken Choi, Ph.D.

Low power is a big challenge in circuit design; the clock gating is a technique to reduce power consumption. This research focus is analysis and simulation of low power design by clock gating technique at register transfer level. In this study, the authors propose a design that optimizes the switching activity in order to save power. The techniques are Bus Specific Clock and Local Explicit Clock Gating. These methods reduce the consumption of the clock gating by filtering the clock toggles. This applied technique reduced the circuit (45nm technology) dynamic power consumption in more than 40%.

Register Transfer Level Power Reduction by Advanced Clock Gating Scheme (ENGR 498.19)

Jose Sandoval Santos Junior

Instructor: Kyuwon Ken Choi, Ph.D.

In this report are summarized the activities carried out during the summer research program at the Illinois Institute of Technology (IIT). Low power is a big challenge in circuit design; the Clock Gating (CG) scheme is a technique at Register Transfer Level (RTL) to reduce power consumption, which can be used for any applications that reduction in power consumption is needed, e.g. portable devices. This research focus is analysis and simulation of low power design by clock gating technique at register transfer level. In this study, the authors propose a design, which optimizes the switching activity in order to save power. This applied technique reduced the circuit (45nm technology) dynamic power consumption in more than 40%.

Register Transfer Level Power Reduction by Advanced Clock Gating Scheme (ENGR 498.19)

Livia Ribeiro

Instructor: Kyuwon Ken Choi, Ph.D.

In circuit design, low power is a big challenge. Based on this problem this research focus is analysis and simulation of low power design by clock gating technique at register transfer level. The clock gating is a technique to reduce power consumption. In this study, the authors propose a design which optimizes the switching activity in order to save power. The proposed technique reduced in more than 40% (45nm technology) dynamic power consumption of the circuit.

Abstracts

Register Transfer Level Power Reduction by Advanced Clock Gating Scheme (ENGR 498.19)

Lucas Nascimento

Instructor: Kyuwon Ken Choi, Ph.D.

Low power is a big challenge in circuit design; the clock gating is a technique to reduce power consumption. This research focus is analysis and simulation of low power design by clock gating technique at register transfer level. In this study, the authors propose a design which optimize the switching activity in order to save power. This applied technique reduced the circuit dynamic power consumption in more than 40%.

Multiuser Coding with Multidimensional Coding (ENGR 498.23)

Augusto Hay Mussi De Andrade, Maira Prata de Araujo , Rafael Moraes, Franciele Nornberg, Yan Real, Jorge Vinicius Andrade dos Santos
Instructor: Guillermo E. Atkin, Ph.D.

The purpose of this research is to simulate and compare the encoding and decoding techniques on Multi Input Multi Output (MIMO) system. MIMO system is able to provide an increased data transmission by using Spatial Multiplexing process or increase the system reliability by using Space-Time Block Coding. In the project is used Space Time coding technique to improve the system diversity, and consequently, increasing the robustness of the system. For the encoding, the input signal is multiplied by generator matrix (Discrete Fourier Transform matrix or Hadamard matrix) in order to generate linear combinations of the input signal which are versions of the input data to improve the system reliability by increasing the redundancy. For the decoding part, it was attempted to recover the input signal using the Most Likelihood (ML) technique based on decodification on X's and decodification on Y's. Once we got results from simulations, a comparison between methods used will be made and the focus will be on the Bit Error Rate (BER) of each transmission.

Portable Wireless Health Monitoring System (ENGR 499.17)

Eliza Amancio

Instructor: Jafar Saniie, Ph.D.

Heart disease is the number one global cause of death for both men and women and a common issue is the delay in medical treatment due to the lack of an early detection of the problem. Thinking of how the first moments after a heart attack, for example, are the most essential in preventing permanent heart damage, the idea of this project was to build a portable electrocardiogram device that can help people monitor and get valuable information about their heart's actions, such as an early warning of a heart attack. This can be done by continuously collecting and analyzing the PQRST wave. In the future, this could be implemented on a wearable device, like a smartwatch, that upon automatic detection of serious irregularities would quickly request medical help, diminishing the help time and, thus, possible sequels. During the four weeks of this research, the main objectives were to build a background by getting familiar with the components to be used and theories to be applied. Then, to implement it, collect and sample the ECG signal, process the data in order to identify irregularities, send the ECG signal and diagnosis to a smartphone wirelessly using Bluetooth and implement an app to display the data and the results. And finally, to research about future implementations and reliability of a system like this. Right now, the system is able to collect the electrocardiogram signals, do some processing on the data and communicate through Bluetooth with mobile devices. The next steps are to develop the mobile app for proper display of the results and to implement a more powerful data processing.

Remote Computer Networks Laboratory Design Tools (ENGR 499.17)

Claudio Manuel da Costa Silva

Instructor: Jafar Saniie, Ph.D.

In the computer network lab, students have access to a small network with 6 machines and 3 routers all tied together via a configurable switch, controlled via a console on the remote computers. This project proposes to develop a python program to simplify the configuration of the switch by simply asking the user what connections should be made, and then implementing the requested configuration by communicating directly with the switch. The main goal of this project is to implement a software to manage the network connections in the context of a computer network lab.

Real-Time Automated Target Tracking System (ENGR 499.17)

Yago Pacheco Teixeira
Instructor: Jafar Saniie, Ph.D.

In this project, was designed a tracking system which consists of a rotating base holding a camera and a turret equipped with a laser, and the aim of the project is to be able to detect and track the target using various image processing algorithms while pointing the laser at it, and after that, shooting it. This project involves a lot of different parts as Image Processing, Servo Control and Shooting System, so the concept of this project can be implemented in many different areas.

Energy-Efficient Techniques for Smartphone (ENGR 499.20)

Alessandra Anami
Instructor: Yu Cheng, Ph.D.

This project creates an application for Android using the platform Android Studio. The application reads the level of the battery, status of the phone (if it is charging or not), count the number of data transmitted and received and also count the packets. The app ran in the simulation and it was tested in the smartphone Nexus 5.

Real-Time Traffic Sign Recognition for Advanced Driver Assistance Systems (ENGR 499.21)

Pamela Goncalves, Esdras Vitor Silva Pinto
Instructor: Erdal Oruklu, Ph.D.

In this report, a robust traffic sign recognition system is introduced for driver assistance applications. The system incorporates two major operations, traffic sign detection and classification. The sign detection is based on color segmentation and incorporates hue detection, morphological filter and labeling. The training features are extracted by SURF algorithm. The proposed system benefits from the SURF algorithm, which achieves invariance to the rotated, skewed and occluded signs. For the classification part, the K-means search is used. Both SURF and classification algorithms are implemented on the Xilinx Zynq platform.

Real-time 3D Reconstruction Using Depth Cameras for Augmented Teleoperation (ENGR 499.26)

Witenberg Santiago Rodrigues Souza
Instructor: Joohee Kim, Ph.D.

This paper work is a report on depth map refinement for 3D reconstruction. Most of data scanned by a depth sensor is noisy and poor in quality. Besides, the presence of holes on depth maps mislead the geometry reconstruction as well as fine details on the surface of objects. The step to revert these issues is the refinement of depth maps by removing noise and performing hole-filling, so that the 3D mesh final quality becomes reasonable. This refinement can be performed by manipulation of depth values in a given neighborhood due to their distance relations.

Development of a Test Bed for Direct Current Microgrids (ENGR 499.36)

Andre Luiz De Souza Antonieto, Hugo Araujo, Martins Galindo, Cleto Fernandes, Luis Kremer
Instructor: John Shen, Ph.D.

DC (direct current) microgrids are an efficient option for distributing high power more efficiently to residential, rural and urban areas to commercial facilities. Despite their high efficiency and simplicity, DC microgrids contrasts with the usual AC power distribution systems especially on safety considerations: DC components need a faster response on short circuit situations than their AC concurrent. The main propose of this project is to design and develop a test bed to test short circuit situations in DC microgrids components. This paper will analyze the characteristics and specifications of all the components that compose the test bed and also explain possible future works.

Abstracts

Virtual.PYXIS Optimization (ENGR 499.43)

Caio Freitas, Gabriel Rodrigues, Joao Mattia
Instructor: Valmir Fleischmann, Ph.D.

Virtual.PYXIS is a structural topology optimization software recommended for engineers and designers who need to design innovative components and assemblies with reduced mass. The software has its own solver and can be applied from a simple to complex optimization situations, and it can handle problems with non-linear analysis features and compliant mechanism systems. As interns, we had to accomplish some tasks such as, improving, developing and testing the software. We also learned how to work as a team, knowing we were guided from the savvy professionals who have been working with the development of the software since the beginning of the company.

Software Engineering (ENGR 499.44)

Raul Souza
Instructor: Amber Autumn

The following paper describes the experience of a member of the Brazilian Scientific Mobility Program with the Summer Undergraduate Engineering Research Immersion Program at the Illinois Institute of Technology in Chicago. The proposed project for this program was the creation of a website that'll be used as a business asset for Dr. Therese Rowley. With this project I learned how to work in a team as we moved on with the software engineering of the website. I acquired valuable practical experience in project development, specifically in the web. The skill that was most valuable for me was the real-world experience of working alongside our client to create a product that had real value to her business.

Software Engineering: Web Development (ENGR 499.44)

Lucas Dzin Pedroso
Instructor: Amber Autumn

This report describes the progress and results during an academic training opportunity at Illinois Institute of Technology hosted by Green Ribbon Foundation and BigMarker. As trainees our task was to create a new website for one of BigMarker's clients. The platform used is called WordPress, which is one of the most popular web development software due to its multiple tools, features and easy-to-use interface. Each developed version was presented to the customer in order to have a feedback about what had been done and guarantee her satisfaction. The results showed in the final project met the client's needs and expectations.



Materials R&D

Double Aging Effect on Corrosion Resistance & Mechanical Properties of Aluminum 7075 (ENGR 498.20)

Lucas Pires Dos Santos
Instructor: Philip Nash, Ph.D.

The current work is concerned to design a schedule of heat treatment based on double aging (DA) of aluminum 7075 in order to reduce process time (energy saving) and also obtaining good corrosion resistance and mechanical properties. Three point bending test and hardness test, were performed to compare the results of the DA with the standard heat treatments (T6 and T73). Although the DA's stress-strain curves were good in comparison to T7, they did not get close to T6. Besides, none of the samples presented the expected hardness in comparison to T6 and T73.

Experimental Evaluation of Metallic Material Properties Al30Co40Ni30 – Sample 11 (ENGR 498.20)

Bruna Madureira
Instructor: Philip Nash, Ph.D.

The Ni-Co-Al is an alloy that vary its behavior when exposed to different temperatures. It is used in aircrafts as turbines, robotics, nano industry, and also used for medical applications. Thus, in order to understand the thermochemical properties of this alloy, a series of procedures were made with samples of different compositions: mounting, grinding, polishing, hardness test, EDS, XRD and optical microscopy. Subsequently, new isothermal sections for each temperature were traced in ternary phase diagrams, showing distinct results compared to the ones made by J. R. Raideren and M. R. Jackson. This report contains the data and conclusions of the specific sample Al30Co40Ni40, and it is part of a group work.

Abstracts

Experimental Evaluation of Metallic Material Properties Ni40Co30Al30 (ENGR 498.20)

Yuri Santorio Torres
Instructor: Philip Nash, Ph.D.

The Ni-Co-Al alloy have been used in particular applications such as gas turbines, turbine blades and others aircraft equipments. This study has the purpose to understand the alloy properties and behavior in different temperatures and compositions, check in which specific temperatures and compositions shape memory effect by magnetic field might occur and comprehend the Ni₃Al compound (γ' phase) which works as a catalyst providing a large scale synthesis of nanostructures based on discontinuous precipitation.

Experimental Evaluation of Metallic Material Properties Ni40Co50Al10 (ENGR 498.20)

Andre Alves da Silva
Instructor: Philip Nash, Ph.D.

This report is a part of a group project who shows the results of experiments performed to verify the thermochemical information of Ni-Co-Al system presently available in literature presented by Jackson M.R. and Rairden J.R, this particular report refers to all experiments made in alloy with the composition of Ni40Co50Al10 in terms of Atomic %, each alloy was quenched, cold rolled and submitted to 5 different temperatures of heat treatment, As Cast, 1100°C for 24H, 800°C for 1 Week, 600°C for 2 Weeks and 550°C for 3 weeks, after all experiments with different alloy compositions had done we could build a new isothermal section for each temperature who shows a divergent results when comparing to the original one, the data shows us a narrowed two-phase region in our results.

Experimental Evaluation of Metallic Material Properties (ENGR 498.20)

Lorena Goncalves Ribeiro
Instructor: Philip Nash, Ph.D.h

The Ni-Co-Al system present different behaviors when exposed to different temperatures; therefore, it has a variety of applications. It is used in the aerospace, nano, and medical industries as turbine blades, large scale synthesis of nanostructures, and shape memory effect respectively. Thereby, in order to understand the thermochemical properties and to build a more accurate ternary diagram for the Ni-Co-Al system, a series of laboratory techniques such as Energy Dispersive Spectrometer, X-ray Diffraction, among others were made determining the alloy composition, phases present, microstructure and magnetic properties of 12 samples with different compositions. This report contains the results for the sample of composition Al₂₀Co₅₀Ni₃₀ as an as-cast structure and at temperatures of 1100, 800, 600 and 550 °C.

Phase equilibria in the Ni-Co-Al system (ENGR 498.20)

Samuel M. Bessa
Instructor: Philip Nash, Ph.D.

In this article, metallography and Vickers hardness test was performed in order to analyze the microstructure and the hardness of samples to understand the evolution of microstructure induced by different homogenization temperatures and nominal compositions. XRD was performed to identify phases present in the samples followed by an EDS analyze. The EDS's objective is understand the chemical characterization of a sample: the phase's composition.

Phase Equilibria in the Ni-Co-Al system (ENGR 498.20)

Guilherme Carvalho Pereira
Instructor: Philip Nash, Ph.D.

This work will talk about the NiCoAl system and how the research was made. The NiCoAl was chosen to understand how these alloys behave in different temperatures and with different heat treatments. Twelve samples were evaluated, and they were divided into three groups: 10 at. %, 20 at. %, 30 at. % Al. Each one of these groups received 5 different heat treatments: ASCast, 1100 °C for 24 hours, 800 °C for one week, 600 °C for two weeks and 550 °C for three weeks. All the information provided for the test with this sample will make possible a better understanding of the alloy system. This report will show the results of the test and the conclusion for the sample Al20Co60Ni20, which is the sample number 8.

Phase Equilibria in the Ni-Co-Al system - As Cast Sample (ENGR 498.20)

Aparecida Silva Magalhaes
Instructor: Philip Nash, Ph.D.

The phase equilibria Al-Co-Ni system, its properties and microstructure were studied in this research. The EDS, microscopic and X-Ray Diffraction data allowed the characterization of samples in a particular temperature and compositions. Besides, the micro hardness test was made with the purpose to better understand the mechanical behavior of this system in different temperatures and compositions. Finally, all data will be put together for the construction of isothermal sections for 1100 °C, 800 °C, 600 °C, 550 °C, and liquidus projection.

Phase Equilibria in the Ni-Co-Al system - As Cast Sample (ENGR 498.20)

Jean Muniz De Souza
Instructor: Philip Nash, Ph.D.

The Al-Co-Ni alloy represented as sample number five, this is, the one with 20% Al, 30% Co and 50% Ni on its composition has only one phase, that is, γ (Co,Ni), and also a lot of eutectic structure between the dendrites present in the microstructure without any heat treatment. As we were looking for γ' precipitation in order to take advantage of the properties found with the coexistence of three different phases in this alloy, which are γ , γ' and β (NiAl, CoAl), without any annealing this alloy is useless. However, as we increase the temperature and/or the time of exposure, we have some changes in the microstructure that lead us to the precipitation of γ' . Almost all the eutectic structure present in the as cast sample was gone after annealing the same for 24 hours at 1100 °C, but we could still see some inside the β phase. The sample annealed for 1 week at 800°C finally showed two well defined phases, γ and β . The γ' could be observed in the two last samples, that stayed for 2 and 3 weeks under 600 °C and 550 °C respectively.

Investigation of Phase Equilibria in the Ni-Co-Al System Ni50Co40Al10 (ENGR 498.20)

Jessica Dornelas Silva
Instructor: Philip Nash, Ph.D.

In this work, we investigated the phase equilibria of 12 alloys in the Ni-Co-Al system, in order to verify existing thermochemical information. This report is related to the studied properties of Ni50Co40Al10. We were able to see that the calculated isothermal section at 1100 °C by Jackson M.R. and Rairden J.R. was not accurate. Equilibrium information of isothermal sections at 800 °C, 600 °C and 550 °C and the liquidus projection were also obtained.

Abstracts

Phase Equilibria of Ni-Co-Al System (ENGR 498.20)

Aline Oliveira

Instructor: Philip Nash, Ph.D.

A review of the literature reveals ternary phase diagram data for a number of systems involving Ni-Co-Al. Although incomplete, the aim of this work is to build a new isothermal section for Ni-Co-Al system to verify thermochemical information presently available in the literature and provides a simile of the built isothermal section with the actual. The data used to be compared where find in Springer Materials database and will be presented isothermal sections for Ni-Co-Al system at four temperatures: 527°C, 800°C, 1100°C, 1200°C and liquidus projection.

Phase Equilibria in the Ni-Co-Al system (ENGR 498.20)

Andre Gonzalez Silva

Instructor: Philip Nash, Ph.D.

The work developed in this research is about the NiCoAl alloy. The NiCoAl alloy have been chosen because it's importance in the industry and the following work shows the behavior of this alloy in different compositions and heat treatments. In total our group studied 12 different samples with different compositions. At the end of our work we were supposed to know the different phase composition in all our samples/ heat treatment and use that to plot an accurate ternary phase diagram of the NiCoAl system in each temperature which we studied.

Phase Equilibria of Ni-Co-Al System at 1100 Degrees Celsius (ENGR 498.20)

Guilherme Teodoro Ferrigatto

Instructor: Philip Nash, Ph.D.

Nickel-based alloys are being applied nowadays in important fields of engineering. Due to its properties, the use in Aircrafts turbines, Bio-medical engineering and robotics is being constantly developed. Once these alloys suffer a heat treatment they may change their properties and with that, change their applications. Depending on the temperature and the time of the treatment, properties such as Hardness, Ferromagnetism and others can suffer a variation. Also the precipitation of another phase may occur. The present literature provides us with diagrams showing the isothermal sections for these alloys at different temperatures. As many researches are still being made on these alloys, the isothermal section may present some issues or divergent information. In this paper, the properties of the system Ni-Co-Al are experimentally tested and a new isothermal section is built for the system. The conclusion, as expected, is that for some temperatures the present information about this alloy is not accurate and some changes are found for the ternary diagram.

Serrated Grain Boundaries via Discontinuous Precipitation in Ni-Co-Al Alloys (ENGR 498.20)

Joao Marcos Ribeiro Martins

Instructor: Philip Nash, Ph.D.

Discontinuous precipitation of γ' phase in Ni-Co-Al alloys can move the grain boundaries and leave a serrated form when dissolved. The serrated grain boundaries produced could be used to increase the creep resistance of the material. Samples of Ni-37-12 atomic composition were produced with normal and serrated grain boundaries and submitted to creep tests in order to compare values of strain for same time intervals. The creep tests were performed at high temperatures and under compression. The temperature and pressure were parameters that affected the data collected for this mechanical property substantially. Tests performed at 700 °C (250 MPa) and 800 °C (100 MPa) contradicted the results expected, once the tests performed at 750 °C (150 MPa) revealed the expected results.

Abstracts

Design & Construction of an Instrumented Urban Model for Time-Resolved Pressure and Velocity Measurement (498-32)

Vitor Silveira De Carvalho
Instructor: Bruno P. Monnier, Ph.D.

The objective of this work is to determine the wind flow velocity and pressure profile in an urban environment. This would be done by taking pressure and velocity measurements inside a wind tunnel using microphones and hot-wires anemometry, respectively. The microphones would be displaced on the surfaces and between two blocks, that would simulate buildings and the hot-wire would be displaced in different points between the buildings so we could get a large variety of locations. The result of this 8 week program was the design and construction of all the experimental setup that will be used inside the wind tunnel. It can be used for future work by Prof. Monnier to take all the measurements and achieve the initial objective of the project.

Double Aging Effect on Corrosion Resistance & Mechanical Properties of Aluminum 7075 (499-13)

Bruna Madureira
Instructor: Philip Nash, Ph.D.

The most common use of AA7075 is the aviation industry due to its lightweight and strength. However, when exposed for a long period of time near chemical plants or large bodies of water, it presents stress corrosion cracking (SCC) problems. T6 and T7 are conventional heat treatments which cause interesting properties to this aluminum alloy. While T6 contributes to a better mechanical performance, T7 gives a better corrosion resistance, both processes require treatments lasting about 48 hours. To obtain a material with both corrosion resistance and desired mechanical properties within a shorter amount of time in processing, a schedule of heat treatments was designed based on double aging of the alloy AA7075. The correct double aging temperature can lead to a reduction of time and energy in production of large scale. This new schedules are being developed at Illinois Institute of Technology and the results of this work are being compared to a previous work.

Microstructure & Mechanical Analysis of WC-Co Cerments (499-15)

Ana Flavia Capdeville Ramos dos Santos
Instructors: Satya Emani, Ph.D. & Leon Shaw, Ph.D.

This work was developed with the tungsten carbide cobalt. That material is a composite widely used as cutting tool because of its good mechanical properties, and high hardness. The purpose of this research was correlate mechanical properties to the microstructure. The work was conducted with different samples of WC-Co cements that were subjected to high temperature compression test, Vickers hardness and fracture toughness measurements, to determine the mechanical properties. In addition, were realized SEM and EDS analyses to determine the microstructure and elemental composition. Some important parameters that modify mechanical properties of the WC-Co are cobalt content, and grain size. All the samples have similar cobalt content, but different grain size. The results showed that samples with smaller grain size, have high hardness.

Processing & Analysis of Nanostructured WC-Co Materials with Platelet Morphology (499.16)

Bruna de Oliveira Coelho
Instructor: Leon Shaw, Ph.D.

Nanostructured materials have widely been study due to its unique physical properties. They can have an improved hardness and strength, and the volume of fraction increased, which can achieve higher ductility of the study material. Since nanomaterials includes most of the materials, they are extensively used for different reasons in the industry. The WC-Co is a nanomaterial mainly used as cutting tools, and is a very important material its technological and economical impact on the industry. The objective of this work was to prepare high quality WC-Co samples with platelet shape to analyze its surface, and see its microstructure properties, so we can understand how though this material can be. To analyze the surface it was necessary to do the graining and the polishing of the material. To test how hard the material could be, the hardness test was applied to. The images showed that the material didn't have the necessary density that we were looking for, and it is going to be necessary to change the steps in the methods.

Abstracts



Product & Process R&D

Airport Runway Landing Analysis Using Finite Elements (ENGR 498-02)

Vinicius Alves, Bruna Rocha, Daniele Koga, Juliangelo de Oliveira, Nathalie Andrade, Paulo Andre Barcelos, Thiago Geda
Instructor: Roberto Cammino, Ph.D.

This report describes the analysis of a runway's behavior based on an A380-800 landing and it is focused on the optimization of the cost of construction, without lack of pavement quality. For this, the design of the runway was made according to the Federal Aviation Administration's standards. The software used to simulate the landing was Hypermesh, in which a mesh of the runway and the aircraft was made. It was considered that the aircraft touch the runway with a velocity of 250 mph, with an angle of landing of 3 degrees and landing weight of 394 tons. The data results on Abaqus showed that the aircraft's tires press the runway with a peak compressive stress of 1.15MPa in the first layer, 1.00MPa in the second layer and 0.93MPa in the third layer. Therefore, through the analysis, it was concluded that the design of the runway can be optimized by modifying the ground initial resistance, in order to reduce the cost.

Computational Analysis of a Fuselage Structure (ENGR 498-02)

Igor Mannes Guesser, Luiz Felipe Saboia, Mariana Luisa Cardoso, Renato F. Sartori
Instructor: Roberto Cammino, Ph.D.

In this project we discussed the effects of stresses generated by forces on an Airbus A-320 fuselage. The fuselage is the structural part of an airplane and it is highly affected during flight, landing and takeoff. To analyze the response of these effects on the airbus A-320 fuselage we used a CAD model of the airbus A-320. With this model, the research group could create a mesh with the software HyperMesh in order to calculate the critical stress points in the airplane using the finite elements method through Abaqus. At the end of the whole study, we could show the critical points and start thinking about some improvements in specific places of the airplane fuselage to avoid failures.

Evaluation of Alternative Materials for Aircraft Structures During Emergency Landings (ENGR 498-02)

Felipe Oliveira, Guilherme Gradim, Vanessa Candido
Instructor: Roberto Cammino, Ph.D.

This report describes the results obtained from a research focused on evaluating different materials used on aircrafts during belly landing or gear up landing. Belly landing or gear up landing occurs when a mechanical or human failure does not allow the landing gear to come out. The tests made consisted on analyzing and comparing the normally used material with alternative ones from a mechanical properties standpoint. The materials were chosen mainly considering tensile yield strength. The four materials were all Aluminum Alloys. The model of the aircraft was made using Autodesk Inventor and Hypermesh, and the impact analysis used the finite element analysis software, Abaqus. We simulated impact of aircraft as it touches the ground as dynamic impact. A comparison of the four materials is made, based on energy absorption and deformation of the aircraft during impact.

Evaluation of Baseball Bats During Impact With a Baseball (ENGR 498-02)

Gustavo Gois, Joao Santana, Rodrigo Pozza
Instructor: Roberto Cammino, Ph.D.

This report describes the stresses on a baseball bat and analyzes the differences of the ball exit velocity(BEV) when hit at different points on the bat. The bat was made of a white ash wood with 33in of length and the ball used was the model ROLB2 from Rawlings. Eight different spots were analyzed, all of them between 5 to 7 inches from the top of the bat. The pitcher ball velocity was assumed at 90 miles per hour and the bat swing speed was assumed at between 49 miles per hour to 58 miles per hour depending on the spot that the ball hits the bat. Excel, SolidWorks, Hypermesh and Abaqus were the programs used in this research. Results showed that 7 inches from the tip of the barrel is the sweet spot i.e. the best spot to hit the ball, where the highest BEV was reached and the bat had the lowest stresses.

Evaluation of Helmet Protection During Impact of Head to Ground & Impact of an Object to Head (ENGR 498-02)

Arnaldo Jacob, Caroline Faria, Gustavo Cardoso, Klebson Reis, Mariana Motta, Thiago Meneghetti
Instructor: Roberto Cammino, Ph.D.

This report describes the results of a research project focused on helmet protection under impact of head to ground, and also impact of an object to head. Three kinds of helmets were considered: construction, motorcycle and bicycle helmets. The goal of this project is to check the amount of stress absorbed by the skull and brain during the impact, as well as evaluate the maximum capacity of helmet protection. The material used for each helmet was the most common material in the current market, in order to make the results more realistic. The analysis consists of dynamic simulation of an impact in the helmet using Finite Element Analysis (FEA). First, the models were meshed using Hypermesh. After the modeling phase, analyses were made using ABAQUS (a computer aided engineering program) that shows the stresses and displacements experienced by the whole group: helmet, skull and brain. The results obtained from the analysis were displayed on charts that show the effect of the helmet according to the boundary conditions: object height for the hard hat, and the rider speed for the bicycle and motorcycle helmets.

Abstracts

Evaluation of Hockey Sticks During Impact with Hockey Puck (ENGR 498-02)

Felipe Buarque Cordeiro de Melo, Rafael Ferreira de Freitas, Vitor da Gama Godoy
Instructor: Roberto Cammino, Ph.D.

The present work describes the process of analyzing a hockey shot using different materials and different hitting positions on the stick's blade. Two materials were used in the study, aluminum and wood, and two hitting positions were evaluated: one on the middle of the stick's blade and the other one on the outer edge of the stick's blade. The hockey stick and the puck were modeled and four scenarios were simulated in Abaqus combining the different materials and the different hitting positions in order to analyze which material and hitting position provides the puck with a higher initial velocity. Stress levels on the stick are also analyzed. The results show similar stress levels for wood and aluminum but the highest initial velocities are observed in the use of aluminum sticks, mainly when the shot occurs in the edge of the stick's blade. Lastly, we present a suggestion to a new study opportunity for future work in this area, exploring composite materials.

Evaluation of Optimization Tools for Strong Mechanical Designs & Comparison to New Software (ENGR 498-02)

Sergio Filho, Lucas Guimaraes, Pedro Franzoni, Lucas Carnio, Felipe Terezani
Instructor: Roberto Cammino, Ph.D.

This report describes the results of a research project focused on comparing methodologies and tools applied by a new software (Virtual.PYXIS) in the advanced simulation engineering market to a well-known software called OptiStruct. The same 'Engine Mount Support' CAD model was used so both software could provide an assembly optimization in order to fairly compare their methods and processes applied. The analysis step was made using Ansys and Hypermesh (computer aided engineering programs). The CAD model was basically consisted by six elements: one fixed support connected to one engine by four screws. There was also a force applied in a certain point of the engine, and a bolt pretension in the screws. The analysis step had a 02 seconds load steps. The data result showed assembly optimizations generated by Virtual.PYXIS and OptiStruct, and also concluded that Virtual.PYXIS provided a new model with 8% higher stiffness in comparison to OptiStruct. In addition, by doing the process through OptiStruct, it needed to utilize Hypermesh to perform the analysis steps, which is a software very difficult and confuse to work. Furthermore, OptiStruct took 3 to 4 times longer for completing the same task as Virtual.PYXIS did by using Ansys.

FEA of a Thermal-Stress Solar Panel with Hypermesh & Abaqus (ENGR 498-02)

Raul Silva, Andre Camara
Instructors: Roberto Cammino, Ph.D. and Aiman Shibli, Ph.D.

This report describes a simulation of a thermal-stress/displacement analysis of a solar panel under radiation and temperature variation that will change the stress and displacement with temperature variation between layers. First, the model used was found in a STEP/IGES format before we mesh that type of model in Hypermesh where were created six meshed layers. These layers have different thickness and materials such as c-Si monocrystalline, tempered glass, ethylene vinyl acetate(EVA), laminated polymer plastic and robust anodized aluminum alloy. The simulation was made on Abaqus, which is an engineering program with electromagnetics analysis. This program showed that we could define materials, initial and boundaries conditions with an input file, which will give us a bunch of outputs as a stress, displacement and temperature through the layers.

Finite Element Analysis of an Aircraft Wing (ENGR 498-02)

Filipe Loureiro, Henrique Alves, Mario Guimaraes, Ronant Monteiro
Instructor: Roberto Cammino, Ph.D.

This group has been assigned to simulate an airplane wing during specific flight conditions and analyze stresses due to the wind loads. We first ran the CFD (Computational Fluid Dynamics) to compute where the wing was affected the most during flight. In this manner, we could analyze the wing in bending and torsion. The material used for the wing analysis was Aluminum 7075-T6 which has a high modulus, therefore, the relatively low, but still a necessary component for design evaluation.

Finite Element Analysis of the Asiana Airlines Flight 214 Crash (ENGR 498-02)

Ivan Pontes, Jonas Silva, Lorena Neves, Lucas Rigobello, Otávio Rosado, Paulo Victor Cerqueira, Raphael Magalhaes
Instructor: Roberto Cammino, Ph.D.

This report synthesizes the results of a Finite Element Analysis (FEA) taking into consideration the Asiana Airlines Flight 214 crash, at San Francisco International Airport (SFO). The goal was to reproduce the movement of the aircraft and to validate how truthfully the method of FEA could represent the real crash dynamically. At first, only rigid elements were used to represent the model with the purpose of using the maximum number of rigid elements in order to save processing time. Secondly, if a combination of rigid and deformable elements were used, in order to find the weak spots during impact. Thirdly, we put some cohesive elements at the weak spots, located at the turbine, tail and wheels, this way we can model part separation during impact. The model used 54,254 nodes, with some rigid, cohesive and deformable elements, proving that home computers are capable of running even a complex structure like the one studied here. In order to achieve a higher level of accuracy, all data and parameters used were loyal to the accident and to the Boeing model, including technical information of the impact, structure and material specifications.

Bike Frame Analysis under Different Loads using Finite Element Method (ENGR 498-03)

Marcos Vidal, Nicole Azevedo, Rafael Almeida, Thais Araujo
Instructor: Aiman Shibli, Ph.D.

This project focus on studying a bike frame structural behavior under ride loads, first order elements and second order elements were considered in the mesh model. Three different load scenarios were used, flat scenario when a person riding the bike in a flat plane, uphill scenario when a person riding the bike going up a hill with 30 degrees of inclination and downhill with negative 30 degrees inclination. The load is based on a person of 150 kg. The materials used in the analysis were aluminum and steel. Abaqus FEA software has been utilized to conduct the analysis and to extract stresses and displacement on the frame. The results will determine the best material that will be applied in the bike, and the best element order.

Creation of a Simple Human Model to Evaluate Crash Performance (ENGR 498-03)

Andre Luiz Tavares, Shenon Silva de Souza
Instructor: Roberto Cammino, Ph.D.

This report describes the results of a research project focused on testing a dummy structure under impact. One kind of impact was considered, the dummy hitting a wall with a velocity of 47 meters per second. The material used in the dummy model were plastic, aluminum and bone matter. The analysis was performed using the Abaqus Program (a computer aided engineering program) that is capable of showing the stresses and displacements experienced by the dummy as well as Hypermesh, in order to create the model and mesh.

Scissor Car-Jack: A Finite Element Analysis (ENGR 498-03)

Carina Villela Manzi, Filipe Costa Martins, Gabriel Francisco de Oliveira
Instructor: Aiman Shibli, Ph.D.

This research refers to a static simulation of a scissor car-jack, a component used to lift and support cars when any problems happen. The car-jack analysis is important because failure during the operation can lead to serious injuries. There are different types of car-jacks depending on the maximum capacity and the lifting mechanism. A scissor car-jack is a type of car-jack that people can easily operate to lift a light-weight car (1 large ton). Using Finite Element Method software such as HyperMesh® and Abaqus®, a scissor car-jack was analyzed in three different opening angles, 90°, 120° and 150°, seeking to evaluate the Von Misses Stress and displacement on its parts. According to the results, the top-bracket can be considered the limiting part of the car-jack hence it demanded a very special carbon steel in order to not reach the yielding point. Even though no mathematical expression could be written to relate angle to maximum stress, it was possible to notice that the beginning and ending of the lifting process are critical for the car-jack.

Abstracts

Static Analysis of Differential Behavior under Torque (ENGR 498-03)

Matheus Alberto Bordignon, Raul Moreira, Guilherme Sales, Heitor Bezerra
Instructor: Aiman Shibli, Ph.D.

This report describes the results of a research project focused on simulating the vehicle differential gears under torque loading until failure. Two materials were considered for the gears, SAE AISI 4320 and the SAE AISI 8620. Both materials were evaluated under same loading conditions. Hypermesh and Abaqus FEA software were used to build the simulation model and to conduct the analysis. Stresses and forces have been extracted throughout the analysis.

Static Structural Analysis of Automotive Damper (ENGR 498-03)

Hamilton Ludvice, Italo Franco Albano Lage, Leonardo Pereira Koehler
Instructors: Roberto Cammino, Ph.D. and Aiman Shibli, Ph.D.

A damper is a mechanical structure which has the function of minimize the imperfections of the road on automobiles. If the car does not have a damper the spring would keep bouncing until it consumes all the energy that was putted on it, by a bump for example, which will make the ride really uncomfortable. The main objective of this project is to analyze the structural performance of the dumper under static loading. In order to do this a damper geometry (Figure 1) was imported into HyperMesh software in order to create a mesh model that will be used for analysis.

Structural Analysis of a Racecar Chassis Using Finite Element Method (ENGR 498-03)

Andre Santos, Bruno Santos, Daniel Santos, Luciano Oliveira
Instructors: Roberto Cammino, Ph.D. and Aiman Shibli, Ph.D.

This report describes the results of a research project focused on testing a Formula SAE racecar chassis. Three different analysis were considered to simulate the main stresses scenarios faced by those cars during a race. A 1.5 G-force torsional analysis were performed to simulate turning maneuver, a 2.0 G-force bending analysis were performed to simulate breaking maneuver and a dynamic analysis were performed to simulate a frontal collision at 60 mph. All tests run using AISI 1020 and AISI 4130 steel in order to know which material would be the better choice for the final chassis design. The simulations were made using HyperMesh and Abaqus (Finite Element Analysis programs) that showed the stresses and displacements experienced by the racecar. After the results review, the AISI 1020 was chosen as the best option for this particular design due to its weldability, safety factor, availability and economic aspects. It is also highly recommended manipulate the order of elements in the mesh model as well as using of an impact attenuator device, since both materials failed in the crashing simulation by reaching Von Mises stresses 73% and 42% higher than the yield and ultimate stresses respectively.

Structural Analysis of Nintendo Gameboy (ENGR 498-03)

Augusto Milani, Larissa Costa, Lucas Figueiredo, Vinícius Rodrigues
Instructor: Aiman Shibli, Ph.D.

This report describes the results of a research project focused on analyzing the stress distributions under daily usage situations of Nintendo Gameboy. Two different situations we restudied: Analysis of wear by pressing the buttons and a drop of the Gameboy at different orientations and heights. The material used in the Gameboy simulation was Acrylonitrile butadiene styrene (ABS plastic) for the back & front housing, A, B and Arrow buttons and battery, Al-Elastic-Plastic material used for the Board and LCD for the screen. The analysis was made by using the Abaqus (Finite Element Analysis software) that is capable of revealing the stresses and possible displacements experienced by the Gameboy. The data results showed that the screen has the highest values of stress and the Gameboy deformed plastically in all the analysis, but it did not reach the ultimate stress.

Technical and Sustainable Evaluation of Short Span Bridge (ENGR 498-03)

Joao Pedro S. Rios, Laecio Nascimento, Rafael Lima de Sa, Rafael Wildson C. Sousa
Instructors: Roberto Cammino, Ph.D. and Aiman Shibli, Ph.D.

This report describes the results of a study focused on analyzing two beams made of wood and steel, and comparing their technical characteristics, as well as sustainability results, to a reinforced concrete beam previously tested in a different study. The goal is to determine the best material in the construction of a short span bridge based on their structural and sustainability impacts. Models were meshed and modified using Hypermesh software which is capable of meshing objects using finite element analysis. The beam cross section area was modified in order to provide the desired strength. The analyses were conducted using Abaqus, Finite Element Analysis software which is capable of extracting several characteristics of an object such as stresses and displacements under given conditions. The results revealed that the best option would be building a wooden bridge especially because of its price and mechanical response.

Steady State & Dynamic Operation of a Catalytic Reaction in Two Coupled Reactors (ENGR 498.29)

Carol Machado, Gustavo Vieira Gomes, Ercilia Regina Silva Dantas
Instructor: Satish Parulekar, Ph.D.

The behavior of a catalytic reaction with inhibition by reactant occurring in two connected reactors was analyzed in this project. It was verified that a single well-mixed reactor may admit up to three steady states, with up to two of these being stable. Most of the examples considered pertain to each reactor having feed and effluent streams and therefore being able to operate independently of the other. In these examples, the reactors in the two-reactor system are identical only in terms of feed composition and reactor space-time. A two-reactor system may admit up to nine steady states, with up to four locally stable steady states. Three of these steady states have identical composition in the two reactors, symmetric steady states. The remaining steady states, the asymmetric steady states, have different composition in the two reactors and are admissible over a range of interaction rates. An additional example considered pertains to only one reactor having feed and effluent streams. Two new steady states are admissible here beyond certain level of interaction between the reactors.

Mobile Devices Antenna Simulation & Analysis (ENGR 498-31)

Aline Santos, Joao Amendola, Joao Vitor Taveira Barbosa
Instructor: Istvan Szini, Ph.D.

Nowadays, the technology has allowed mobile phones to have many functionalities. Since this demand has been increasing, this paper explains how antennas work, and what kind of design were made that achieve all specifications. Four antennas were designed in this project. First, it is a Wi-Fi antenna. Second, a Bluetooth antenna. Third, it is for 4G LTE. Last, it is a GPS antenna. After simulated the cellphone and its antennas in the software CST Microwave studio, all results were gathered and analyzed. Many results and measurements were examined, including Specific Absorption Ratio, Total Efficiency, Return Loss parameter, and Antenna Impedance. The objective of this research is to learn how antennas work in an actual phone and how to design and tune a perfect antenna in different situations that the world face at the present time.

Analysis of Hyperelastic Material Models (ENGR 498-34)

Edson Luz, Felipe Pedrosa, Gabriel Macedo, Iago Pruano, Paulo Loz
Instructor: James Grudzinski, Ph.D.

Arcan test is a relatively new type of material characterization test and in this report, we present the results of a study with the main objective of showing the behaviors of different material models when applied to rubber material using finite element method. The material models used were Arruda-Boyce, Marlow and Neo-Hookean. The stress and strain in the specimen is determined using Abaqus and Hypermesh software. The final data shows us that the Marlow model has a better response to stress versus strain when compared to the available real data. Other comparisons between different models and load conditions are also considered.

Abstracts

Biomechanics: Finite Element Studies of Monkey Mandibles (ENGR 498-34)

Allan Magalhães Ferreira, Igor Ferreira de Paiva, Matheus Passos Sarmento Santos
Instructor: James Grudzinski, Ph.D.

It is hypothesized that the current shape of a monkey's mandible is determined through an evolutionary process through its eating habits. Prior work has emphasized that chewing foods with different material properties might be related to mandible morphology. In order to analyze the design of the mandible, strain gages were surgically implanted in the mandible of a real monkey. Considerable additional engineering information could be obtained using the Finite Element Method (FEM), with which one can simulate and analyze in a computational manner what strains occur over the whole mandible structure while the monkey was biting the food. This allows observing the main stresses and deformation in many different parts of the mandible, however such an analysis requires validation. One way to perform validation is by comparing the strain gage data from the monkey jaw during biting motions. Some results obtained in the experiment can be compared with the results from FEM. A surgical procedure was performed on the monkey to install the strain gages on the mandible. Bone strain magnitudes in the mandibular corpus and symphysis during transducer biting on incisors, premolars and molars can be relatively high, and often higher than those recorded during mastication. This suggests that an evaluation of bone strain regimes in the mandible during a broad range of feeding behaviors might be informative for the determination of mandibular form. In this research these three loads were analyzed accurately (incisors, premolars and molars) in order to get a clear result.

Structural Analysis of a Gravity Dam Using Finite Elements (ENGR 498.34)

Aline Almeida, Arthur Boaventura, Caio Jardim, Glaucio Gonçalves, John Almeida
Instructor: James Grudzinski, Ph.D.

Dams are structures used thoroughly in the modern civilization to control some aspects of a water reservoir or watercourse. In this work, a gravity dam (a type of dam held only by its own weight) is analyzed using the finite elements method. Different water levels are simulated and conclusions about the dam behavior are drawn and compared with the existent dam theory. Finally, some discussions about earthquakes and its simulation acting on the same dam are made.

Design & Simulation for Bioenergy & Food (ENGR 499.01)

Felipe do Nascimento Inocente, Joao Carlos Silva Lira, Kenji Urazaki Junior,
Instructor: Fouad Teymour, Ph.D.

The objectives of this research was to use 3D computation and simulation tools to design equipment for two projects in the areas of bioenergy and food. The first design consisted of fabricating an air distributor capable of providing homogeneous air distribution in a vessel to grow sprouts of beans in a small container. In the second project, the focus was on producing bioenergy by utilizing algae. The objective was to design and simulate a new loop reactor as a replacement for a current photo bioreactor used in the lab and to design and simulate a separator of solid particles from the reactor. This new system should be capable of simultaneously and continuously growing algae and separating biomass. The air distributor construction was successful and it has been used for one month to grow sprouts. The Loop reactor design needs further simulations to select the design that will be constructed, but one of the designs that the flow simulation is presented in the next picture was chosen as the best design.

Engineering Solutions for Food & Nutrition (ENGR 499.01)

Luana Ribeiro Lante
Instructor: Fouad Teymour, Ph.D.

Studies have shown that sprout is a nutritious food for the human diet; however, it is also an appropriate medium for bacterial growth. Microbiological testing has been indicated as part of an overall strategy to enhance the safety of sprouts. Alfalfa and broccoli seeds were run in bioreactors in conjunction with distilled water and fertilizer. The sprouting medium was tested daily during sprouting for total counts by Pour Plate Technique for 4 days, on agar medium, at 37°C. The effect of chlorine on the sprouts showed an efficient method to reduce the microorganism growth, whereas the probiotics presented a different colony forming in the analysis controlling the development of previous microorganism.

Study of Carbon Monoxide Oxidation in an Autothermal Catalytic Reactor (ENGR 499.33)

Ana Carla F. Valente, Fabiola Da S. Freitas
Instructor: Nader Aderangi, Ph.D.

The health hazards of carbon monoxide is well established. The gas is lethal even at very low concentrations in air. The common sources of carbon monoxide are incomplete combustion of hydrocarbons such as in automotive exhaust, household heaters, stoves, and tobacco smoking. The simplest method of removal of carbon monoxide is oxidizing it into carbon dioxide which is relatively harmless at low concentrations. Unfortunately, at low concentrations the rate of oxidation is very slow and a combination of initial heating and a suitable catalyst is necessary. In this work an authothermal reactor was employed to oxidize carbon monoxide in its mixture with nitrogen and oxygen. The autothermal reactor used the heat of combustion of CO to heat the feed to the reactor and thus a self-sustained preheating of the feed gas. Temperature rise due to this heat recovery was as high as 100 K at CO concentrations as low as 1000 ppm. At higher CO concentrations, about 10000 ppm, the temperature rise was too high and for the safety of the equipment lower oxygen concentrations was used. Experimental work involved programming work for data acquisition and control using LabVIEW. Mathematical modeling of the autothermal reactor was conducted by solving the energy and mass nonlinear ordinary differential equations in Matlab. Both, Euler's method and Matlab ODE45 were used to compare the solutions to the boundary value problem. The high conversion of CO in short entrance length of the reactor was in agreement with the experimental observation.

Idea to Product - The Prototyping Process for Entrepreneurial Engineers - 2 Ways Storage Report (ATR 498-06)

Rafael Diniz
Instructors: Mike Stacey and Abhiroop Chattopadhy

This paper consists basically in a new way how to design plastic packaging, as well as saving space by having only one recipient for 2 liquids, gels, or creams. A 3D software was applied to design and get the necessary dimensions of this new product. Also, a 3D printer has worked to fabricate the prototype.

Idea to Product - The Prototyping Process for Entrepreneurial Engineers - Blackout Nap (ATR 498-06)

Regis Salles
Instructors: Mike Stacey and Abhiroop Chattopadhy

The academic research is about the development of a new product to substitute the conventional sleep mask. The new product is Blackout Nap, a disposable eye patch to sleep. It was developed prototypes to improve the product and research was made to know more about the addressable market, competition, patents and business plan to launch the product into the market.

Idea to Product - The Prototyping Process for Entrepreneurial Engineers - Extendable Cube Outlet (ATR 498-06)

Thiago Souza Mendes
Instructors: Mike Stacey and Abhiroop Chattopadhy

An idea is all that you need to start something that can change the world. In this case, an idea can help people in their need for power at home, office, garage, and so. A simple idea that can change the way we use power outlets, giving more utility to it and making it, in many ways, more useful in day-to-day life style. An Extendable Cube Outlet that can offer power to up to 4 devices instead of just one, and all of it in the simplest possible way.

Abstracts

Idea to Product - The Prototyping Process for Entrepreneurial Engineers - Surgical Dental Articulator Edelthur (ATR 498-06)

Arthur de Araujo Antunes

Instructors: Mike Stacey & Abhiroop Chattopadhy

The objective of the Surgical Dental Articulator Edelthur is to replace the traditional dental articulator used in the classical method of mock surgery in order to speed up and simplify the process. The mock surgery are used to fabricate the surgical guide which is used by the surgeon in orthognathic surgery to reposition the segments of maxilla and mandible in the desired position.

Idea to Product - The Prototyping Process for Entrepreneurial Engineers - Umbrella Sharing (ATR 498-06)

Rodrigo Dos Santos Francisco

Instructor: Abhiroop Chattopadhy

The implementation is one of the great difficulties faced by innovative minds. The purpose of 498.06 - Idea to Product - The prototyping process for Entrepreneurial Engineers was going through the stages of idea generation until the development of a prototype. Students were also able to learn and understand more about how a start-up company. This project deals specifically with the generation and development of an umbrella sharing system.

Research Expo Posters



Posters



Biomedical Engineering & Health Technology

Effects of Headphones Electromagnetic Radiation on Blood Rheological Properties Leading to Cerebrovascular Disorders

Author(s): M. Al-Ghamdi, David E. Dosemeci, Kevin T. De Angelis, S. Thivayak, C. Lim*, Walter M. Macdonald, Raviola Ober*

Acknowledgements: Department of Biomedical Engineering, U.S. Army Research Institute of Environmental Medicine, Waltham, MA, USA.

Background:

- According to the World Health Organization (2012), stroke is the second most common cause of death or disability.
- Blood flow disorders cause vascular diseases.
- Continuous exposure to headphones and television headphones are used worldwide.
- Cerebral lesions and radiation can affect blood vessels.

Purpose and Hypothesis:

- To assess the effects of exposure to the electromagnetic radiation of headphones on blood vessels.
- Long time exposure to headphones can lead to abnormalities in blood rheology leading to the disease of stroke.

Methods

Setup the Platform:

Measurements:

Results

Hematocrit parameters of blood exposed to electromagnetic waves during 2 and 4 hours were compared to control samples. Control-Matched samples showed the blood samples exhibit non-Newtonian behavior.

Conclusions

- The aggregation of red blood cells increased with the exposure to EMR.
- Red blood cells became more susceptible with time.
- Blood viscosity did not change significantly.
- Microscopic analysis revealed no changes in the rheology.
- The process of hemostasis started at about 1 hr and stabilized at 4 hr.

Future Work

- Schmeogenic factor changes in blood rheology after the exposure to EMR.
- Monitoring deformability of red blood cells.
- Microscopic imaging using optical coherence tomography.
- Pre-Thrombotic analysis.

Acknowledgement:

Open Access Statement: We thank Dr. Michael P. Peczkis for his support and guidance throughout this study. We also thank Dr. Mark H. Loeffler and Dr. Michael J. Finsen for their valuable contributions to this work. This work was funded by the Defense Advanced Research Projects Agency.

Bibliography

(1) WHO. (2012). Global status report on non-communicable diseases 2010. Geneva, Switzerland: World Health Organization. Retrieved from: http://www.who.int/nmh/media_centre/press_releases/05_nmh_ncds_2010/en/

(2) Dosemeci, D.E., et al. (2005). Apparent viscosity influenced by a low-intensity magnetic field. *Journal of Biomedicine and Biotechnology*, 2005, Article ID 26072.

(3) Al-Sabti, K., et al. (2004). Importance of blood viscosity in the pathophysiology of stroke. *Journal of Clinical Neuroscience*, 11, 633–637.

(4) Kim, K., et al. (2004). Effect of magnetic field on the rheological properties of blood. *Journal of Biomedicine and Biotechnology*, 2004, Article ID 70547.

(ENGR 498.06) Effects of Headphones Electromagnetic Radiation on Blood Rheological Properties Leading to Cerebrovascular Disorders

Improving Molecular Imaging in Oncology

Alaa Pasha, Arthur Maiman, Daniel G. J. Carvalho, Michael S. Hoffman, Raviola Ober*

Acknowledgements: Department of Biomedical Engineering, U.S. Army Research Institute of Environmental Medicine, Waltham, MA, USA.

Abstract:

Molecular imaging is a diagnostic technique that uses pictures of what is happening inside the body to help in cancer research and management. It has been proposed as a useful technique for early cancer screening and detection – helping cancer researchers to better understand the disease process and possibly improve its treatment.

Background:

Dr. Alaa Pasha, Arthur Maiman, Daniel G. J. Carvalho, Michael S. Hoffman, Raviola Ober*

Introduction:

Molecular imaging is a diagnostic technique that uses pictures of what is happening inside the body to help in cancer research and management. It has been proposed as a useful technique for early cancer screening and detection – helping cancer researchers to better understand the disease process and possibly improve its treatment.

Methodology:

Dr. Alaa Pasha, Arthur Maiman, Daniel G. J. Carvalho, Michael S. Hoffman, Raviola Ober*

Conclusion:

Dr. Alaa Pasha, Arthur Maiman, Daniel G. J. Carvalho, Michael S. Hoffman, Raviola Ober*

Applications:

Dr. Alaa Pasha, Arthur Maiman, Daniel G. J. Carvalho, Michael S. Hoffman, Raviola Ober*

(ENGR 498.21) Improving Molecular Imaging in Oncology

Advanced Molecular Imaging for Guiding "Personalized Medicine" in Cancer Therapy

Source: P. S. Tang, Shekar, Xu, Oshiro, Tschoepe, Nd, K.

INTRODUCTION:

Molecular imaging, enabled when several disciplines, such as cell biology, biomedical engineering, pharmacology and many others, tried to find further new areas of interest and to expand our knowledge in the molecular mechanisms of disease. The molecular imaging has become one of the most important tools in the molecular medicine and biology mechanisms in medicine. A goal of molecular imaging is to provide a non-invasive diagnostic method for the detection of normal and pathological processes in living organisms.

One limitation of this method is that it is model specific on single species of target molecules. Target concentration is dependent on the molecular concentration. The regular metabolism influences its stability, permeability and many other characteristics of the molecule. The imaging target depends on its parameters.

The goal of this study is to explore methods that can overcome this limitation, and that provides early diagnosis and treatment in cancer.

METHODS:

The difference of the targeted and untargeted receptor follows the two-flavor compartment theorem.

RESULTS:

The figures below show the fluorescence spike of for targeted and untargeted imaging experiments; second figure also shows binding protein maps.

DISCUSSION:

In this model, the concentration of the targeted receptor in the region of interest is the sum of the concentration of the reporter in the blood and the concentration of the receptor in the target. Thus, the regular metabolism influences its stability, permeability and many other characteristics of the molecule. The imaging target depends on its parameters.

REFERENCES:

1. Tolkaas M. K. et al. Mol Imaging Biol 2011; 13: 521–528.
2. What is Molecular Imaging, UC Davis | College of Engineering
3. David A. Shultz et al. The Journal of Nuclear Medicine, June 2011; 52(6):1210-1212.

ACKNOWLEDGES:

ILLINOIS INSTITUTE OF TECHNOLOGY CAPES MIRC

(ENGR 498.21) Advanced Molecular Imaging for Guiding "Personalized Medicine" in Cancer Therapy

TECHNICAL

IT Armour College of Engineering
ILLINOIS INSTITUTE OF TECHNOLOGY

Outline:

A biosignal, in order to be used on the computer needs to reduce proper filtering and amplification of the signal from noise and low amplitude. In addition each biosignal has unique properties that require specific acquisition and processing. After obtaining the signal, the signal must be quantitated in a digital form so that it can be processed. This process involves the signal and the noise to interpret its characteristics.

Block Diagram:

Differential Amplifiers are used to eliminate noise coming from power line source. Next there is a filter stage to eliminate low and high frequency noise. After the filter stage the signal is analyzed. This is followed by an amplification stage and softwares in order to make the signal readable by the microprocessor's Analog-Digital converter. The signal is then sent via bluetooth to a device.

Prototyping and Building:

The signal was read by the Arduino and was sent via bluetooth.

Results:

Signal record with noise

Signal record with the BA signal

Signal record with the BA signal with noise

As can be seen comparing with a commercial device the plots above show that the acquisition of an electrocardiogram waveform was a success.

(ENGR 498.24) BIIT Electrophysiology Teaching Device - Technical Poster

ABOUT THE PROJECT



We are a group of students from BIIIT who participated in the project Sensors without Borders. We came in Illinois Institute of Technology to do a summer research led by Dr. Ramin Esfandiari. We are working in the Human Electrophysiology group which is intended to develop and commercialize medical devices and medical mobile apps. Therefore, we developed the BIIIT Uninformed Life Monitor.

Electrophysiology



Electrophysiology is an important part of the biomedical market. However, current electrophysiology systems have limitations:

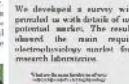
- An uncomfortable number of wires attached to the subject, resulting in limited movement.
- Costly hardware which does not allow a complete understanding of what is happening within the system.

Costs

BIIIT



User Needs



We developed a survey with questions that included us with details of use needs in BIIIT's potential users. The results of this survey were the main requirements of the electrophysiology market for advancement and research laboratories.

Solutions & Differentiation



The Open Box Hardware solution is a low-cost, wireless, and low-cost solution for electrophysiology.

(ENGR 498.24) BIIT Electrophysiology Teaching Device -
Business Poster

Biit is a portable ECG device designed for personal health monitoring. The collage includes:

- A top-left logo for IIT Armour College of Engineering, Illinois Institute of Technology.
- A top-right section titled "COMMERCIAL" featuring a QR code and the text: "Scan me! Use our website using your QR code reader in your mobile app; no Wi-Fi needed!"
- A large central image showing two people sitting at a round table in a lounge, with one person holding a Biit device. Below this image is the hashtag "#justgo".
- A middle-left text box containing the quote: "This hardware is 'open-box' so you can change the components and configuration to see how that affects your results."
- A middle-right image of two people working on a computer, with the hashtag "#timeforCHANGE" overlaid.
- A bottom-right image of a person sitting at a desk with a computer monitor, with the hashtag "#LETGO" overlaid.
- A bottom-left text box containing the quote: "Biit has wireless technology that allows you to move around as much as you want during your ECG."
- A bottom center text box containing the quote: "LET IT GO! LET Biit GO!"

(ENGR 498.24) BIIT Electrophysiology Teaching Device -
Commercial Poster

Software Description

When the software starts, screen 1 will pop up. In this screen, the sequence to be analyzed can be entered in three different ways. The user can upload a FASTA file, a text file can be specified, or the user can search for the sequence by name in the third input option. The user inserts the target sequence into a text input field. The number of screens can be specified to narrow down the result at the end.

Next is screen 2. In this screen the user can make a gene by adding specific genomic mutations, or delete part of the gene. In screen 3, we see an example of a typical result provided by the software for a specific gene. This is a screenshot from our website. The data necessary for the analysis is extracted from the HTML document and the data is processed and spliced.

A typical result is shown in screen 4. After the processing is completed and the subterms are generated, an option to save the data into a CSV document is provided. This CSV file will contain all the information about the analysis, and all the valid terms corresponding to the user-specified constraints.

Team Structure

(ENGR 498.25) Software Engineering for Cancer Research

Software Engineering for Cancer Research

Alberto Costa, Alvaro Sales, Arthur Senna, Carla Tavares, Edsona Gómez, Henrique Kassomenos, Júlio Santos, Luana Costa, Marcelo Saad, Michel Silveira Nonnem, Frederic Vieux, Mauro Basso, Renato Maffei

Introduction

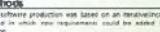
In the United States, it is estimated that 1,084,910 people will develop cancer in 2013, and 585,830 will die because of it [1]. The main goal of this research is to contribute to the prevention and often cause side effects reduction of cancer. In addition, medical records may be very useful for cancer treatment and prevention [2].

The National Institutes of Health (NIH) estimates that 1.5 million diagnosed each year in the United States and 3 to 5 percent of patients with cancer have a second primary tumor [3]. In the United States, in which the number of repeats is a microcosm of the general population, the number of patients with a second primary tumor is MS could take the lots of normal progression, which contributed to the problem [4].

Scientists at AT&T discovered that MS mutation in the human慷慨基因 can be managed by unusual signal processing [5]. This work was done to demonstrate that it is possible to restore function in the 700 genes commonly mutated in cancer. In addition, the use of signal processing techniques for analysis would make it unnecessary to analyze at the cellular level (solid surfaces directly) [6]. The MS algorithm can be used to analyze the tumor cells in the body. The number of subtypes to be analyzed in the tumor cells is not limited, as long as the system is functional, therefore reducing the problem cost, confirming manageable.

Methods

- The software platform was based on an reinforcement learning method, in which new requirements could be added in every iteration.



The language used to implement was Java because it is one of the most used languages in the development processes and design.

This team was divided in groups as needed (depending on specific modules of the software and migration).

Three public datasets were integrated to the application:

- The Lung dataset from UCI Machine Learning Repository.
- The Colon dataset from UCI Machine Learning Repository.
- The Breast Cancer Wisconsin dataset from UCI Machine Learning Repository.

• The language used to implement was Java because it is one of the most used languages in the development processes and design.

• This team was divided in groups as needed (depending on specific modules of the software and migration).

• Three public datasets were integrated to the application:

- The Lung dataset from UCI Machine Learning Repository.
- The Colon dataset from UCI Machine Learning Repository.
- The Breast Cancer Wisconsin dataset from UCI Machine Learning Repository.

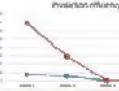
Results

There are three ways to input a gene sequence: using a text box, choosing from PubMed or simply inputting a fasta document. The sequence to be analyzed should be inserted in the text box and the user can choose the database to search in the system and there can be combine and splice other public databases for that sequence using biological rates to narrow down the results. The user can compare three isoforms with the parent form (isoconversion). The diagram illustrates the general flow of the system.



The graphic: Prediction Efficiency

Shows some information about the importance of the parameters in the amount of prediction efficiency. The graph shows that different configurations were settled in order to test the best solution and the best is the one with the highest prediction efficiency. It shows the numbers of solid surfaces (S) and the prediction efficiency (PE). It also shows the exponential increment of results as the number of solid surfaces increased. It is believed in the graph differently by the user.



Discussion

- Molecular solid sequences can be processed using a reinforcement learning method, and prediction efficiency is high, but there are still a few problems that must be considered more than one place. Time and processing can increase exponentially as the number of solid surfaces increases.
- One of the big shortcomings was the integration with different databases. However, the Wang Computing framework is a good solution for this problem.
- The system is modular, so requirements need something to be overcome, by the nature of the project, some results highlighted the need to modify the system to support the new requirements that could be introduced while the software was developed.
- Several biological rates can be introduced in a future version of the system.

Acknowledgement

• Brazilian Science Ministry, Programa de Inovação, at the institution.

• Dr. D. J. Braga for collaborative effort with use case definition.

References

[1] American Cancer Society, "Cancer Facts & Figures 2013," Atlanta, GA, 2013.

[2] A. Costa, "Software Engineering for Cancer Research," Ph.D. dissertation, University of São Paulo, São Paulo, Brazil, 2013.

[3] National Institutes of Health, "Cancer Statistics," Bethesda, MD, 2013.

[4] M. Silveira Nonnem, "Software Engineering for Cancer Research," Ph.D. dissertation, University of São Paulo, São Paulo, Brazil, 2013.

[5] A. Costa, "Software Engineering for Cancer Research," Ph.D. dissertation, University of São Paulo, São Paulo, Brazil, 2013.

[6] M. Silveira Nonnem, "Software Engineering for Cancer Research," Ph.D. dissertation, University of São Paulo, São Paulo, Brazil, 2013.

(ENGR 498.25) Software Engineering for Cancer Research

(ENGR 499.02) PEG Hydrogel Matrices for Studying the Role of Matrix on Breast Cancer Responsiveness

(ENGR 499.03) Quantification of Pro-angiogenic Peptide Release from Hydrogel Nanoparticles

Posters

Sustained co-delivery of pro-angiogenic and vessel stabilizing peptide mimetic sequences for neovascularization of hydrogel nanocomposite scaffolds

Laura C. Lima¹, Daniel A. Young¹, Georgia Panayiotou²

¹ Department of Chemical Engineering, Federal University of Ceará, Fortaleza, Ceará, Brazil
² Department of Chemical Engineering, Illinois Institute of Technology, Chicago, Illinois, USA

Background & Purpose
Tissue engineering (TE) involves the use of cells, integral supporting materials, and biological substitutes to repair, regenerate, or replace tissue and/or organ function lost due to disease, damage or injury. The clinical success of tissue engineering depends on the ability to produce functional tissue that can be integrated with specific implants that graft onto a patient's own tissue to restore tissue function. Our lab has developed a novel approach to tissue engineering that uses peptide mimetics to promote the growth of blood vessels (angiogenesis) and stabilize existing blood vessels (vasculostabilization). This is highly promising for the treatment of diabetic ulcers, which are a major problem in the US today.

Methods
The hydrogels used in this study were composed of PEGDA (poly(ethylene glycol) diacrylate) and were functionalized with peptides. These peptides have been shown to be effective in promoting angiogenesis and stabilizing blood vessels. The peptides used in this study are mimics of the native extracellular matrix and were designed to bind to the extracellular matrix proteins fibronectin and laminin. The peptides were designed to bind to these proteins to promote the growth of new blood vessels and to stabilize existing blood vessels.

Results
Figure 1 shows the results of the diffusion coefficient estimation from hydrogel nanopores. The diffusion coefficient was found to be approximately 0.12 nm²/s. Figure 2 shows the results of the diffusion coefficient estimation from hydrogel nanocomposites. The diffusion coefficient was found to be approximately 0.14 nm²/s. Figure 3 shows the results of the diffusion coefficient estimation from hydrogel nanocomposites. The diffusion coefficient was found to be approximately 0.15 nm²/s.

Conclusion & Future Directions
Our results show that the diffusion coefficient of PEGDA hydrogels is dependent on the peptide sequence used. We are currently investigating the effect of different peptides on the diffusion coefficient of PEGDA hydrogels.

Acknowledgments

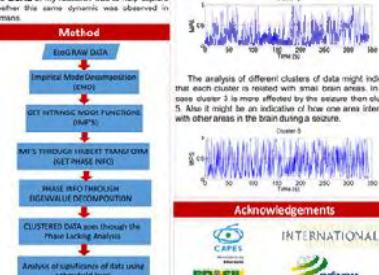
Illinois Institute of Technology

(ENGR 499.03) Sustained Co-delivery of Pro-angiogenic & Vessel Stabilizing Peptide Mimetic Sequences for Neovascularization of Hydrogel Nanocomposite Scaffolds

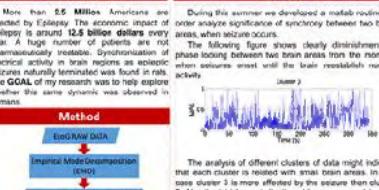
III Armour College of Engineering Analysis of Electrical Brain Dynamic for Epilepsy in Humans Wellington Pinheiro, Tiwahle Sotayo², David Mogul¹

¹ IIT R&D department professor at IIT (CPM) student at IIT

Introduction
More than 5.5 MILLION Americans are affected by Epilepsy. The economic impact of Epilepsy is around 12.5 billion dollars every year. Epilepsy is a brain disorder that is not fully pharmaceutically treatable. Glycogenization of electrical activity in brain regions as epileptic seizures are often associated with cognitive and physical disabilities. The GOAL of my research was to help explore whether this same dynamic was observed in humans.

Method


The analysis of different clusters of data might indicate that some clusters interact with other brain areas. In this case, cluster 3 is more often affected than cluster 5. It also might be an indicator of how one area interacts with other areas in the brain during a seizure.

Result


During this summer we developed a mobile routine, in order analyze significance of synchrony between two brain areas, when seizure occurs.

Discussion/Future Work

- Increase the amount of data which can be processed simultaneously.
- Generate 40 plots with time x frequency x cluster N
- Find correlations (correlation strength) between clusters.
- Figure out if the IMF's represents actual activity or groups of neurons in the brain, or it is just a mathematical representation.

References
[1] Shin, H. M., et al. "Review of Epileptology, Diagnostic Evaluation and Treatment of Epilepsy." Neurochirurgia (Wien) 11.129 (2010): 2276-2282.
[2] Fine, Arnold S., David P. Nickells, and David Mogul. "Assessing instantaneous synchrony of nonlinear nonstationary oscillations in the brain." Journal of neuroscience methods 186.1 (2009): 40-51.
[3] Sejnowski, Tadeusz J., et al. "Synchrony dynamics and cognitive interactions in limbic epilepsy: voltage between initiation and termination phases of seizures." Biomedical Engineering IEEE Transactions on 80 (2003): 827-829.

Acknowledgements


(ENGR 499.06) Analysis of Electrical Brain Dynamic for Epilepsy in Humans

Computer Model of a Specific Brain Circuit for Epileptic Seizures

Student: Bárbara Martins Research Advisor: Dr. David Mogul ENGR499.06

Introduction
Epilepsy is a neurological disease characterized by recurrent, unprovoked episodes of a nervous system activity called seizures. About 50 million people worldwide are living with epilepsy.

Results
There are some results of the neural network program using two types of neurons and the following parameters: $a = 10$, $b = -92$, $c = -0.02$, $d = 1.5$, $E_1 = 10$, $E_2 = 10$, $I_1 = 10$, $I_2 = 10$, $\tau = 0.02$, $\omega = 0.0001$. The figure 1 shows the existence of 75% of excitatory neurons and 25% of inhibitory neurons.

Discussion/Future Work

- This model could be used to better understand the behavior of epilepsy.
- Using this model, we can start changing the number of excitatory or inhibitory neurons.
- Increasing the population of neurons and changing their connectivity.
- Comparing the result of the modeling with the actual data from experiments with mice.

Acknowledgments

- Antônio Carlos J. de Oliveira for helped.
- Engineering Physics students team.
- Institute of Interdisciplinary Education (IE).
- C. R. M. da Silva for helped in the implementation of the model.
- David Mogul (IE).
- Laboratory of Brain Electrophysiology and Neural Engineering.

References
[1] Wallach, P. (2008). AMPLAB for neuroscientists: A software for simulation and analysis of LIF&LSS. *Advances in Bioelectronic Medicine*.

[2] Sotayo, T., Pinheiro, A. L., Gomes, E., Antunes, C., & Mogul, D. (2010). Modeling the dynamics across brain structures in limbic epilepsy vary between initiation and termination phases of seizures. *Journal of Neuroscience Methods*, 197(2), 218-225.

[3] Pinheiro, W., Sotayo, T., & Mogul, D. (2010). *Epileptic Seizures As a Network Model of the Hippocampus and Anterior Thalamus*.

(ENGR 499.06) Computer Model of a Specific Brain Circuit for Epileptic Seizures

III Armour College of Engineering Design Control for New System to Acquire Data from Rat Experiments

Maria Célia Serafim de Oliveira
Dr David Mogul, ENGR499-07

Introduction
Over 1M of the world's population suffer from the most frequent seizure that defines epilepsy. Although the primary therapy of antiepileptic drugs (AEDs) can disrupt seizure onset, over one-third of patients do not respond to AEDs and must rely on using AEDs. The mechanisms that lead to a seizure are not well understood. In order to better understand what causes a seizure, it is possible to induce a seizure and measure the response of the brain to the stimulus. This project aims to analyze a electrical signal of the brain, to analyze the first step to record this data.

Methods
Using the software LabVIEW it was possible design a system to acquire data from rat experiments. Based on the current system used to record data was increased the number of channels and create a system that can record data from 32 channels. The experimental data can be seen on figure 1. The figure 1 shows 3 electrodes inserted in the brain of a rat that receives the electrodes we measure hippocampal and interneuronal discharges.

Results

- User panel shows the signal acquired and the trigger events.
- It is user configuration for the acquisition data and leave comments to the records.

Discussion

- Improving with Matlab/Simulink models of the data.
- The LabVIEW helps to obtain discharges between repeat and volume name.
- Save the timestamp of acquisition of samples directly to the hardware cap (PCI).
- Batch sample has no problems of recording time.

Next Steps

- Design for rat brain stimulation
- Recording of more sites of the brain
- Integration with new acquisition hardware

Contact
mceliaoliveira@iit.edu

(ENGR 499.07) Design Control for New System to Acquire Data from Rat Experiments

III Armour College of Engineering Graphical User Interface for Wireless Implantable Electrical Stimulation

Caió César G. Fernandes and PhD Philip R. Troyk, Ph.D Zhe Hu, ENGR499.09

Introduction
Intracranial medical procedures
It is a specific area where in humans, medical devices have been on the field of medical applications for a long time. These medical applications are mainly focused on the treatment of diseases such as Parkinson's disease, epilepsy, depression, etc. However, there are still many challenges in this field, such as the development of safe and effective medical devices. One of the main challenges is the development of a wireless implantable medical device. This project aims to develop a wireless implantable medical device for the treatment of depression.

Results


Figure 2 - WiFi chip assembly with a microcontroller and a battery.

Conclusion

- Obtaining a wireless medical device for depression treatment.
- Developing a graphical user interface for the user to use. And build the WiFi chip assembly.
- Test the WiFi chip assembly.
- Test the WiFi chip assembly.
- Test the WiFi chip assembly.

Discussion and Implementation

- Obtaining a wireless medical device for depression treatment.
- Developing a graphical user interface for the user to use. And build the WiFi chip assembly.
- Test the WiFi chip assembly.
- Test the WiFi chip assembly.
- Test the WiFi chip assembly.

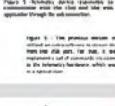
Methods


Figure 3 - WiFi chip assembly with a microcontroller and a battery connected to a computer via a USB port.

References
[1] Philip R. Troyk, Zhe Hu, Caió César G. Fernandes, "Graphical User Interface for Wireless Implantable Electrical Stimulation", <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3118470/>
[2] Philip R. Troyk, Zhe Hu, Caió César G. Fernandes, "Graphical User Interface for Wireless Implantable Electrical Stimulation", <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3118470/>

(ENGR 499.09) Graphical User Interface for Wireless Implantable Electrical Stimulation

Magnetic susceptibility in Gray Matter is Associated with Age-related Neuropathology: An ex-vivo QSM Study in a Community Cohort

Caio César G. Fernandes and PhD Philip R. Troyk, Ph.D Zhe Hu, ENGR499.09

Introduction
Magnetic susceptibility in gray matter is associated with age-related neuropathology: An ex-vivo QSM study in a community cohort

Methods
This study examined the magnetic susceptibility in gray matter and white matter in a community cohort of 100 healthy volunteers aged 18-80 years. The subjects were recruited from a local community and were assessed for cognitive function and MRI scans. The subjects were divided into three age groups: young (18-39 years), middle-aged (40-64 years), and elderly (65-80 years). The subjects were scanned using a 3T MRI scanner with a QSM sequence. The QSM sequence measures the magnetic susceptibility of the brain tissue, which is related to the presence of iron and other metal ions. The QSM sequence was performed on the whole brain, and the results were analyzed using a statistical analysis software.

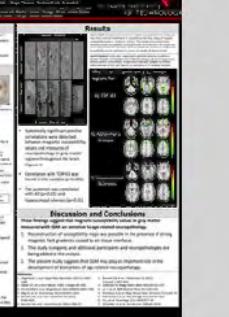
Results


Figure 1 - Brain scan showing QSM results for different age groups.

Conclusion and Conclusions

- Age-related neuropathology is associated with increased magnetic susceptibility in gray matter.
- Age-related neuropathology is associated with decreased white matter magnetic susceptibility.
- Age-related neuropathology is associated with increased white matter magnetic susceptibility.

Objective
The objective of this research is to acquire and represent features in a graphical user interface (GUI) for a wireless implantable medical device for depression treatment. The GUI will be used to control the WiFi chip assembly and monitor its performance. The WiFi chip assembly will be used to stimulate the brain and treat depression.

Structural Design
The structural design of the WiFi chip assembly consists of a WiFi chip, a microcontroller, a battery, and a USB port. The WiFi chip is responsible for wireless communication and signal processing. The microcontroller is responsible for controlling the WiFi chip and the battery. The battery provides power to the WiFi chip and the microcontroller. The USB port is used to connect the WiFi chip assembly to a computer for programming and monitoring.

WIFI
Requirements for WiFi chip assembly and WiFi chip assembly implementation.

(ENGR 499.08) Magnetic susceptibility in Gray Matter is Associated with Age-related Neuropathology: An ex-vivo QSM Study in a Community Cohort

Brain MR Elastography Registration via DTI: Exploration and Quantification
Marcus V. Tchено, Nicolai R. Gallo, MSc., John G. Georgiadis, PhD.

Objective
Find a way to quantify the success of MRE image registration with DTI.

Introduction
Magnetic resonance elastography (MRE) is a non-invasive tissue imaging method that measures shear stiffness [1]. A microstructure alteration in the tissue can be detected by measuring the shear stiffness. This method can be used to detect early signs of neuromuscular diseases, such as stiffness [2].

Diffusion tensor imaging (DTI) was used to map and characterize the brain's three-dimensional diffusion of water as a function of spatial location [3]. DTI is a non-invasive technique that can be used to align multiple scans from a single integrated image. It helps overcome issues such as image rotation, scale, and skew.

Methods
Using Matlab, we found a way to display and manipulate the diffusion tensor imaging (DTI) and MRE imaging files (.nii).

Results

Fig. 1. Brain DTI showing the input calibration (DWI) in the center of bright red. B: MRE CC mask overlaid on the DTI image.

Fig. 2. A: Sharpened MRE CC reconstructed from binary 3D matrix. B: MRE mask overlaying the DTI CC. C: CC binary reconstructed from DTI mask.

Fig. 3. Structure similarity (SSIM) and mean square error (MSE) comparing MRE CC mask and DTI CC mask. Sharpness of the MRE CC mask is improved by applying DTI CC mask sharpness threshold.

Discussion
It was possible to extract the CC from DTI and compare it with the MRE CC. After extracting the CC from DTI, we compared the two CCs from both MRE mask and DTI mask of CC was found. We therefore have a quantitative technique to assess future changes in our MRE registration method.

References:
[1] Johnson GL. 2014. Magn Reson Med.
[2] Johnson GL, et al. 2015. Neuroimage.
[3] Jevremović GA, et al. 2014. Magn Reson Vis.

Acknowledgments:
We are grateful to the Institute of International Education for the International Research & Development Program for my participation in this research program. We also would like to thank Azam Ardalan from University of Illinois Urbana-Champaign for the MRE and DTI data.

(ENGR 499.19) Brain Magnetic Resonance Elastography Registration via Diffusion Tensor Imaging: Exploration & Quantification

Ocular Drug Delivery System: use of nanoparticles
Flávia E. Vilela, Lívia Moraes, Rafael Moraes, Renato Pinto, Christian H. Oliveira, Emily Júnior, Michaela Luis, Adriana J. Basso-Aldred, Department of Biomedical Engineering, Illinois Institute of Technology, Chicago, IL, USA

Purpose
There is a public backlog of other eye diseases. Biological drug delivery system (BDS) will allow for extended release of anti-viral antiviral eye drops (VAD).

Background
• Poor medication delivery to the eye (Fig. 1).

Fig. 1. The ability to penetrate the cornea is determined by the tear film. Due to the blood-ocular barrier, which separates the eye from the systemic circulation, the therapeutic agent is limited to large doses (second).

Methodology
• Ability to encapsulate a variety of drugs;
formulation of different ratios of polymeric and hydrophilic materials;
encapsulation of hydrophobic drugs;
assay of cytotoxicity and bioactivity;

• These characteristics of PLGA 90:10 is a more ideal polymer formulation based on its apparent release rate, and a more accurate and consistent administration.

• Alternatively, PLGA 50:50 provided a higher encapsulation rate.

• Thus, as part of this research is the definition of the combination of PLGA 90:10 and PLGA 50:50 with variables in encapsulation, release rate, and cytotoxicity.

Results
• Encapsulation results obtained using PLGA nanoparticles:
encapsulation to achieve 100% encapsulation (E) and initial burst (IB) with variables in encapsulation.

Table 1. Nanoparticles characteristics using various ratios.

Atmosphere	Monomer	TGIC	E%	IB%
Nitrogen	PLGA 90:10	1.0	~90	~10
Nitrogen	PLGA 50:50	1.0	~90	~10
Nitrogen	PLGA 90:10	0.5	~90	~10
Nitrogen	PLGA 50:50	0.5	~90	~10
Nitrogen	PLGA 90:10	0.2	~90	~10
Nitrogen	PLGA 50:50	0.2	~90	~10

• This study aims to evaluate if the combination of PLGA 90:10 and PLGA 50:50 can yield sustained release and controlled release of hydrophobic and hydrophilic drugs.

Future Work
• Encapsulation of hydrophobic drugs (VAD);
• 50:50 with hydrophilic; assessment of release rate, initial burst and encapsulation efficiency will be evaluated against synthetic polymers.

Acknowledgements: CAPES (Brazilian Ministry of Education), for funding this research.

Literature [1] Dabholkar DR, Balooch M. 1993. Controlled and sustained release of macromolecules from biodegradable polymers. *J Mater Sci*. 23: 103-110. [2] Laike X, Liang Y, Chen Y, et al. 2010. In vitro release behavior of ibuprofen from PLGA microspheres. *Drug Deliv Optim*. 1: 103-107. [3] Vilela FE, Moraes R, Pinto R, et al. 2014. Evaluation of the in vivo performance of a novel ocular drug delivery system. *Journal of Pharmaceutical Research*. 1: 1-5.

(ENGR 499.23) Determining the Ideal Concentration of PEG-PLLA-DA in a Microspherehydrogel Drug Delivery System to Make it Fully Biodegradable

ILLINOIS INSTITUTE OF TECHNOLOGY
Diabetic Retinopathy – Comparing Indocyanine Green to Fluorescein
Tafta Iskandar Bodiroga¹, Clinton Osswald, Emily Donnan, Jennifer J. Kang-Meier, Kenneth M. Tickauer², Undergraduate Student, Electrical Engineering, Illinois Institute of Technology, Chicago, IL, USA

INTRODUCTION
A significant complication of diabetes mellitus is the development of diabetic retinopathy. Diabetic retinopathy is the leading cause of blindness in the United States. The disease is characterized by progressive damage to the blood vessels of the retina. These vessels are responsible for bringing oxygen and nutrients to the retina. Over time, damage to these vessels leads to leakage and accumulation of fluid in the retina, which leads to the development of diabetic retinopathy.

• Ability to encapsulate a variety of drugs;
formulation of different ratios of polymeric and hydrophilic materials;
encapsulation of hydrophobic drugs;
assay of cytotoxicity and bioactivity;

• These characteristics of PLGA 90:10 is a more ideal polymer formulation based on its apparent release rate, and a more accurate and consistent administration.

• Alternatively, PLGA 50:50 provided a higher encapsulation rate.

• Thus, as part of this research is the definition of the combination of PLGA 90:10 and PLGA 50:50 with variables in encapsulation, release rate, and cytotoxicity.

Methods
The objective of this research is to determine the optimal ratio that will yield the best encapsulation rate at any given time. We can implement this strategy, aiming to maximize the encapsulation effect of the patient. As such, we can implement this strategy to increase the encapsulation rate over time, thereby providing better glucose levels and leading to a reduction in the risk of developing diabetic retinopathy.

RESULTS
The objective of this research is to determine the optimal ratio that will yield the best encapsulation rate at any given time. We can implement this strategy, aiming to maximize the encapsulation effect of the patient. As such, we can implement this strategy to increase the encapsulation rate over time, thereby providing better glucose levels and leading to a reduction in the risk of developing diabetic retinopathy.

REFERENCES
[1] Johnson, GL. 2014. Magn Reson Med.
[2] Johnson, GL, et al. 2015. Neuroimage.
[3] Jevremović GA, et al. 2014. Magn Reson Vis.

ACKNOWLEDGEMENTS
INSTITUTE OF EDUCATION
CAPES

Diabetic Retinopathy - Comparing Indocyanine Green (Retina +Choroid Flow) to Fluorescein (Retina Flow)

(ENGR 499.27) Diabetic Retinopathy - Comparing Indocyanine Green (Retina +Choroid Flow) to Fluorescein (Retina Flow)

How Diet and Exercise Influence Fat Distribution in Elderly Women
Mariana Costa Mendes, Nicolas R. Gallo, MSc, John Georgiadis, PhD.

Background
Fat and muscle mass distribution in the elderly changes with age, increasing risk for chronic diseases such as osteoporosis and sarcopenia [1]. New methods, not requiring muscle biopsy, are needed to assess muscle quality. Protein and hormone levels (BMI, waist circumference, waist-to-hip ratio, triglycerides) are associated with body fat within the body [2]. This project evaluated fat composition of the thigh in three groups of older women: sedentary, low physical activity levels and adipose tissue, using MRE.

Objectives
• Quantify the differences in fat, IMCL (intramyocapillary spaces) and SMCL (extreme-myoepicardial lipids) concentrations between lean and active (LA), sedentary (Sed) and obese (Obese) women.
• Determine the effect of weight-loss diet and exercise intervention on the muscle of the thigh.

Results
• On obese and sedentary individuals, the lipid distribution was found to be very similar.
• The inactive group has IMCL more localized than the SED group.
• Diet was found to decrease lean body mass and increase lipid concentration.
• Exercise did not decrease the total fat mass, but decreases IMCL levels.

Conclusion
• MRE is very useful to help in diagnosing and treating diseases.
• Weight loss was shown to significantly reduce relative fat volume and intramuscular lipid concentration.
• Exercise was found to not be metabolically beneficial.
• An increase in physical activity level seems to promote a better response for metabolism, access to the lipid for metabolism, lipid distribution in lean individuals, which hints at a possible method for prevention.

Fig 1: Volumetric analysis of the thigh. Sarcopenia, SMCL, IMCL and example of IMCL distribution.

References
1. Glass B. Generalization of the effects of physical activity and inactivity on human health: a review of the literature. *Am J Health Promot*. 2000; 14(3): 186-196.
2. Chatterjee A. Proc Int Soc Mag Res Med 2012.

(ENGR 499.22) How Diet & Exercise Influence Fat Distribution in Elderly Women

Ocular Drug Delivery System: use of hydrogel
Flávia E. Vilela, Lívia Moraes, Rafael Moraes, Renato Pinto, Christian H. Oliveira, Emily Júnior, Michaela Luis, Adriana J. Basso-Aldred, Department of Biomedical Engineering, Illinois Institute of Technology, Chicago, IL, USA

Purpose
To produce a fully biodegradable, microspherehydrogel drug delivery system (BDS) for eye drops.

Background
Importance of current work:
• Current eye drops are not effective in the treatment of eye diseases due to the poor absorption of the drug by the eye.
• The main problem is that the drug does not penetrate the eye effectively.
• The hydrogel system can improve the absorption of the drug by the eye.

Fig. 1. Scheme of BDS (BDS=Microspherehydrogel).

Methods
• The main idea is to combine the eye drops with hydrogel.

Drug Delivery System Developed by IIT
• The main idea is to combine the eye drops with hydrogel.

Results
• Our previous work demonstrated that microspheres can penetrate the eye and released the drug in a sustained manner.
• The drug delivery system developed by IIT is a hydrogel system that can penetrate the eye and release the drug in a sustained manner.
• Fig. 2 shows the drug release profile of the hydrogel system.

Fig. 2. Drug release of PEG-PLGA-DA BDS and conventional eye drops over time for sustained eye drops.

Future Work
• Change the ratio of PEG-PLGA-DA BDS and conventional eye drops over time for sustained eye drops.

ACKNOWLEDGEMENTS
COPES, Science without Borders, Brazilian Ministry of Education & Illinois College of Engineering Funding.

REFERENCES
[1] Osswald, C., Balooch, M. 1993. Controlled and sustained release of macromolecules from biodegradable polymers. *J Mater Sci*. 23: 103-110. [2] Laike X, Liang Y, Chen Y, et al. 2010. In vitro release behavior of ibuprofen from PLGA microspheres. *Drug Deliv Optim*. 1: 103-107. [3] Vilela FE, Moraes R, Pinto R, et al. 2014. Evaluation of the in vivo performance of a novel ocular drug delivery system. *Journal of Pharmaceutical Research*. 1: 1-5.

(ENGR 499.24) Ocular Drug Delivery System Produced by Combination of Different PLGA Formulations

Exoskeleton to Assist Hand Pinch Movement for a Brain-Machine Interface
Luiz Antônio dos Anjos Junior, Kui Qian, Denirk Kamper, ENGR499.30

Background
• Incorporating sensory feedback while a brain-machine interface (BMI) performs a task has long been a challenge because the BMI does not provide enough information about the user's movement to correctly perceive the movement.

Fig. 1. The brain-machine interface for pinch force control.

Design
• The IAD drive shafts align with the anatomical rotation of the distal joints MCP and PIP/DIP 20 degrees clockwise.

Fig. 2. Design of the mechanism. (a) Index, (b) thumb.

Prototype
• The IAD drive shafts are connected to servomotors through torque multipliers.

Fig. 3. Prototype created with 3D printer. (a) lateral and (b) top view while being used.

Validation
• Measure rotation of the IAD while being activated.

Fig. 4. IAD vs. the pinching force measured of thumb.

Future work
• Change the design of the index finger IAD to allow better adjustment of the pinch position.
• Improve the duration of the IAD for the monkey hand for conducting the BMI experiment.

References
[1] Kamper, D. 2014. Exoskeleton to Assist Hand Pinch Movement for a Brain-Machine Interface. *Journal of Pharmaceutical Research*. 1: 1-5.

(ENGR 499.30) Design of an Exoskeleton to Create Pinch for a Brain-Machine Interface

Posters

Influence of Palm Oil on the Rheological Properties of Peanut Butter

Ruben Franselle (life)
Address: Mr. Gérard Wink, Prof. Dr. Jozef Geuskens

Introduction

Rheology is the field of science that studies the deformation and flow of matter.

Materials behave like a solid or a liquid depending on:

- Characteristics time of fluid (τ_{fluid}) relative to the time of flow (τ_{solid})

$$\dot{\gamma} = \frac{\tau_{\text{fluid}}}{\tau_{\text{solid}}} \quad \begin{cases} \dot{\gamma} > 1 & \text{Fluid (Newtonian fluid)} \\ \dot{\gamma} = 1 & \text{Plastic (Bingham fluid)} \\ \dot{\gamma} < 1 & \text{Solid (Non-Newtonian fluid)} \end{cases}$$

- level of applied stress (τ_{app}) relative to Yield Stress (τ_{yld})

$$\dot{\gamma} = \begin{cases} \infty & \tau_{\text{app}} > \tau_{\text{yld}} \\ 0 & \tau_{\text{app}} = \tau_{\text{yld}} \\ \infty & \tau_{\text{app}} < \tau_{\text{yld}} \end{cases}$$

Yield Stress (τ_{yld}) is the minimum shear stress applied to a material leading to flow or deform plasticity.

Shear Flow - Uniform shear rate and stress, Constant $\dot{\gamma}$ or constant τ_{app} (Figure A).

Shear History - Non-uniform measure of shear and extension, constant $\dot{\gamma}$ (shear of strain or constant TA (Poisson's ratio))

Hencky Bubble Test

$\tau_{\text{yld}} = 10 \pm 10^2$

References

1. G. A. Gerspach et al., Yield Stress in Food Measurement and Prediction, *Journal of Food Applications*, 2000, 20(2), 200.

(ENGR 499.46) Influence of Oil on the Rheological Behavior of Peanut Butter



Civil & Construction Engineering

Issues in Green Building Design, Construction and Operation

Amanda Trindade, Gelly Nereis, Luiz Gustavo, Jéssica Oliveira, Jéssica Oseiroz
Advisors: Professor David Arditi and Karine Ferreira.

Introduction
Assessing the Energy Performance Design (EPD) is a green building certification program that recognizes buildings that conserve energy and resources.

To receive EPD certification, building projects must demonstrate how they achieve different levels of certification. This certification applies to different types of buildings and structures.

Prerequisites
Fundamental Understanding and Verification of Requirements: This section establishes the functional and performance requirements of the various measures and components of the system.

Methodology and Results
Building-Level Energy Performance
Shows to save energy using a step-by-step process. It includes a flowchart and a table showing the data with the USEG.

Obtaining Plan and Information about Alarms
Obtaining information about alarms and the alarm system of Almenar Hall by interrogating the alarm system at all spaces.

Credit 1 Enhanced Guiding
Supports the design, construction, and eventual operation of buildings that are energy efficient, waste, quality, and durability.

Obtaining documents related to the required documents
Almenar Hall has been evaluated based on the required documents (useg 101 out of 101 points).

Prerequisites
Credit 2 Enhanced Guiding

Prerequisites
Requires to reduce the environmental and economic impacts of buildings through the reduction of energy consumption and distribution systems, more efficient and reliable, and reduce greenhouse gas emissions.

Obtaining documents related to the required documents
Almenar Hall has been evaluated based on the required documents (useg 101 out of 101 points).

Credit 4 Reduced Response
Requires taking part in demand response programs and distribution systems more efficient and reliable, and reduce greenhouse gas emissions.

Obtaining documents related to the required documents
Almenar Hall has been evaluated based on the required documents (useg 101 out of 101 points).

Credit 5 Renewable Energy Production
Aims to minimize the environmental impact of energy production and distribution systems, more efficient and reliable, and reduce greenhouse gas emissions. It encourages the use of self-supply of energy.

Obtaining documents related to the required documents
Almenar Hall has been evaluated based on the required documents (useg 101 out of 101 points).

Acknowledgments
The authors would like to thank the team of Almenar Hall (Fig. 1) at Illinois Institute of Technology for their support in the development of the Almenar Hall category of LEED. The building was designed by Ludwig Mies van der Rohe and constructed in 1956.

Figure 1
The Almenar Hall is a modernist building located in Chicago, Illinois, United States.

(ENGR 498.04) Issues in Green Building Design, Construction, & Operation

A NEW APPROACH TO THE PULL FLOW BASED ON A CONTROLLED INVENTORY METHOD

Mathias Gonzalez and Ivan Mutu, ENGR498.05

Research Problem
Based on the statements by the Womack, Jones and Roos (1990) about the lack of mass production, this research aims to propose a new approach to the pull system that allows interconnection of parts that will work with complete, attach different parts to each other.

Methodology
The methodology consists of three main phases: Research, Simulation, and Experimentation. The simulation phase uses a simulation software called "Line & Interconnection.net".

Conclusion
Almenar Hall received LEED-NR 2010 certification in the Energy and Atmosphere category.

Results
As a result of this research and using the interaction between Lean Construction and Building Information Modeling (BIM), a new approach to the pull flow based on the controlled inventory method was proposed to optimize the construction process. The concept applies to the method consists of a plug-and-socket system that allows the connection of parts that will work with complete, attach different parts to each other.

Discussion/Future Work
Within the implementation of the proposed controlled inventory method, it is expected to have a better approach to the assembly of parts, especially the improvements on the attaching of different parts. The simultaneous use of Lean Production activities, as well as the implementation of the proposed improved virtual visualization that reduce the use of paper, the use of mobile devices, and the use of sensors, as well as the use of QR codes, and so on, and the savings caused by the integration of diverse operations (Salent et al., 2006) are also expected. In addition, the authors expect that this programming concept can make it available for testing and implementation.

Acknowledgements
The authors would like to say how helpful IIT Armour College of Engineering was for making this opportunity possible. We also thank the support and motivation of the IIT Armour College CARESNP and the promotion of International Education for making us confident and available to develop this research.

References
Sekiya, K., Baroff, A., Bechtling, S., Gurnich, U., & Pilat, L. (2012). An integrated lean construction and BIM process: implementation and field testing. *Construction Management & Engineering*, 3, 2(1), 19-34.
Sekiya, K., Baroff, A., Steen, B. A., & Owen, R. (2010). Interaction between lean and building information modeling in construction. *Journal of Construction Engineering and Management*, 136(1), 1-10. doi:10.1061/(ASCE)0733-9377(2010)136:1(1)
Womack, J. P., Jones, D. T., & Roos, D. (1990). *Machine Shop on the Floor*. Simon and Schuster.

(ENGR 498.05) A New Approach to the Pull Flow Based on a Controlled Inventory Method

Enhancing Quality Control for Communication in Building Information Modeling Sessions

Gilmara Viana Rosa and Dr. Ivan Mutu, ENGR498.05

Introduction
Informal language, known as "messy talk," in BIM sessions are used to help the actors directly in the communication process. However, due to the flexible, active, and informal artifacts,¹¹ messes, messy talk is by nature informal. In consequence, it is requested to make a formal structure for managing information.

Background
Communication is defined as transmission of information (either oral, written, or electronic) and reception as message.¹² Communication has several important characteristics such as: being a social activity, such as sharing, forming social bonds, helping others, and managing how others perceive us.¹³ Figure 2 illustrates some basic communication purposes.

Methods
In order to get a better visualization of the problem, observations of BIM sessions will be made to verify what is happening during the sessions, and other associated issues to informal language.

Future Work
The next step of our research is to implement this framework to real situations, and to evaluate its effectiveness. Analysis and experiments with user and post sessions are expected.

References
[1] BRUNEAU, S. & NEFF, G. (2011). Messy talk and its role in the communication of professionals in engineering design. In: *Proceedings of the 10th International Conference on Engineering Design (ICED)*, 2011, 89-93. McGraw-Hill, New York.
[2] ADRIAN, P. (2012). *Grouped: How small groups of people are changing the way we live and work*. New York: McGraw-Hill, New York.
[3] SUMMERS, C. C. (2000). *Quality - David Edward*. McGraw-Hill, New York.
[4] BURKEFIELD, D. A. (1994). *Quality Control - Fourth Edition*. Prentice Hall, Inc., New Jersey.

Figure 2 Communication Purposes

Figure 3 The five of informal communication during a BIM session

Figure 4 Alternative representation

(ENGR 498.05) Enhancing Quality Control in Communication with Building Modeling Design

Using UAVs to Monitor Sealing Masonry Quality Inspection

José Roberto Souza and Ivan Mutu, ENGR498.05

The Problem
The sealing masonry is one of the construction activities that presents the highest waste rates of materials. Thus, there is a need to improve the quality control of these environments, which represents a key resource to reduce costs.

Introduction
Seals - When the insulation of an activity meets its planning requirements. In this case, the insulation of the sealing masonry, when properly performed, enables smaller thicknesses of mortar, avoiding the overuse of materials and reducing the cost of the activity, increasing accuracy in the measures of the environment (Sekiya, 2012).
• UAVs can be applied in a huge variety of activities;
• Farmers are using UAVs to take aerial photos of their fields, which costs around \$1,000 an hour (Achenbach, 2014);
• If our masonry is to be performed, the repair will be significantly faster and more accurate than manual maintenance masonry. Moreover, the final cost will be much lower, especially if the repair is not performed (Barcia, 1984);
• The economic magnitude of the construction industry is about 40% of the global economy (Barcia, 1984);
• Construction Industry:
- Construction activities;
- Sealing masonry activity;
- Quality inspection;
- Monitoring;
- Verifying whether an UAV can optimize the sealing masonry quality inspection by reducing the activity time and increasing the efficiency of the current methods;
- Notification;
- Efficient rewards on sealing masonry;
- UAVs have been improving processes & offering economic savings.

Results and Analysis
Cell phone camera experiment (last part of the research's objective).
• Verifying whether it is possible to take measurements with a camera built-in to a cell phone (the same method will be used to verify the quality of the sealing masonry);
• The measures consist of angles and linear distances.
Angle verification
Linear distance verification

Methodology
The Scientific Method as an Ongoing Process
• Doing Research;
• Making Observations;
• Asking Questions;
• Gathering Data;
• Formulating Hypotheses;
• Testing Hypotheses;
• Reaching Conclusions;
• Communicating Results;
• Revising Hypotheses;
• Repeating the Process

References
[1] BAROFF, A. (2012). Agricultural drivers. *Business Week* and *Journal of Business* and *Management*. Retrieved from <http://www.jbm.com.br/2012/06/25/agricultural-drivers/>
[2] BAROFF, A. (2012). *Lean Construction*. *Construction Management & Engineering*, 3, 2(1), 19-34.
[3] BAROFF, A. (2010). *Interaction between lean and building information modeling in construction*. *Journal of Construction Engineering and Management*, 136(1), 1-10. doi:10.1061/(ASCE)0733-9377(2010)136:1(1)
[4] SEKIYA, K. (2010). *Line of site for optimization*. In: *Proc. of the 2010 International Conference on Construction Project Management, Cost Engineering and Quantity Surveying (CPMC)*, 2010, 39-44. McGraw-Hill, New York.

Future Work
• Using UAVs to have significant improvements in jobsite activities.

(ENGR 498.05) UAVs on Construction Sites: Economic & Functional Study to Perform Sealing Masonry Quality Inspection

Posters

UAVs as a Monitor of Brazilian Roadways Conditions after Storm
Matheus Ondio Siqueira and Dr. Ivan Muts, ENGR498.05

DEFINITION
Unmanned aerial vehicles commonly referred to as UAVs are defined as powered aerial vehicles (tailored in flight by aerodynamics) fit over most of their flight path and automated or piloted over manually or partially or full automated bases in the areas of intelligence surveillance and reconnaissance. [1]

SOME WAYS TO MAINTENANCE


MODEL


WHY TO MAINTENANCE
<ul style="list-style-type: none"> • Avoid fuel consumption in recovery [2] • Save of Brazilian industry is transported by roadways [3] • Avoid consumption of fuel in worse routes [3] • Higher than in better routes [3]

FUTURE WORKS
<ul style="list-style-type: none"> • Check the quality of the pictures • Check the position of UAV GPS • Check how much routes it can scan • Check another way to mapping

REFERENCE
<ol style="list-style-type: none"> 1. Matheus, O., 2018. <i>PRACTICAS IMPORTANTE Y BÁSICAS PARA UN MONITOR DE VÍAS CON DRONES</i>. Unpublished Master's Thesis, University of Illinois at Urbana-Champaign, IL, USA. 2. Matheus, O., 2018. <i>Investigación en el uso de imágenes de alta resolución para la inspección de infraestructuras viales</i>. Unpublished Master's Thesis, University of Illinois at Urbana-Champaign, IL, USA. 3. Matheus, O., 2018. <i>Monitoreo de las vías terrestres de Brasil con drones y su impacto en la economía</i>. Unpublished Master's Thesis, University of Illinois at Urbana-Champaign, IL, USA.

(ENGR 498.05) Unmanned Aerial Vehicles as a Monitor of Brazilian Roadways Conditions & Help Keeping the Maintenance

Use of Unmanned Aerial Systems for an Effective Monitoring of PPE Utilization in Trenching or Excavation Activities
Renato HERNANDEZ B. SOARES, Dr. Ivan Muts, ENGR498.05

RESEARCH	METHODS	INFECTED RESULTS
Objectives: UAV Unmanned Aerial System Use: - For surveying - To observe areas of interest or construction activities - To monitorize an environment Dataset: Legacy of PAI - Functional use (trenching/excavation) - Construction sites (sites are not allowed to fly them) - Insurance Market - Weather	Operational Standards: - Inspect your site - Take pictures of workers wearing protective equipment - To make sure workers are wearing protective equipment - Check if workers are wearing protective equipment Physical Requirements: - Military standards - 3 miles radius around project - 30 minutes to fly - Major public events, in the PAN determines use by law - The new law, the decision of the National Congress Quality Standard: - Inspect - Check if it's happening what is happening - Inspect Physical Requirements: - Military standards - Distance from Building, Basement, and Possible Hazards Trenching and Excavation: Excavation: any excavation, trench, or depression in earth surface formed by hand tools, machinery, or explosives Trenching: narrow excavation made below the surface of the ground Scope: - Collapse protection - Exposure to sufficient oxygen - Protection from falling objects - United States of America - Conductive and toxic gases - Protection from electrical and magnetic fields - Fall Protection Trenching Action PTS: - Hardhat - Safety Glasses - Gloves (Leather) - Gloves (Synthetic) - Fall Protection Equipment	INFECTED NUMBER: - Inspect - Inspect - Inspect - Inspect - Inspect - Inspect - Inspect ACKNOWLEDGMENT/INTS: - Acknowledgment of Publishing, Seminar Research Paper - ACKNOWLEDGMENT OF PAPER REFERENCES: https://www.semanticscience.org/index.php?journal=semanticscience&volume=2&issue=1&page=1&id=16

(ENGR 498.05) Use of Unmanned Aerial Systems for an Effective Monitoring of Personal Protective Equipment Utilization in Trenching or Excavation Activities

III Armour College of Engineering ILLINOIS INSTITUTE OF TECHNOLOGY
Julide Demirdöven, PhD, Int'l Assoc. AIA
Amanda Dos Santos Alves
Diane Cremers
Fernanda Calidára Brazil Bozzo Dias
Nivânia Silvati Justino
Roney Fethy Manzane
Wadens Eratigrar Soatto

Abstract:
Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a facility. It is used to support decision making throughout its life cycle from conception onward.
Awards: many awards, the BIM team selected the primary roles creating a BIM team and explored the interoperability of selected tools to operate effectively.
This cross-disciplinary and collaborative process the researchers gained some skills for BIM capabilities of the integrated system and also learned how to use BIM tools and materials and software licenses provided for their research.
The methodology of this research team was focused on the methodology in terms of “learning by doing” in a limited time frame. This methodology allowed the researchers to define the main points and to understand more realistic cases and helped them to learn how different tools and methods integrate with each other.

COLLABORATION WITH BIM: AN EXPERIMENTAL LEARNING CASE
ENGR 498.10: Building Information Modeling in Design, Construction and Operation

Method: Interoperability and Design Integration with BIMs

The figure illustrates categorizes the BIM three ways: a product, a collaboration tool and a lifecycle management requirement.

Experimental Approach: Learning by Doing

The transition from paper-based workflow methods to BIM requires the use of integrated tools to facilitate the exchange of information between software applications.

(ENGR 498.10) Collaboration with BIM: An Experiential Learning Case (Group Poster)

Use of Augmented Reality and Text Based Representations as an Efficient Pedagogical Intervention in Construction Engineering
I. Muts¹ and L. H. Mcle²

Background
The construction industry are getting press for preferring virtual and augmented reality (AR), VR, immersion, with other features in their physical environments. This poster will present the use of AR and text based representations to have a real educational potential intervention in particular for in their ultimate visualization utility.

Methods
The students might in this work see the components of the module, the skills required for the module and the topics covered in the module. In this way, the students will be able to identify the skills they need to develop in order to complete the module. The students will be able to explore topics and problems. The selected elements will be augmented using computer devices. For example we will select structural elements like columns and beams and will use the augmented reality to show them in their real environment. This will help the students to explore topics and problems. The selected elements will be augmented using computer devices. The arrangement of texts and images will be incorporated in the augmented reality. The students will be able to understand described concepts which extend and expand previous learning through more clear learning.

Implementation Framework
The proposed system from Cognitive Theory of Multimedia Learning (Mayer, 2015) has been selected to this research because it is a well-known model for learning. This theory aligns the presentation of concepts in order to reduce the need for the user with complex or overly simplified concepts.

Discussion
The hypotheses tested in this study were to examine the influence in an AR environment to achieve higher efficiency in learning. The results show that there is a significant influence in traditional static picture learning. Thus the hypothesis would have the same efficiency in an augmented reality environment compared with the traditional teaching methods.

(ENGR 498.05) Use of Augmented Reality & Text Based Representations as an Efficient Pedagogical Intervention in Construction Engineering

Multiscale and Multiphysics Modeling of Concrete Durability
Bacavaris, Luis Carvalho, Guilherme Castro, Andrey, Covalevici, Helio, Júnior, Lima, Tânia, Pires, Pinto, Santos, Andrey, Silva, Leonor Souza, Gasp, Trenor, Tânia, Tânia, Superponer, Li, Tengyan Pan

ENGR 498.06: Department of Civil, Architectural and Environmental Engineering, Armour College of Engineering, Illinois Institute of Technology

Introduction
Reinforced concrete is the primary civil engineering material. It is durable to maintain its mechanical and physico-chemical properties of concrete throughout its service life.

Results

Conclusion & Discussion

(ENGR 498.08) Multi-scale & Multi-Physics Modeling of Concrete Durability in Service Conditions

IIIT Armour College of Engineering ILLINOIS INSTITUTE OF TECHNOLOGY
Amrinda Dos Santos Aires
Dr. Julide Demirdöven, Int'l. Assoc. AIA

Abstract:
The uses of BIM in the architectural design process and daylight analysis. An Architect develops area of interest and performs a daylight analysis to discover how efficient BIM can make the design process from conceptual modeling to building a performance.

Introduction

Method: Architectural Design and Daylight Analysis

The figure illustrates the flowchart of the process of design and daylight analysis.

Materials

For the development of this research, we were provided with a variety of courses materials, such as readings, lecture notes, software tutorials and certain software licenses, i.e. for construction and analysis studies. Software license was provided.

Activities

During our time together, we developed a number of interesting activities. My favorite one was “Tug-of-war” at the Turquoise Restaurant.

(ENGR 498.10) Collaboration with BIM: An Experiential Learning Case



ILLINOIS INSTITUTE OF TECHNOLOGY

Gimma Crescente Verissimo Santos

Dr. Juile Demirdoven, Int'l. Assoc. AIA

Abstract

The collaborative nature of BIM allows for instant status detection between design layers. Design reviews and 3D model coordination required by interoperable tools in 1-month, with the team members help stakeholders to reduce wastes and inefficiency during construction.

Introduction

How Process
Materials
Task: 3D Model Coordination and Clash Detection
Tools: AutoCAD Revit and Microsoft Project

Materials and Management Plan
Materials
Management Plan

Materials

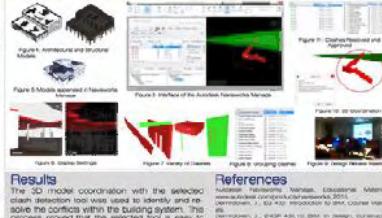
For the development of this research we were provided with a variety of course materials, such as readings, videos and class meetings. For instance, during the first year of my studies Autodesk Revit and AutoCAD were used in the ESD class.

Activities
During our time together we developed a couple of interesting activities. My favorite was the BIM Collaboration Workshop in the ESD, Inc.

Figure 1 BIM Collaboration Workshop in design studio

**COLLABORATION WITH BIM:
AN EXPERIENTIAL LEARNING CASE**

ENGR 498.10: Building Information Modeling in Design, Construction and Operation

Methods: 3D Model Coordination and Clash Detection**Results**

The 3D model coordination with the selected clash detection tool was used to identify and resolve conflicts between components in the building design process. This tool helped to identify which selected tool is easy to use and early clash detection avoids change orders from clients directly in the schedule and budget of the project.

Future Works

My project created an understanding for collaboration and future opportunities arose. During the workshop, I developed my skills in using the theoretical and practical knowledge available on my experience in the workshop held by ESD+DCVS.

Acknowledgements**Abstract**

Design, analysis, and collaborate more accurately with structural engineering tools related to Building Information Modeling (BIM) to provide stability, quality and strength for the structure.

Introduction
How Structure Create
Task: Structural Design and Analysis
Tools: Autodesk Revit and AutoCAD
Materials and Management Plan

Materials

For the development of this research we were provided with a variety of materials, such as readings, software tutorials and certain software licenses. For Structural Design and Analysis Autodesk license was provided.

Activities

During our time together we developed a couple of interesting activities. My favorite one was the ESD Concert.

**COLLABORATION WITH BIM:
AN EXPERIENTIAL LEARNING CASE**

ENGR 498.10: Building Information Modeling in Design, Construction and Operation

Methods: Structural Design and Analysis**Results**

The results found in the research relate to the structural engineer were better productivity, coordination and consistency of design. In addition, improved visualization and simulation of engineering situations.

Future Works

This research has given great opportunity to improve knowledge related to different areas of Civil Engineering and Architecture focused on Building Information Modeling which certainly a future process that most companies will adopt, especially in Brazil [4].

Acknowledgements**(ENGR 498.10) Collaboration with BIM: An Experiential Learning Case**

ILLINOIS INSTITUTE OF TECHNOLOGY

Wadham Engring Baccatin

Dr. Juile Demirdoven, Int'l. Assoc. AIA

Abstract
BIM is a powerful approach for energy use documentation and design review. An Energy Modeler interactively tests, analyzes and seeks for opportunities to improve the building performance, creating prescriptive strategies using intelligent 3D model.

Introduction
How Energy Efficient
Task: Autodesk Revit and Green Building Studio
Materials and Management Plan

Materials

For the development of this research we were provided with a variety of materials, such as readings, videos and class meetings.

Activities

During our time together we developed a couple of interesting activities. My favorite one was the Concert at the Millennium Park.

**COLLABORATION WITH BIM:
AN EXPERIENTIAL LEARNING CASE**

ENGR 498.10: Building Information Modeling in Design, Construction and Operation

Methods for Energy Modeling**Results**

The results found in this research are that building can be improved to increase energy efficiency and cost savings. Our office building saved almost 30% in energy usage. These numbers represent \$18 million savings in a period of 5 years.

Future Works

"The knowledge learned in this research is very important to Brazil and I believe this appearing so improve the energy efficiency of new buildings in an affordable way." - W.E. D.

Acknowledgements**(ENGR 498.10) Collaboration with BIM: An Experiential Learning Case**

ILLINOIS INSTITUTE OF TECHNOLOGY

Fernando Colodira Brant Barreto Dias

Dr. Juile Demirdoven, Int'l. Assoc. AIA

Abstract

BIM is a powerful process to perform different types of analysis during building design, construction, and operation. One of the key benefits of BIM is that it can reduce the cost of project by bringing the 3D model which is used for BIM modeling (3D+time+cost information).

Introduction

How Cost Estimator
Task: Cost Estimating and Analysis
Tools: Autodesk Revit and Microsoft Project

Materials

For the development of this research we were provided with a variety of materials, such as readings, videos and class meetings. For instance, during the first year of my studies Microsoft Project and Revit were used.

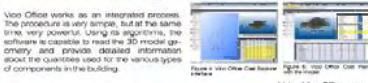
Activities

During our time together we developed a couple of interesting activities. My favorite one was the ESD+DCVS.

Figure 1 Microsoft Project

**COLLABORATION WITH BIM:
AN EXPERIENTIAL LEARNING CASE**

ENGR 498.10: Building Information Modeling in Design, Construction and Operation

Methods: Cost Estimating and Analysis**Results**

Upon Office works as an integrated process. The procedure is very simple, but at the same time very powerful. Using this algorithm, the software is capable to reduce the 3D model generated by the project, displaying the costs of each component used for the various types of components in the building.

Activities

During our time together we developed a couple of interesting activities. My favorite one was the ESD+DCVS.

Figure 2 Revit Microsoft Project

Using Microsoft Project, video lectures, training data for data and accurate scheduling of tasks and planning reports, have a better production control, reduce risks and develop healthier relationships. What leads to better chances to win business.

Figure 3 Microsoft Project

Figure 4 Cost Estimating and Analysis via Office Cost Estimator

Figure 5 Cost Estimating and Analysis via Office Cost Estimator

Cost Estimating and Analysis via Office Cost Estimator

Using Microsoft Project, video lectures, training data for data and accurate scheduling of tasks and planning reports, have a better production control, reduce risks and develop healthier relationships. What leads to better chances to win business.

Figure 6 Cost Estimating and Analysis via Office Cost Estimator

Figure 7 Cost Estimating and Analysis via Office Cost Estimator

Figure 8 Cost Estimating and Analysis via Office Cost Estimator

Figure 9 Cost Estimating and Analysis via Office Cost Estimator

Figure 10 Cost Estimating and Analysis via Office Cost Estimator

Figure 11 Cost Estimating and Analysis via Office Cost Estimator

Figure 12 Cost Estimating and Analysis via Office Cost Estimator

Figure 13 Cost Estimating and Analysis via Office Cost Estimator

Figure 14 Cost Estimating and Analysis via Office Cost Estimator

Figure 15 Cost Estimating and Analysis via Office Cost Estimator

Figure 16 Cost Estimating and Analysis via Office Cost Estimator

Figure 17 Cost Estimating and Analysis via Office Cost Estimator

Figure 18 Cost Estimating and Analysis via Office Cost Estimator

Figure 19 Cost Estimating and Analysis via Office Cost Estimator

Figure 20 Cost Estimating and Analysis via Office Cost Estimator

Figure 21 Cost Estimating and Analysis via Office Cost Estimator

Figure 22 Cost Estimating and Analysis via Office Cost Estimator

Figure 23 Cost Estimating and Analysis via Office Cost Estimator

Figure 24 Cost Estimating and Analysis via Office Cost Estimator

Figure 25 Cost Estimating and Analysis via Office Cost Estimator

Figure 26 Cost Estimating and Analysis via Office Cost Estimator

Figure 27 Cost Estimating and Analysis via Office Cost Estimator

Figure 28 Cost Estimating and Analysis via Office Cost Estimator

Figure 29 Cost Estimating and Analysis via Office Cost Estimator

Figure 30 Cost Estimating and Analysis via Office Cost Estimator

Figure 31 Cost Estimating and Analysis via Office Cost Estimator

Figure 32 Cost Estimating and Analysis via Office Cost Estimator

Figure 33 Cost Estimating and Analysis via Office Cost Estimator

Figure 34 Cost Estimating and Analysis via Office Cost Estimator

Figure 35 Cost Estimating and Analysis via Office Cost Estimator

Figure 36 Cost Estimating and Analysis via Office Cost Estimator

Figure 37 Cost Estimating and Analysis via Office Cost Estimator

Figure 38 Cost Estimating and Analysis via Office Cost Estimator

Figure 39 Cost Estimating and Analysis via Office Cost Estimator

Figure 40 Cost Estimating and Analysis via Office Cost Estimator

Figure 41 Cost Estimating and Analysis via Office Cost Estimator

Figure 42 Cost Estimating and Analysis via Office Cost Estimator

Figure 43 Cost Estimating and Analysis via Office Cost Estimator

Figure 44 Cost Estimating and Analysis via Office Cost Estimator

Figure 45 Cost Estimating and Analysis via Office Cost Estimator

Figure 46 Cost Estimating and Analysis via Office Cost Estimator

Figure 47 Cost Estimating and Analysis via Office Cost Estimator

Figure 48 Cost Estimating and Analysis via Office Cost Estimator

Figure 49 Cost Estimating and Analysis via Office Cost Estimator

Figure 50 Cost Estimating and Analysis via Office Cost Estimator

Figure 51 Cost Estimating and Analysis via Office Cost Estimator

Figure 52 Cost Estimating and Analysis via Office Cost Estimator

Figure 53 Cost Estimating and Analysis via Office Cost Estimator

Figure 54 Cost Estimating and Analysis via Office Cost Estimator

Figure 55 Cost Estimating and Analysis via Office Cost Estimator

Figure 56 Cost Estimating and Analysis via Office Cost Estimator

Figure 57 Cost Estimating and Analysis via Office Cost Estimator

Figure 58 Cost Estimating and Analysis via Office Cost Estimator

Figure 59 Cost Estimating and Analysis via Office Cost Estimator

Figure 60 Cost Estimating and Analysis via Office Cost Estimator

Figure 61 Cost Estimating and Analysis via Office Cost Estimator

Figure 62 Cost Estimating and Analysis via Office Cost Estimator

Figure 63 Cost Estimating and Analysis via Office Cost Estimator

Figure 64 Cost Estimating and Analysis via Office Cost Estimator

Figure 65 Cost Estimating and Analysis via Office Cost Estimator

Figure 66 Cost Estimating and Analysis via Office Cost Estimator

Figure 67 Cost Estimating and Analysis via Office Cost Estimator

Figure 68 Cost Estimating and Analysis via Office Cost Estimator

Figure 69 Cost Estimating and Analysis via Office Cost Estimator

Figure 70 Cost Estimating and Analysis via Office Cost Estimator

Figure 71 Cost Estimating and Analysis via Office Cost Estimator

Figure 72 Cost Estimating and Analysis via Office Cost Estimator

Figure 73 Cost Estimating and Analysis via Office Cost Estimator

Figure 74 Cost Estimating and Analysis via Office Cost Estimator

Figure 75 Cost Estimating and Analysis via Office Cost Estimator

Figure 76 Cost Estimating and Analysis via Office Cost Estimator

Figure 77 Cost Estimating and Analysis via Office Cost Estimator

Figure 78 Cost Estimating and Analysis via Office Cost Estimator

Figure 79 Cost Estimating and Analysis via Office Cost Estimator

Figure 80 Cost Estimating and Analysis via Office Cost Estimator

Figure 81 Cost Estimating and Analysis via Office Cost Estimator

Figure 82 Cost Estimating and Analysis via Office Cost Estimator

Figure 83 Cost Estimating and Analysis via Office Cost Estimator

Figure 84 Cost Estimating and Analysis via Office Cost Estimator

Figure 85 Cost Estimating and Analysis via Office Cost Estimator

Figure 86 Cost Estimating and Analysis via Office Cost Estimator

Figure 87 Cost Estimating and Analysis via Office Cost Estimator

Figure 88 Cost Estimating and Analysis via Office Cost Estimator

Figure 89 Cost Estimating and Analysis via Office Cost Estimator

Figure 90 Cost Estimating and Analysis via Office Cost Estimator

Figure 91 Cost Estimating and Analysis via Office Cost Estimator

Figure 92 Cost Estimating and Analysis via Office Cost Estimator

Figure 93 Cost Estimating and Analysis via Office Cost Estimator

Figure 94 Cost Estimating and Analysis via Office Cost Estimator

Figure 95 Cost Estimating and Analysis via Office Cost Estimator

Figure 96 Cost Estimating and Analysis via Office Cost Estimator

Figure 97 Cost Estimating and Analysis via Office Cost Estimator

Figure 98 Cost Estimating and Analysis via Office Cost Estimator

Figure 99 Cost Estimating and Analysis via Office Cost Estimator

Figure 100 Cost Estimating and Analysis via Office Cost Estimator

Figure 101 Cost Estimating and Analysis via Office Cost Estimator

Figure 102 Cost Estimating and Analysis via Office Cost Estimator

Figure 103 Cost Estimating and Analysis via Office Cost Estimator

Figure 104 Cost Estimating and Analysis via Office Cost Estimator

Figure 105 Cost Estimating and Analysis via Office Cost Estimator

Figure 106 Cost Estimating and Analysis via Office Cost Estimator

Figure 107 Cost Estimating and Analysis via Office Cost Estimator

Figure 108 Cost Estimating and Analysis via Office Cost Estimator

Figure 109 Cost Estimating and Analysis via Office Cost Estimator

Figure 110 Cost Estimating and Analysis via Office Cost Estimator

Figure 111 Cost Estimating and Analysis via Office Cost Estimator

Figure 112 Cost Estimating and Analysis via Office Cost Estimator

Figure 113 Cost Estimating and Analysis via Office Cost Estimator

Figure 114 Cost Estimating and Analysis via Office Cost Estimator

Figure 115 Cost Estimating and Analysis via Office Cost Estimator

Figure 116 Cost Estimating and Analysis via Office Cost Estimator

Figure 117 Cost Estimating and Analysis via Office Cost Estimator

Figure 118 Cost Estimating and Analysis via Office Cost Estimator

Figure 119 Cost Estimating and Analysis via Office Cost Estimator

Figure 120 Cost Estimating and Analysis via Office Cost Estimator

Figure 121 Cost Estimating and Analysis via Office Cost Estimator

Figure 122 Cost Estimating and Analysis via Office Cost Estimator

Figure 123 Cost Estimating and Analysis via Office Cost Estimator

Figure 124 Cost Estimating and Analysis via Office Cost Estimator

Figure 125 Cost Estimating and Analysis via Office Cost Estimator

Figure 126 Cost Estimating and Analysis via Office Cost Estimator

Figure 127 Cost Estimating and Analysis via Office Cost Estimator

Figure 128 Cost Estimating and Analysis via Office Cost Estimator

Figure 129 Cost Estimating and Analysis via Office Cost Estimator

Figure 130 Cost Estimating and Analysis via Office Cost Estimator

Figure 131 Cost Estimating and Analysis via Office Cost Estimator

Figure 132 Cost Estimating and Analysis via Office Cost Estimator

Figure 133 Cost Estimating and Analysis via Office Cost Estimator

Figure 134 Cost Estimating and Analysis via Office Cost Estimator

Figure 135 Cost Estimating and Analysis via Office Cost Estimator

Figure 136 Cost Estimating and Analysis via Office Cost Estimator

Figure 137 Cost Estimating and Analysis via Office Cost Estimator

Figure 138 Cost Estimating and Analysis via Office Cost Estimator

Figure 139 Cost Estimating and Analysis via Office Cost Estimator

Figure 140 Cost Estimating and Analysis via Office Cost Estimator

Posters

NEW TECHNOLOGIES FOR EFFICIENT DESIGN AND CONSTRUCTION OF EMERGENCY SHELTERS

Students: Lucas Maia, Rafael Miranda, Ualan Nogueira; Instructor: Mehdi Modaresi, DNGR499.04

Introduction

Emergency shelters are used worldwide for accommodate different types of relief operations. Emergency shelters are mainly made up of fabrics or other common materials without any framing system. Moreover, these structures are usually open to the occupants from outdoors events (e.g. fire, heat).

Structural Design

The integrated concept design explained is schematically depicted. Moreover, the detail of the composite panel is shown.

Discussion-Future Work

Upon successive development and manufacturing of the design techniques, a new generation of emergency shelter will be available for the use of people around the world. Moreover, the cost analysis performs shows the economic viability of the design specifically if it is constructed in higher numbers.

The Future Outlook of this project:

- Reduces a larger initial costs and save
- Further designs the connection details
- Develops the light weight cost to price structure
- Increases the durability of the design as a holistic structural design

Acknowledgements

The authors acknowledge Brazil's Conselho de Desenvolvimento Científico e Tecnológico (CNPq) and the Brazilian Science Mobility Program (BMP) for funding this research.

References

1. Brazilian Institute of Geography and Statistics (IBGE). *Demographic and Social Indicators*. IBGE, 2012.
2. Brazilian Ministry of Health. *Ministry of Health National Health Policy (MNH)*. Brasília, 2009.
3. Brazilian Ministry of Health. *Ministry of Health National Health Policy (MNH)*. Brasília, 2009.
4. Brazilian Ministry of Health. *Ministry of Health National Health Policy (MNH)*. Brasília, 2009.
5. U.S. Code website. <http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfazdo/ResourceList.cfm?CategoryID=1>

(ENGR 499.04) New Technologies for Efficient Design & Construction of Emergency Shelters

Development of an importance category factor for temporary structures subject to seismic and wind loads

Authors: D'Anco, Eduardo de Faria, Igor Silva, Pedro Peranho, Uiana Medino and Vitor Tresoli Dr. Jamshid Mohammadi, ENGR 499.05

Introduction

Temporary structures are defined as all those structures, which have functions to provide temporary facilities to the construction process for short periods of time. These structures are usually removed less than one year. However, there are many kinds of temporary structures, for instance: mag, tents, containers, steel structures, concrete structures, scaffolding, etc.

Examples of Temporary Structures

- Scaffolding
- Tools
- Shelter
- Sheds
- Electrical

Objective

Developing an importance category for temporary structures similar to those in permanent structures.

Provide guidelines for determining design loads and wind loads of temporary structures based on their previous usage history and importance category

Background

The research was based in existing permanent structures classifications and some municipalities building codes.

What we did so far

For the classification is important considerate different factor that could influence in the structures classification, such as:

- Occupancy Factor
- Periodic Factor
- Seismic Factor
- Wind Factor
- Human Use

Why is important?

The main idea of this research would be possible consider these factor and they would interfere in the structures classification.

Expected Contributions

The results from this research and the expert generated guidelines will be implemented by contractors and fabricators of temporary structures to have a more reliable method for estimating the design loads based on the importance category. This classification will indicate the severity each loads as a whole methodology to be considered for design of these special structures.

References

AIAA - American Society of Civil Engineers
CSRA - Occupational Safety and Health Administration
NYC Building Code
IRC - International Building Code

Acknowledgements

BMP - Brazilian Scientific Mobility Program
CNPq - Conselho Nacional de Desenvolvimento Científico e Tecnológico

(ENGR 499.05) Development of Importance Category Factor for Temporary Structures Subject to Seismic & Wind Loads

Importance category for temporary structures

Author: M. da Costa, Instituto Federal de São Paulo, José Alencar, Luciano Daniel S. de Oliveira, Meirão P. Soárez
Instructor: Jamshid Mohammadi, ENGR499.05

Objective of the study

Description of an importance category factor for temporary structures applied to civil and related works.

Why is it important?

Temporary structures are widely used in the construction industry. They are rapidly deployed in a short period of time. In addition, they are used in the construction of large-scale projects, such as dams, roads, airports, ports, industrial plants, among others. These structures may compromise the safety of these projects.

Design Guidelines for temporary structures

Temporary structures are temporary structures that are designed to serve specific purposes. They are rapidly deployed in a short period of time. In addition, they are used in the construction of large-scale projects, such as dams, roads, airports, ports, industrial plants, among others. These structures may compromise the safety of these projects.

Background and review of literature

In temporary structures, there are three main areas of research: design, safety and serviceability. They are closely related and must be considered in the design of structures for temporary structures.

Conclusion

It is important to consider the importance of the temporary building systems, Emergency medical applications, Design issues, Seismic and Wind load resistance, and the use of appropriate materials for temporary structures.

References

AIAA - American Society of Civil Engineers
CSRA - Occupational Safety and Health Administration
NYC Building Code
IRC - International Building Code

Acknowledgements

The authors acknowledge Instituto Federal de São Paulo, Luciano Daniel S. de Oliveira, Meirão P. Soárez and José Alencar.

(ENGR 499.05) Development of Importance Category Factor for Temporary Structures Subject to Seismic & Wind Loads

Fundamentals of Collaborative Design Process and Lean Methodology

Student: Felipe Moreira Silva Instructor: Amber Autumn, ATR498.11

Green Ribbon Foundation

We are Green Ribbon Foundation is a newly forming non-profit organization that is the newest leader in the field of green building. We strive to teach, initiate and act sustainability.

Green School Project

What we do: Green Ribbon Foundation is a newly forming non-profit organization that is the newest leader in the field of green building. We strive to teach, initiate and act sustainability.

Summit Jobsite Visit

On the fourth week, from June 25th to June 26th We experienced an exciting job site tour where we the students learned about the various phases of the building construction sites and keep in touch with the jobsite daily activities.

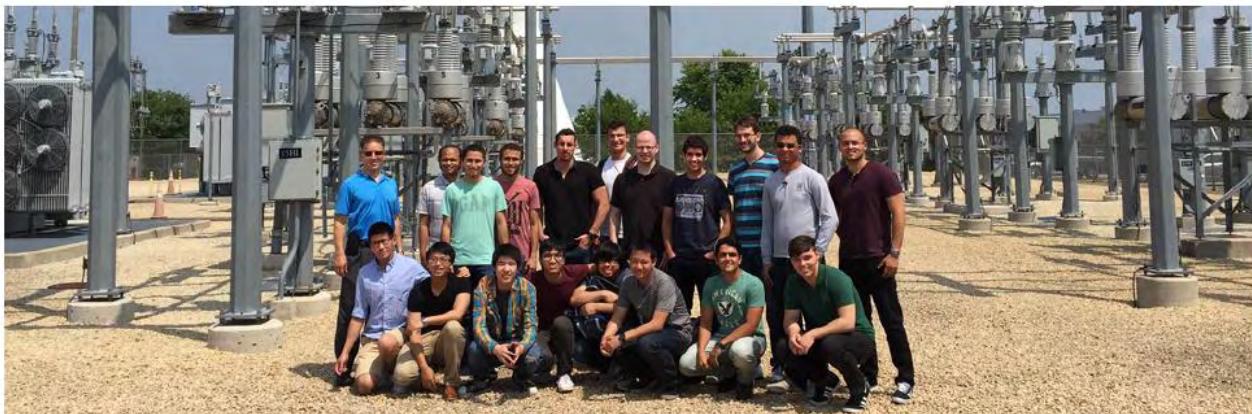
Method Soap Factory Visit

What is the goal? The main purpose of the project is to teach students how to solve real world problems that require global and local resources. Besides being environmentally sustainable and having a positive impact on the community, the project is also educational, since nature gives you opportunities to learn through observation and problem solving. The students will learn how to work together and collaborate to solve problems. They integrate the environment with learning and become a valuable tool that helps bring new interest to the students.

What to teach? The main purpose of the project is to teach students how to solve real world problems that require global and local resources. Besides being environmentally sustainable and having a positive impact on the community, the project is also educational, since nature gives you opportunities to learn through observation and problem solving. The students will learn how to work together and collaborate to solve problems. They integrate the environment with learning and become a valuable tool that helps bring new interest to the students.

Where? The fitness class concept is based on outdoor classes that stimulate and improve the students' health. The students will be exposed to the outdoors to promote classes that are healthy, fresh and sustainable by using the natural elements of the surrounding area.

(ATR 498.11) Fundamentals of Collaborative Design Process & Lean Methodology



Energy, Water, Transportation, & Sustainability

Transport of Heat and Moisture in Building Materials
Caio Potenza Sampaio and Dr. Paul Anderson ENGR498.CI

Background	Methods	Future Work
<p>My case study for applying the Finite Element Methods (FEM) to coupled heat and moisture transport processes in building materials (version 3.0.2, Mathworks Research, 2014) is based on the paper "An analytical method to calculate the coupled heat and moisture transfer in building materials" by Qin et al. (2008).</p> <p>This importance of these studies can be seen in the thermal performance of the building envelope. Excessive heat transfer can lead to an over-use of heating, cooling, and insulation. On the other hand, if there is no addition, high moisture levels can result in microbial growth, causing delamination and respiratory complaints.</p> <p>A better understanding of these coupled process may help us to reduce energy consumption and costs we will face over its lifetime, leading to a better choice of material and a better designed HVAC which will decrease the cost of energy and maintenance and also health problems.</p>	<p>The analysis is governed by two equations, and the system has four boundary conditions:</p> $\frac{\partial T}{\partial x} = \frac{\partial^2 T}{\partial x^2} + \rho C_p \left(\frac{\partial \theta}{\partial x} + \frac{\partial \psi}{\partial x} \right)$ $-\lambda \frac{\partial \theta}{\partial x} = D_w \frac{\partial^2 \theta}{\partial x^2} + D_s \frac{\partial^2 \psi}{\partial x^2}$ $\frac{\partial \psi}{\partial x} \Big _{x=0} = \alpha_1(T(x=0)) - \alpha_2(T(x=L)) - \alpha_3(\theta(x=0)) - \alpha_4(\psi(x=0))$ $-\frac{1}{\lambda} \frac{\partial \theta}{\partial x} \Big _{x=0} = \alpha_2(T(x=0)) - \alpha_3(\theta(x=0)) - \alpha_4(\psi(x=0))$ $\theta(x=L) = \theta_0$ $\frac{\partial \psi}{\partial x} \Big _{x=L} = \alpha_2(T(x=L)) - \alpha_3(\theta(x=L)) - \alpha_4(\psi(x=L))$	<p>As shown in my results, the equations are not quite right in the Mathematica's language, I still need to work on them, and then I can run the FEM. This project can generate a Mathematica file for me.</p> <p>I will now write the equation of the analytical solution given by Qin et al. (2008) and reproduce the graph of moisture and temperature transfer to better compare it with mine.</p>
Results...so far		
<p>Math generated in Mathematica</p> <p>NSolve command:</p> <pre>NSolve[θ == θ0, {T, θ, ψ}, {x, 0, L}, {t, 200, 400}]</pre> <p>Plot generated in Mathematica</p>		

(ENGR 498.01) Applying Finite Element Methods for Coupled Heat & Moisture Transport Processes in Porous Materials

Carbon Isotope Fractionation during Diffusion and Biodegradation of Petroleum Hydrocarbons in the Unsaturated Zone
Marcus Luan Rosa Freixa, Dr. Paul Anderson ENGR498.MJ

Background	Results
<p>The article talks about a natural attenuation process that could be used to manage contamination of a petroleum hydrocarbon source site.</p> <p>Contamination process is an important environmental problem, it is bounded to soil and groundwater, and the rate of diffusion.</p> <p>The author describes the need to demonstrate the utility of natural attenuation.</p> <p>It is important to demonstrate that hydrocarbon degradation is actually occurring at the site.</p>	<p>Figure demonstrating by Biodegradation Figure demonstrating by Diffusion Figure demonstrating by Diffusion Figure demonstrating by Biodegradation Figure demonstrating by Biodegradation Figure demonstrating by Biodegradation Figure demonstrating by Biodegradation</p>
References	

(ENGR 498.01) Carbon Isotope Fractionation During Diffusion & Biodegradation of Petroleum Hydrocarbons in Unsaturated Zone: Field Experiment & Modeling Using Finite Element Methods

FINITE ELEMENT METHOD APPLIED TO THE FATE AND TRANSPORT OF PETROLEUM HYDROCARBONS IN THE LOWER MISSISSIPPI RIVER DELTA
Hian Cisman de Medeiros Costa, Paul Anderson, ENGR498.DI

Background	Approach	Future Work
<p>The developed fossil fuel market requirement in the market, will move the oil companies to more tank trucks transporting oil from offshore to areas inland. However, many oil spills occur because of oil releases on the rivers, which can have huge environmental impacts.</p>	<p>The fate and transport of oil can be described using the Navier-Stokes equations, as a result, the flow can be simulated using the finite element method. In this poster, I will present the simulation process to simulate the fate and transport simulation more precise spreading, evaporation, re-liftation and oil-in-magnets.</p>	<p>Solve the Navier-Stokes equation on the mesh of a fragment of Mississippi River. Then, add the particle-tracking module to simulate the fate and transport of oil droplets and the interaction of oil with magnet.</p>
Acknowledgments		
References		

(ENGR 498.01) Finite Element Method Applied to the Fate & Transport of Petroleum Hydrocarbons in the Lower Mississippi River Delta

Finite Element Methods for Environmental Transport Process Wastewater Treatment Modeling: Heavy Metals Removal and Reagent Particle Size Effects
Dieley Celentino da Costa, Dr. Paul Anderson ENGR498.01

Background	Methodology and Results	Future Work
<p>Heavy metal pollution has caused in several rivers around the world, mainly in mines and industrial sites [1]. High concentrations of cadmium and zinc are an environmental threat to the environment. Zinc removal, using conventional precipitation methods, is a difficult alternative, requiring a passive remediation process.</p> <p>After the remediation process, the pH higher and the metals precipitated and removed from the wastewater. To remove the heavy metals, three methods were used. The first column containing 250 g of aqua vitae, the second column containing 20% of MgO, and the third column containing the small size zinc sludge. Specific surface area of the MgO particles are the key factors that influence the performance of the fine-grained columns.</p>	<p>Mathematical model was used to model the changing of MgO concentration in the aqueous solution. There were different transport process occurring in the columns, such as advection, dispersion, convection, and reactions.</p> <p>The diffusion and transport of metals was described on Mathematica software.</p> <p>In the FEM the diffusion coefficient (D) was simulated 100 times higher in both columns to obtain the graphs.</p>	<p>Figure showing results from Bottling et al. (left) to the REM results (right)</p>
References		

(ENGR 498.01) Finite Element Method for Environmental Transport Process

Posters

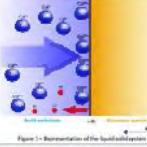
Finite Element Methods for Environmental Transport Processes Cadmium Biosorption Rate in Protonated Sargassum Biomass

III Armour College of Engineering
ILLINOIS INSTITUTE OF TECHNOLOGY

Olivio Foresto da Silva Cardozo
Dr. Paul Anderson, ENGR498.01

Introduction

A brown alga called Sargassum is very effective at removing heavy metals from aqueous waste because it has a high capacity to adsorb metals. It is a fast growing species in the wet-cell, where it is concentrated in a gel form with characteristics including high porosity and high permeability to small ions species. It is used to treat the residual effluents of oil and gas plants for removal of cadmium is wastewater due to its high sorption capacity, easy regeneration, and cost-effectiveness [1].



Methods and Results

The Finite Element Method (FEM) is a numerical method used to solve partial differential equations. It creates subdivisions within the problem region, or finite elements, to approximate the solution. The FEM can be used in Mathematics [2] and Physics [3] to solve the mass balance equations (below) and obtain profiles for the cadmium uptake and the concentrations in the biomass adsorbent and in the bulk solution.

$$\frac{\partial C}{\partial t} + \frac{\partial}{\partial x} = D_s \frac{\partial^2 C}{\partial x^2} \quad (1)$$

$$\frac{\partial C}{\partial t} = -D_s \frac{\partial C}{\partial x} \quad (2)$$

$$C_{bulk} = C_0 \quad (3)$$

$$C_t = C_0 \quad (4)$$

$$\frac{dC}{dx} = 0 \quad (x = 0, r > 0) \quad (5)$$

$$C_0 = C_{bulk} \quad (r = 0) \quad (6)$$

$$C_t = C_0 \quad (r = R, r > 0) \quad (7)$$

- C = uptake of metal in the biomass
- x = position coordinate in the biomass particle
- C_0 = initial concentration in the biomass
- r = radius of the biomass
- D_s = effective interparticle diffusion coefficient
- t = time of bulk solution
- R = total surface area of particles
- θ = half-thickness of the biomass

Figure 1: Representation of the simulation domain.

Discussion / Future Work

Initially, the FEM must be modified so a non-dimensional variable is represented as a limit, although to make it a lot more challenging, the method will also be applied to a two-dimensional system.



Figure 2: A 2D finite element mesh with boundary conditions T1, T2, and T3.

References

[1] Song, Jihua, and Behzad Vafaei. "Cadmium Biosorption Kinetics by Protonated Sargassum biomass." *Environmental Pollution* 113 (2006): 719-725.

[2] Liu, Lulu, and David George Flath. *Finite Element Method for Partial Differential Equations*. Wiley-Interscience, Inc., Mathematica, Version 10.1, Champaign, IL (2013).

[3] Wolfram Research, Inc. Mathematica, Version 10.1, Champaign, IL (2013).

Acknowledgments

The author acknowledges Dr. Paul Anderson for his guidance and support throughout the project. The Illinois Institute of Technology, the author would also like to thank Armour College of Engineering for supporting the graduate research program. The author also thanks the Illinois Institute of Technology for funding his scholarship.

(ENGR 498.01) Finite Element Method for Environmental Transport Processes Case Study: Cadmium Biosorption Rate in Protonated Sargassum Biomass

To be, or not to be: that is the question: to take arms against a sea of troubles

Ananda de G. Antunes and Dr. Paul Anderson, ENGR498.01

Introduction

Great Lakes beaches provide a variety of recreational opportunities for people each year. High levels of beach bacteria, particularly *Escherichia coli*, are a potential human health risk.

A finite element model (FEM) can improve our understanding of local bacteria and impacts.

Methods and Results

Figure 1: FEM simulation of Lake Michigan showing the infection and the near-shore area of Lake Michigan.

The equation 1-3 describe the advection-diffusion-reaction equation of bacteria and the concentration of bacteria and the concentration of water.

$$\frac{\partial C}{\partial t} + U_x \frac{\partial C}{\partial x} + U_y \frac{\partial C}{\partial y} + D \frac{\partial^2 C}{\partial x^2} + D \frac{\partial^2 C}{\partial y^2} - R(C) = 0 \quad (1)$$

$$U_x = 0.01 \text{ m/s} \quad (2)$$

$$U_y = 0.01 \text{ m/s} \quad (3)$$

Future work

Depending on the time, the FEM will be used to evaluate the transport of temperature in the near-shore of Lake Michigan.

References

[1] Liu, Lulu, and David George Flath. *Finite Element Method for Partial Differential Equations*. Wiley-Interscience, Inc., Mathematica, Version 10.1, Champaign, IL (2013).

[2] Software Mathematica, version 10.1, Champaign, IL (2013).

Acknowledgements

I am grateful to Dr. Paul Anderson for his guidance and support throughout the project. I am also grateful to my advisor, Dr. Paul Anderson, for his support and encouragement.

(ENGR 498.01) Finite Element Method: Modeling the Transport & Inactivation of E. coli in the Near-shore Region of Lake Michigan

Remediation of Groundwater Contaminated with Cu²⁺ by Waste Foundry Sand Permeable Barrier

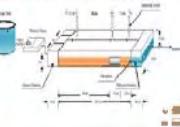
Maria Fernanda C. Gonzaga and Dr. Paul Anderson, ENGR498.01

INTRODUCTION

The presence of contaminated groundwater is among the most difficult challenges faced by society. This is often the primary factor limiting closure of contaminated sites. In addition, there is a need to develop new remediation technologies to remove the contaminants. Remediation with heavy metals, however, has some limitations. One viable option is the use of permeable reactive barriers (PRBs). The focus of this research is to investigate the potential effectiveness of waste foundry sand as a permeable reactive barrier (PRB) for the removal of copper (Cu²⁺) from the contaminated groundwater.

MATERIALS AND METHODS

Finite difference analysis (FDA) is the tool used for the numerical simulation of the contaminant transport process. The accurate prediction of the 2D migration of copper ions (Cu^{2+}) and simulated the subsurface aquifer and PRB barrier under saturated condition for the equilibrium case.



RESULTS

2D FEM DESIGN-MODEL SETUP

$$D_x = \frac{\partial^2 C_{Cu}}{\partial x^2} + D_y \frac{\partial^2 C_{Cu}}{\partial y^2} - V_z \frac{\partial C_{Cu}}{\partial z} = R_{Cu} \quad (1)$$

$$R = 1 + \frac{C_{Cu}}{K_{d,Cu}} \quad (2)$$

$$D_L = 7.51 \text{ m} \times 0.282 \text{ m} \quad (3)$$

Cu-Diffusion coefficient
Cu: Copper mass concentration in water
Vz: Velocity
D: Permeability of the barrier
D_L: Depth of the WFS

DISCUSSION / FUTURE WORK

BOUNDARY AND INITIAL CONDITIONS

Time	Location	Value
0	Upper boundary	Inflow boundary
0	Lower boundary	Outflow boundary
0	Left boundary	Fixed boundary
0	Right boundary	Advection BC
0	Bottom boundary	Permeation-React
0	Top boundary	Permeation-React

RESULTS

Figure 1: Schematic diagram of the experimental setup showing a flow-through column with various components labeled A through T.

(ENGR 498.01) Simulation of Groundwater Contaminated with Copper Ions Remediated by Waste Foundry Sand Permeable Barrier

Finite Element Method in Heat, Air and Moisture Transport Through Hollow Porous Blocks.

Joao Augusto Silveira Barreto and Dr. Paul Anderson, ENGR498.01

Overview

The study of heat, moisture, and air transport through structures can be used to evaluate indoor air quality, structure endurance, development of heat exchanges, oil extraction and removal, drying processes, and many other applications involving new insulating materials.

Numerical Method and Results

- The finite element method package of Mathematica can be used in the following steps:
 - Defining a region and its initial and boundary conditions (initial temperature or relative humidity).
 - Impact key parameters (e.g. thermal conductivity, density, specific heat, etc.)
 - Solving the system of equations (using NDSolve).
 - Plotting the results for the whole system (including a graph).

Problem Statement

1. Air capacity density: An energy and material balance for the structure.

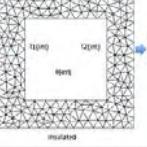


Figure 1: A schematic diagram of a hollow porous block with dimensions 120mm x 120mm x 40mm, with boundary conditions T1, T2, and T3.

Future Works

- For the remaining weeks of research, the researcher will continue the work for the following:
 - Also, repeat the calculations with more materials and an experiment to compare with the analytical solutions.

(ENGR 498.01) Finite Element Method in Heat & Moisture Transport Through Hollow Porous Blocks

Using the Mathematica Finite Element Package to Trace Contaminant Pathways in a Clay Bed

Luisa Mirandinha Mendes, Professor: Dr. Paul Anderson, ENGR498.01

Objectives

The purpose of this project is to better understand the flow environment around clay beds in a paleo-roothole using the finite element method. The project will consist of developing a computer code to simulate contaminant pathways in a clay bed.

FUTURE WORK

- Compute the data found at White et al. (2008).
- Validate the code developed.
- Solve the mathematical model based on the article from Sulsky et al. using the function NDSolve.
- Try to reproduce the results using a triangular mesh.

Background Information

- Contamination of groundwater is a problem of growing importance due to the increasing number of industrial phase liquids (IMPLs) common in industrial byproducts to soil and groundwater.
- Finite Element Method (FEM) is a mathematical approach used to solve groundwater problems. Mathematica is a software that offers efficient solutions to FEM problems.

Background Information

- Clay bed contamination is a serious threat to the environment. The problem is to find the exact location and quantity of organic compounds in the soil.
- To generate the contaminant pathways in the clay bed, we will use a finite element method to generate a new mesh and reproduce the same results using simpler equations.

Figure 1: Clay bed simulation using Mathematica.



Figure 1: Clay bed simulation using Mathematica.

Materials and Methods

White et al. (2008) found a clay bed in the United Kingdom, which operated from 1950 to 1970 and released 8000 tonnes of IMPLs mainly benzene and styrene.

Figure 1: Clay bed simulation using Mathematica.

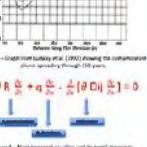


Figure 1: Clay bed simulation using Mathematica.

Acknowledgements

RODRIGUES, P. J. (2008). A control volume finite element approach to simulate contaminant pathways in a clay bed. *Journal of Computational Science*, 9, 2, pp. 209-219.

WHITE, A. J., SULSKY, D. J., and HALL, J. (2008). A finite element model of contaminant pathways in a paleo-roothole. *Computational Geosciences*, 12, 4, pp. 561-574.

WHITE, A. J., SULSKY, D. J., and HALL, J. (2008). The use of finite element methods to predict contaminant pathways in a paleo-roothole. *Computational Geosciences*, 12, 4, pp. 561-574.

WHITE, A. J., SULSKY, D. J., and HALL, J. (2008). Paleoroothole Facilitated Transport of Aromatic Hydrocarbons through a Holocene Clay Bed. *Environmental Sciences and Technologies*, 42, 23, pp. 73-78.

(ENGR 498.01) Paleo-Roothole Facilitated Transport of Aromatic Hydrocarbons through a Holocene Clay Bed

Modeling of the Mass Transfer Zone in a Biosorption Column

Student: Joao Vitor Mortera Lopes Advisor: Dr. Paul R. Anderson

Background

This study is essential to determine the optimal operation conditions and design parameters of a biosorption column to efficiently treat wastewater.

Modeling

Contaminants can diffuse between the biosorbent and the metal to be treated.

Simulation

For the simulation of this process, the column height and the biosorbent load must be modeled and solved simultaneously. The use of the Finite Element Method (FEM) to simulate the column biosorption process relies on dividing the column into small segments.

Acknowledgments

The software Wolfram Mathematica is used to solve the given set of differential equations numerically using NDSolve.

The results of the mass transfer zone in the column can be generated to find the optimal operation conditions of the column.

Figure 1: Column height and biosorbent load.

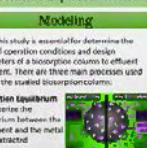


Figure 1: Column height and biosorbent load.

Figure 2: Biosorption column.

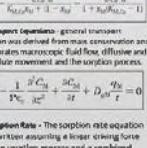


Figure 2: Biosorption column.

(ENGR 498.01) Modeling of the Mass Transfer Zone in a Biosorption Column

EDMEC Battery Thermal Management System
Natalya E. M. Kublik, Francisco L. P. Neto and PhD Mahesh Krishnamurthy

Introduction

- Lithium batteries importance in transportation
- Temperature effect on performance
- Thermal management need to avoid runaway and alleviate cell aging
- Phase Change Materials as a cooling system

Objective

- To design a PMSM based thermal management solution for 18650 Li-ion battery pack that provides online temperature estimation

Methods / Approach

- Coupled electro-thermal model
- Equivalent circuit used
- Digital and analog heat generation
- Pulse relaxation test to acquire model parameters
- Model validation to obtain current profile: Dynamic Stress Test

Results

- Cell Terminal Voltage comparison between model and experimental
- Errors (calculation and improvements)
- Observability and position of sensors
- Future Work

Acknowledgments

- Mohamed Salameh, for all teaching, support and support on the topic
- Autodesk, for the software
- RE and CAPES, for all financial support on our programs

References

Lin, X., Xu, H., Chen, H., Tang, J., Krishnamurthy, M., Ding, Y., & Cao, X. (2008). A novel battery thermal management system for hybrid electric vehicles. *Journal of Power Sources*, 188(1), 1-6. doi:10.1016/j.jpowsour.2008.07.075

(ENGR 498.09) Battery Thermal Management System

Comparing Interior Permanent Magnet (IPM) Machines used in Hybrid Electric Vehicle
Renato Goldine, Césio Notini, Supervisor: Dr. Mahesh Krishnamurthy, ENGR 498.09

Objectives

- Design a motor for Toyota Prius 2004 and 2010 electric motors using Infineon Magneti software
- Improve the performance of the two motors using the software
- Analyze results of the simulations
- Comparison between motors results
- Identify and worth improvements in motor design

Approach / Background

- What are IPMSM motors?
- Magnets are buried in the rotor
- Magnets are more expensive
- Magnet torque and reluctance torque combined
- Reluctance torque from magnets than SPM
- High power density
- High power to weight ratio
- High torque density
- Low torque density

What can we evaluate?

- CAE software: FEA, Field, Magnet
- Back electromotive force (EMF)
- Back EMF
- Locked rotor torque/torque angle
- Torque angle peak/Normal
- Material: Al 10, neodymium iron boron, Copper

Results

The motors designs and results are presented below:

Conclusion

- Proposed at Toyota Prius 2004 and Toyota Prius 2010 electric motors through simulations.
- Lower consumption parameters have influence in the results and performance of a motor.
- Design and analyze processes in this kind of researches.
- Acquisition knowledge in the design and operation of motors.

Acknowledgements

Capes/CNPq, Aramco College of Engineering

(ENGR 498.09) Comparing Interior Permanent Magnet (IPM) Machines used in Hybrid Electric Vehicle

Design and Thermal Analysis of DC/DC Converters on PHEVs
Everton Coelho Cancian, Pedro Henrique Brossi Liger, Dr. Mahesh Krishnamurthy, ENGR 498.09

Objectives

- The design and optimisation of a DC/DC converter requires a multi-physics (electrical and thermal) analysis to answer the following questions:
 - What should be the current of the converter device?
 - What should the size of the heat sink or cooling system?

Approach / Simulations / Results

Task 1: Application Requirements
Task 2: DC/DC schematic
Task 3: Model of the converter
Task 4: Thermal simulation

Conclusions / Future Work

The best design requires a simultaneous optimization of the electrical components and the cooling system. Increasing the size of the converter, using forced convection cooling, decreases the operating temperature of the converter. The next step will be adding the resistive losses in the losses model using different heat sinks in order to reduce the losses.

Acknowledgements

The authors would like to thank Alexandre Pires Arantes for his support and encouragement, and the Brazilian National Research Support, and Illinois Institute of Technology for technical assistance.

(ENGR 498.09) Design & Thermal Analysis of DC/DC Converters on PHEVs

Electric-Hydraulic Hybrid (EH2) Vehicle Drivetrain
Christophe Emelich and Gustavo Campos, Instructor: Mahesh Krishnamurthy, ENGR 458.09

Project Overview

Seeking better efficiencies in energy usage and environmental friendly transportation systems. After the success of the first hybrid vehicle developed at IIT, the second one is being developed. This second vehicle will be implemented for testing and then simulate the forces acting in the Hydraulic system. The main goal of this project is to better understand the EH2 and how to improve the performance such as pushing and pulling weight of the components.

Goals

The present work intend to model a car-like prototype built at IIT where the EH2 system will be implemented for testing and then simulate the forces acting in the Hydraulic system. The main goal of this project is to better understand the EH2 and how to improve the performance such as pushing and pulling weight of the components.

Conclusion

Due to time issues it was not possible to apply the desired simulation. This is shown in the figure. The EH2 car is shown in the figure.

References

Wangguan Sun, Garcia, I., Krishnamurthy, M., "A novel fuel displacement Electric-hydraulic Hybrid(EH2) drivetrain for city vehicles," *Transactions of the Chinese Society of Agricultural Engineering*, 2012, 28(1), vol. 28, no. 1, pp. 30-36, 2012.

"Hybrid vehicles," *Industrial Electronics, IEEE Transactions on*, vol. 55, no. 6, pp. 237-241, June 2008.

(task, V), "Vehicle Motor, An," *Hybrid Vehicles: Architecture and Motor Drives*, Proceedings of the IEEE, vol. 95, no. 8, pp. 231-236, 2007.

(ENGR 498.09) Electric-Hydraulic Hybrid (EH2) Vehicle Drive Train

HEVs, PHEVs and EVs: Identifying opportunities and predicting future trends
Cassiano Ferri, Caroline Rosa, Fernando Wosiak and Mahesh Krishnamurthy, ENGR 498.09

Objectives

- Analyze the standards and policies for electric vehicles
- Analyze the environmental issues due the massive adoption of electric vehicles
- Analyze the fuel markets and materials for the future
- Analyze the available infrastructure for electric vehicles
- Determine the viability of electric vehicles around the world

Introduction

- Climate changes as result of many years of increasing pollution intensity
- Concerned governments have started to look for solutions to mitigate effects of modernization and development
- One of the most promising technologies are electric vehicles
- Electric vehicles (EVs) are vehicles which use one or more electric motors as propulsion methods
- There are different types of EVs such as: hybrid electric vehicles, battery electric vehicles, fuel cell electric vehicles

Methods

- Research based on:
- Academic papers available in the internet
- Government agencies database
- Market projections
- Historical events
- Expert analysis

Pros

- '2010' greenhouse gases emissions
- More efficient than internal combustion engine
- Operational efficiencies
- Unprecedented clean air
- Low maintenance costs

Conclusion

- Electric vehicles sales represent a small portion of the market
- Developments are more and more offering incentives to buy electric vehicles
- The available infrastructure is not enough to support a mass fleet of electric vehicles
- There is a lack of research and innovation

Are Electric Vehicles really the future?

Cons

- Electricity production largely depends on fossil fuels
- Limited range
- More expensive than internal combustion engine
- Infrastructure costs
- Lack of available infrastructure
- Long recharge time

Acknowledgments

KAREN Hauseman, Advisor of Education of Brazil, IIT, Mahesh Krishnamurthy, Dr. David R. Williams, ENGR 498.09, Aramco College of Engineering

(ENGR 498.09) HEVs, PHEVs and EVs: Identifying Opportunities and Predicting Future Trends

Coanda Airfoil in Compressible Subsonic Flow
Researchers: Jessica Julia Veronese Concalves, Rafael Silva Reigão, Advisor: Dr. David R. Williams, ENGR 498.16

Motivation

This project seeks to find an alternative aircraft flight control system. The aircraft has several control surfaces such as elevators, rudders and ailerons, for that it used active aileron control to replace ailerons and flaps.

Objectives

Measure the airfoil's circulation control under compressible flow conditions. Test the airfoil's circulation control under compressible flow conditions. Compare the circulation control with conventional control components such as ailerons and rudders.

Results

Tests were made for the pressure sensors and airfoil boundaries before the airfoil and the airfoil were smaller than 5% in the worst case, and incrementally it also smaller due to the high amount of samples per second.

Experimental Setup

The airfoil was mounted under the wind tunnel's test section, where the pressures sensors and flow direction were measured. The flow direction readings to the computer program are processed by the data acquisition system. The data acquired is processed for analysis.

Conclusion

The circulation control impacts the lift coefficient of the aileron and wing with increasing flow intensity, however this change is still small compared to control surface deflections. The airfoil's circulation control tests are some discrepancies between the obtained data and the data from the literature. In the range of lift coefficient and angle of attack as a function of Mach number, one measure that could cause this variation is that the airfoil is not perfectly flat, while the theory assumed was for a 2D wing.

References

Hwang, C., Hwang, C., "Flow Control Using aeroelastic Instabilities for Aircraft Maneuvering," *Journal of Aircraft*, 2010, Vol. 47, pp. 20-25.

Wang, Y., "Aeroelastic Instabilities and Maneuvering with Coanda Effect," *Journal of Aircraft*, 2009, Vol. 46, pp. 10-15.

Wang, Y., "Aeroelastic Instabilities and Maneuvering with Coanda Effect," *Journal of Aircraft*, 2009, Vol. 46, pp. 10-15.

Acknowledgements

Our sponsors on the Brazil Scientific Mobility Program: Coordination of Aeronautics of Federal de Santa Catarina (CNAE) and Institute of Interdisciplinary Education (IEI).

(ENGR 498.16) Coanda Airfoil in Compressible Subsonic Flow

Posters

Fan Performance in IIT Low Speed Wind Tunnel

Denis S. Fernandes, Rafael C. Jaramillo
Advisors: Professor David R. Williams
Electrical Engineering

Objectives
Obtain the performance map of the low speed wind tunnel fan using a wireless connection and digital pressure sensors to obtain data.

Background
It is important to know how the wind tunnel fan performs under different conditions to help aerodynamic effects on a wing. This research aims to obtain the performance map of the fan (Fan Static and after fan, respectively). The sensor data is stored in memory and sent to a computer to analyze the data and store it in the central database, thereby creating a clearer easier and smaller archive.

Data Acquisition Setup
The data was collected by two digital pressure sensors located in the downstream areas of the Fan Static (before) and after (respectively). The sensor data is stored in memory and sent to a computer to analyze the data and store it in the central database, thereby creating a clearer easier and smaller archive.

Digital Sensor and Wireless Connection System
The digital pressure sensor provides a direct interface with the microprocessor and a faster performance. The WiFi module provides a Linux processor, enabling a wireless connection between the sensor and the computer in the central database, thereby creating a clearer easier and smaller archive.

Conclusions and Future Work
The fan performance map represents the analytical map for the wind tunnel fan. This analytical map is obtained from the generated noise level results. A closer look to the pressure up and down stream showed that this is that the fan has a very good performance. The fan static pressure may as well as the flow rate were used to prove that the shaver presents a small effect on the fan's performance. The fan after the fan has a very good performance. This project has to be done, such as, increase the frequency of data acquisition working in new pressures in the fan static and after the fan. The fan after the fan is to increase the process and demonstrate the sequence of data in dynamic systems.

Experimental Results
The WiFi pressure acquisition system was able to collect data from both sensors simultaneously. With a mean error of 2.0% and also able to analyze the changes over the time, and to obtain the fan performance map according to different operating settings. The correlation between the fan rate in the test section of the tunnel and the IAV speeds for each shaver setting was evaluated at the end.

Acknowledgments
Thank you Leslie Fernandes for your help in the development of the wireless system and support, especially during the initial stages of the project. Also thank you to the Illinois Institute of Technology for the help with the wind tunnel and its programs setting.

(ENGR 498.16) Fan Performance in IIT Low Speed Wind Tunnel

Unsteady Lift Enhancement Using Active Flow Control

Diego Soares Gonçalves, Alvaroing As
Advisor: David R. Williams

Motivation
Enhance lift and delay the onset of flow separation.

Results
Vertical velocity vs. non-dimensional time.

Single pulse

Multi-pulse

Objective
Measure time averaged flow measurements to evaluate the dynamics lift responses following single and multi-pulse activation.

Experimental Setup

Observations
➤ Activator pulse produces a vortex that convects over the wing surface.
➤ Flow field shows two vortices on suction surface at minimum lift.
➤ Dynamic lift increases occurs ($\tau = 1.5$) for both types.
➤ There is almost no exchange between the flow structures for the maximum ($\tau = 3$) and minimum lift ($\tau = 1.5$).
➤ New vortex structures appear at $\tau = 7.5$, 10.5 and 30 in the wake. This occurs dynamic lift oscillations.
➤ No new vortex formation observed in the single-pulse case.

Conclusions
➤ Differences in flow structure between single and multiple pulse activation were identified using PIV analysis.
➤ Flow structures appear to correlate with dynamic lift oscillations.

Acknowledgement
This research is funded by the Brazil Science Research Councils. This research was partially sponsored by the Brazilian National Laboratory Program (LNFM).

(ENGR 498.16) Unsteady Lift Enhancement Using Active Flow Control

Smart Grid Analysis of Centralized Power and Cooling for an Urban Community

Viana, F.L.; Benítez, J.M.M.; Souza, L.S.; Rezende, L.L.; Martins, M.S.; de Melo Neto, R.; D.J.C. Jimenez

Case 3

Preliminary Results
Initial Cost: \$ 140,000,000
Operational Cost: \$ 660,000,000
NPV: \$ 300,000,000

Case 2:
Initial Cost: \$ 210,000,000
Operational Cost: \$ 620,000,000
NPV: \$ 360,000,000

References
Figure 1 - Case 3 diagram: Power + Air-cooled Chiller + Desiccant Chiller
$$\dot{Q} = \min \left(\sum_{i=1}^n C_i T_{ext} - C_i T_{int}, Q_{des}^C \right)$$

$$Q_{des}^C = Q_{des}^H - T_0 q_{des} = Q_{des}^H$$

$$-C_i \frac{\partial T}{\partial x_i} + v_i^c T_{int} - v_i^d T_{ext} = 0$$

Figure 2 - Results of case 3

ILLINOIS INSTITUTE OF TECHNOLOGY

(ENGR 498.18) Smart Grid Analysis of Centralized Cooling for an Urban Community - Poster 1

Smart Grid Analysis of Centralized Power and Cooling for an Urban Community

Viana, F.L.; Benítez, J.M.M.; Souza, L.S.; Rezende, L.L.; Martins, M.S.; de Melo Neto, R.; D.J.C. Jimenez

Centralized System - Background

Case 2

Figure 3 - Standard and Variable Chiller scheme

Figure 4 - Case 3 diagram: Power + Air-cooled Chiller + Desiccant Chiller

Figure 5 - Power Performance Test Diagram
$$\dot{P} = \min \left(\sum_{i=1}^n C_i T_{ext} - C_i T_{int}, Q_{des}^C \right)$$

$$Q_{des}^C = Q_{des}^H - T_0 q_{des} = Q_{des}^H$$

$$0 \leq \dot{P} \leq \dot{P}_{ref}$$

$$0 \leq \dot{P} \leq \dot{P}_{max}$$

$$0 \leq \dot{V} \leq \dot{V}_{ref}$$

$$0 \leq \dot{P} \leq \dot{P}_{ref}$$

$$-Q_{des}^C \frac{T_0}{COP_{ref}} + v_i^c T_{int} - v_i^d T_{ext} = 0$$

Figure 6 - Results of case 2

(ENGR 498.18) Smart Grid Analysis of Centralized Cooling for an Urban Community - Poster 2

Smart Grid Analysis of Centralized Power and Cooling for an Urban Community

Viana, F.L.; Benítez, J.M.M.; Souza, L.S.; Rezende, L.L.; Martins, M.S.; de Melo Neto, R.; D.J.C. Jimenez

Objectives
Perform a techno-economic analysis to determine the net present value of a centralized power generation and cooling system for an urban community under price of Change in the context of variable electricity price structure.

Introduction

Case 1

The electrical power for the cooling system:
$$P = \frac{Q}{COP}$$

COP = Cooling Load / (Power + the coefficient of performance for the cooling system / 1000)

Figure 3 - Electrical Chiller (COP = 4 at 114W/kWh)

Figure 4 - Cooling load model
The cooling load was obtained by adapting Cooling Load Temperature Difference (CLTD) method proposed by the ASHRAE in its report.

Figure 5 - Centralized Cooling System

NPV Method
$$NPV = IC + PV$$

$$IC = \text{Initial cost}$$

$$PV = OC = \frac{(1 + r)^{-1} - 1}{(1 + r)^{-1} - 1} \cdot r$$

$$r = \text{Annual interest rate}$$

$$OC = \text{Operational costs}$$

$$r = \text{Value of the withdrawals}$$

Results for Case 1:
Initial Costs \$170 millions
Operational Costs: \$110 millions
NPV: \$301 millions

Figure 6 - Cooling and PV load

(ENGR 498.18) Smart Grid Analysis of Centralized Cooling for an Urban Community - Poster 3

Advanced Vehicles – Hovercar

Student: Daniel Rodrigues Rocha - Instructor: Professor Francisco Rui - (ENGR 498.22)

Introduction
We are building a Hovercar capable of levitating by electromagnetic forces. An alternating current is applied to a coil. If the current has a magnetic field, the ferromagnetic surface, the current induces below the surface produces a magnetic field opposite polarity. As a result, the two surfaces repel each other so that the coil can levitate.

Methods
Parts from a small transformer were used to measure the repulsive force produced when AC current passes through a coil. From this we can calculate the voltage and frequency necessary to levitate a given weight at a given height. The lifting height is proportional to the square of the number of turns in the coil, the current through the wire and the radius of the coil.
$$F = \mu_0 N^2 I^2 / 4 \pi r^2$$

Results
We have found the relationship between the current and force as well as voltage and force.

Discussion - Future Work
Although some experiments were made to prove that the armature should work, it is still necessary to do some more tests before we start to design a scaled-down prototype and after we build the first prototype, which will include these initial parts.

- Magnetic core with coil of wire.
- Electronic components (Calibra Oscilloscope, Power Amplifier, Battery Supply).
- Cooling system.
- Hovercar Housing.

References

- Thompson, Marc. "Eddy current Magnetic Levitation: Model and experiments," March 2000.
- "New Vista (April, 2010). What is Eddy current? Retrieved from <http://www.youtube.com/watch?v=qZlgm3ANVY>

Applications

- Transportation Sector: Cars, Trains.
- Entertainment: Theme park attractions.
- Residential/Industrial usage: Money lifting.

Acknowledgements

- Adithya Menon
- Wesleye de Goyds
- Daniel Petrucci

(ENGR 498.22) Advanced Vehicles Research

Brayton 6-Stroke Engine Analysis
Michel Martins, Gabriel Malta, Filipe Martins, Advisor: Prof. Francisco Ruiz, ENGR498.23

Introduction
We analyzed the Brayton cycle engine using DELLER-RK software. The goal was to obtain efficiency and a variety of conditions across the cycle, at 5 bar of tank pressure. Also the team analyzed the probability of knock.

Results

Figure 1: Adaptive 6-strokes cycle.

Figure 2: Diesel-RK simulation p-v diagram for different expansion cycles.

Table 1: Consumption with 4 stroke angles for each stroke cycle.

Figure 3: Knock analysis. Knock occurs when the onset of knock based on DELLER-RK simulation after TDC and high compression ratios, static of similar engines were collected. Supercharged engines with high boost, the knock onset occurs later with a greater range of information.

Figure 4: pV of adaptive cycle steady state.

Figure 5: Work x Air charge for expansion (left) and compression (right).

Conclusion
DELLER-RK software was used to analyze the consumption of work and air charge for each cycle, both compression and expansion. A savings of 38.5% compared with the conventional cycle was obtained. The knock onset occurs later with more essential models than exist today. Steady state data (fractional charge). The storage and return processes will be modeled. We need a better tool to predict knock.

(ENGR 498.22) Graphical Analysis and Simulation of the Brayton 6-Stroke Hybrid

water and cities

01 urbanfront revitalization
In the mid-century, the megacity of São Paulo will have 20 million inhabitants and 100 million people in the metropolitan area. This will be a major challenge for the city's infrastructure, economy, culture, and environment. In order to meet these challenges, it is necessary to implement a sustainable urban development strategy.

02 greenland system
This institution has a rearing department and a research center for water quality. The goal is to improve water quality by reducing the amount of organic matter in the water. The water recycling system is a way to reuse treated water for irrigation and other purposes. The water recycling system is a way to reuse treated water for irrigation and other purposes.

03 watercooling system
The watercooling system is a way to reuse treated water for irrigation and other purposes. The watercooling system is a way to reuse treated water for irrigation and other purposes.

04 wetlands system
Wetlands are natural areas where water is the dominant factor in the ecosystem. They are important for the regulation of water levels, the reduction of flooding, and the improvement of water quality. Wetlands are also important for the conservation of biodiversity.

(ENGR 498.26) Research on the Relationship between Cities and Water - Poster 1

Site analysis

Site strategy

01 urbanwaterfront revitalization
The project consists of the revitalization of the urban waterfront area of the city of São Paulo. The goal is to create a new urban space for the city's residents and visitors. The project includes the construction of a new promenade, the creation of a new park, and the renovation of existing buildings.

Design Concept

future

(ENGR 498.09) Research on the Relationship between Cities and Water - Poster 2

02 watercooling system

03 wetlands system

(ENGR 498.09) Research on the Relationship between Cities and Water - Poster 3

Implementing Custom Route Design Using GIS
Students: Andreia, Felipe, Gabriele, Giselle, Ingrid, Lucas, Luis Carlos, Matheus, Mirella, Pedro, Samuel, Telysnne
Instructor: Adjunct Professor Laurence Richter PE - ENGR498.27

Acknowledgements

Methodology

System Architecture

Conclusion

(ENGR 498.27) Implementing Route Design Using GIS

Integration Between GPS and INS in Embedded Systems
Alexandre Lira, Daniela Guedes, Lucas Neubert, Luiz da Silva Jr., Ozielio Mota, Rafael Ferraz, Tales Dantas, Wirkles Stock, Wesley Paixão and Dr. Samir Khananah

Introduction

Results

Discussion/Future Work

Conclusion

Future Work

Acknowledgements

References

(ENGR 498.28) Localization and Navigation Using Smartphones

Posters

AERODYNAMICS OF VERTICAL-AXIS WIND TURBINES

Beck, Júder; Berling, Aline; Borges, Victor H. A.; Brumotti, Karina; Costa, Guilherme A. P.; Dos Santos, Luiz Felipe S.; Montalvão, Góisikarne; Nasimento, Eduvardo de S.; Prof. Dipl.-Ing. René Kroll, Ph.D.; Peter Knack, M.S.

ENGR 498.30-15
Chemical Engineering

Introduction

- Two kinds of wind turbines: Horizontal-Axis (HAWT) and Vertical-Axis (VAWT).
- Advantages of VAWTs:
 - More efficient than their counterparts.
 - Lower maintenance and construction costs.
 - Shakeshakes of VAWTs.
 - In less efficient than HAWTs.
- Horizontal: Advantages of aerodynamics, more robust.
- Vertical: Advantages of aerodynamics.

Figure 1 Diagonal cut of a VAWT

3-Dimensional Correction

- The airfoil databases are only available for infinite aspect ratio.
- Correction applying a lifting factor (k_0) to the profile.
- This correction was made using a Moritz code created during the research with Lehigh University's fluid theory behind the theory project by CFDBLT using the theory of Vortex and Complex airfoil.

Figure 2 Inlet flow field

Figure 3 Lift coefficient and lift coefficient vs chord

Variable Blade Pitch

- Optimal stall and wake separation change the optimal operating rotating rates and angles.
- The optimal pitch can be found and a control system is developed to fit the optimal angle.
- The control system also increases the power output of the turbine.

Figure 4 Pitch angle vs R/R_t and Pitch Angle

Multiple Turbines

- Global Flow: Provide a tool to find an optimum configuration that maximizes the power generated in these environments.
- Multiple turbines, site by site and find the optimum position of a three turbines placed at once.
- Important considerations: the turbines affect each other.
- Wake model: because each of these turbines will affect the performance of the others.

Figure 5 Global Flow for the arrangement of the turbines

References and Acknowledgments

The author would like to thank CAPES – Coordination for the Improvement of Higher Education Personnel - Brazil, CNPQ – Conselho Nacional de Desenvolvimento Científico e Tecnológico - Brazil, and FAPERJ – Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro - Brazil for their financial support. The author would like to thank Prof. Peter Knack, M.S., Institute of Chemical Process Engineering, Lehigh University, Bethlehem PA, USA, for his valuable guidance and help throughout this research.

(ENGR 498.30) Computational Aerodynamics of Vertical-Axis Wind Turbines

Timing Signal Optimization of Intersections in Chicago Loop

Students: Alan Filho, André Barros, Debra Pacheco and Elton Maximino; Instructor: Dr. Jozéph LIENGR 498.45

R&D

Introduction

Engineers have become increasingly interested in traffic signal optimization to improve the safety and efficiency of intersections. In this poster, we present our research project focused on optimizing traffic signals at intersections in the Chicago Loop. Our goal is to reduce travel times and increase the efficiency of traffic flow through better timing signals.

Prepared Methodology

Our methodology involves several steps to optimize traffic signals:

- Initial data collection and analysis: We collect traffic data from various sources such as the Chicago Department of Transportation (CDOT) and the Illinois Department of Transportation (IDOT) to understand traffic patterns and signal timing requirements.
- Intersection analysis: We analyze each intersection to determine its unique characteristics and constraints. This includes identifying turning movements, signal phases, and traffic volumes.
- Signal optimization: Using the collected data, we develop optimization models to calculate the best timing signals for each intersection. These models consider factors such as traffic flow, signal priority, and pedestrian crossings.
- Implementation: Once the optimized signals are determined, they are implemented at the intersections to evaluate their impact on traffic flow and travel times.
- Evaluation: We continuously evaluate the effectiveness of the optimized signals and make adjustments as needed to further improve traffic efficiency.

Results

The key results show that the optimized signals help to reduce travel times by up to 15% to 20% compared to the existing signals. For instance, at a major intersection in the Chicago Loop, the total travel time was reduced by 20% after the implementation of the optimized signals.

Discussion

The results show that the optimized signals significantly reduce travel times and improve traffic efficiency. By optimizing traffic signals at intersections in the Chicago Loop, we contribute to making the city more efficient and sustainable. We expect that the implemented changes will continue to bring positive results in the future.

References

CDOT (Chicago Department of Transportation). Average Daily Traffic Counts. Available at: [http://www.cdot.ca.gov/adt/adt.html](#). Accessed: 10/04/2023.

IDOT (Illinois Department of Transportation). Average Daily Traffic Counts. Available at: [http://www.IDOT.state.il.us/adt/adt.html](#). Accessed: 10/04/2023.

CDOT (Chicago Department of Transportation). Average Daily Traffic Counts. Available at: [http://www.cdot.ca.gov/adt/adt.html](#). Accessed: 10/04/2023.

Figure 1: Intersection Diagrams of Blockbuster and Randolph St.

Figure 2: Chicago Loop map showing the location of the Blockbuster and Randolph Street intersection.

(ENGR 498.45) Timing Signal Optimization of Intersections in Chicago Loop

Study of Wind Turbines under Rainy Conditions

Caroline Alves, Advisors: Hamid Arastoopour and Ahmad Chehrehzai, ENGR499.12

Introduction

The creation of different technologies to supply the energy demand of humanity has been a challenge for centuries. One of the most effective sources of natural energy has been wind energy. Some studies have increased the efficiency of wind turbines by decreasing the angle of attack, which has caused a lot of dramatic changes in the planet. In this research, the main focus is to study the development and understanding of the "rain effect" on wind turbines. The "rain effect" is an event where there is a heavy rainfall that causes water droplets to fall directly on the wind tunnel, differing the current use of (off)shore wind energy. However, rain and solar photovoltaic cells are the most important source of energy in the world, due to the increasing of wind power depends directly of some environmental factors, and these factors vary a lot depending of the environment. In this research, the main objective is to study the "rain effect" on wind turbines. The challenge, it is necessary to study and analyse further the effect of these phenomena, in order to improve the efficiency and performance of wind-turbine turbines.

Methods

In this research, a study using CFD simulation of the behavior of wind turbines under many conditions is being made, using two other previous studies as baselines. The data used is from an experiment made in the aerospace facility NASA-64-210 being simulated in a wind tunnel under a rain simulation system. The basic work was a CFD model of the NASA 64-210 wind tunnel using ANSYS FLUENT and an ANSYS VRM reader were combined and used to simulate the water layer boundary to the rain. In this study, the Lagrangian approach is used to track rain droplets, while the Eulerian method is being used to track the water film. The boundary condition is a free surface boundary condition and the turbulence is random. The experimental data for the NASA 64-210 will be simulated using the numerical model previously developed by our group. After obtaining the necessary data and to obtain the numerical values of the "rain effect", we will analyse the results. The results will be discussed in the simulations, a single phase flow simulation will be made. Finally, the results will be used as validation of the multiphase model using ANSYS and VRM approaches will be done.

References

Bessa, N. G., Doherty, N., & E. E. Gentry Jr., L. B. (1995). Wind Tunnel Measurements of the Characteristics of a Two-Mass Wind Turbine. *Journal of Fluid Mechanics*, 299, pp. 1–20.

Ming, L., Imanishi, A., & Anagnoski, N. (2012). Analysis of the performance of a Wind Turbine Airfoil under Rain. *Journal of Wind Engineering and Industrial Aerodynamics*, 105, pp. 9–16.

Ming, L., Imanishi, A., & Anagnoski, N. (2012). A Study on the Wind Tunnel Measurements and Numerical Simulations of Wind Turbines Under Rainy Conditions. *Journal of Wind Engineering and Industrial Aerodynamics*, 105, pp. 9–16.

Acknowledgements

There are no external funders or grants for this research. The authors are grateful to the Instituto Federal de Santa Catarina for the support and to the Coordination for the Improvement of Higher Education Personnel (CAPES) for the scholarship.

(ENGR 499.12) Study of Wind Turbines under Rainy Conditions

Production of Natural Gas from Unconventional Resources

Mica Renné, Hamid Arastoopour and Beatriz Nini, ENGR499.12

Introduction

Hydrocarbon dissociation in a porous sandstone core was conducted in this research. The porosity of the sandstone was assumed that the fracture was charged in the pores of the matrix. The simulation results are shown in Figure 1. The formation and sealing of gas hydrate are determined when the formation pressure increases and the pressure and temperature decrease. When the pressure is low, the formation of the gas hydrate is hindered. However, when the pressure is high, the gas hydrate is formed. When the pressure and temperature are low, the formation of the gas hydrate is hindered.

Methods

For different core temperatures and various initial water saturation conditions, the effect of the formation pressure and temperature on the formation of methane hydrate were simulated. The time evolution of methane gas and water flow rate at the outlet were also evaluated.

Results

Figure 2: Effects of Methane Hydrate Formation.

Natural gas hydrate is a solid ice-like crystalline substance composed of methane molecules trapped in a lattice of water molecules. The reason is its importance in different fields of interest, ranging from a potential energy resource to environmental issues.

Discussion/Future work

The simulation results were compared with the literature. As the simulation results showed, the formation pressure of methane hydrate decreased when the temperature decreased. When the temperature increased, the formation pressure increased. The core model contains three separate phases: methane hydrate, methane gas, and water. The simulation results show that the value at one end of the core was increased compared to the value at the other end of the core. The pressure and temperature decrease from the inlet to the outlet. When the temperature increases, the pressure decreases. When the pressure increases, the temperature increases. The results are in accordance with the literature.

References

- Hamidi & Ahmed (2004). Computational modeling of methane hydrate dissociation in a sandstone. *Journal of Petroleum Science and Engineering*, 45, pp. 29–38.
- Kanjwani et al. (2009). Analytical 2009 and 2008 gas hydrate production experiments in a sandstone at 5°C: *Marin II* 2008 wellthrough numerical simulation.
- FLOWNT Theory Guide - Ch. 11 Multiphase Flows - Methane Hydrate Model.
- FLOWNT User Guide - Section 6.23: Methane Hydrate.
- FLOWNT UG Guide.

(ENGR 499.12) Production of Natural Gas from Unconventional Resources

ALLCELL

Manufactured by design

Agracel Moira and Fernando Cassano | Prof. Roberto Cammin | Armour R&D

Ullih-ion Battery Packs

• Stop propagation of thermokinetic runaway

• Absorb high thermal fluxes

• Protects cells from hot environmental conditions

• Maintains uniform temperature across cells and time

• Conform to coil cooling

Design Production Testing

AllCell PCC™

• Single or passive, requires no moving parts or power

• Less expensive and lighter than active cooling systems

• Uniform cell-to-cell cooling

• Conforms to coil cooling

Nakeld™ Lithium-ion Battery Packs

• Cost saving

• Light weight

• Repairs are easy

• High cycle life

• Great for protection

• Robust design

Safe, Longer Lasting, Compact Lithium-ion Batteries and Thermal Management Systems

Single and Low Cost, Lightweight and Compact, Passive Cooling

(ENGR 499.29) Process Engineering Internship with All Cell Technologies, LLC

High Fidelity "Faster than Real-Time" Simulator for Predicting System Dynamic Behavior

R&D

Introduction

The predicting and forecasting of system dynamics is a huge and complex task, mainly due to the large number of variables involved in the system. Once this problem is solved, it is possible to predict the behavior of the system to increase its efficiency. A fast and accurate prediction of system dynamics is essential to predict the system's behavior and to make better decisions. In this research, the need for a faster and more accurate simulation of system dynamics is addressed. The aim is to predict the system's behavior in real-time to enable faster decision-making processes.

Methods

The need for a simpler and rapid system dynamics model is addressed. The proposed model is a Reduced Order Model (ROM) based on the Reduced Basis Method (RBM). The ROM is a simplified version of the full-order model that is able to capture the dominant features of the system dynamics while reducing the computational cost. The ROM is constructed by a greedy algorithm that identifies the most important modes of the system. The ROM is used to predict the system's behavior in real-time, enabling faster decision-making processes. The ROM is used to predict the system's behavior in real-time, enabling faster decision-making processes.

Results

Figure 1: This figure is what the Reduced Order Model (ROM) looks like. It looks very similar to the real system dynamics.

Conclusions

This project is to predict the system's behavior in real-time, enabling faster decision-making processes. The Reduced Order Model (ROM) is used to predict the system's behavior in real-time, enabling faster decision-making processes. The ROM is used to predict the system's behavior in real-time, enabling faster decision-making processes.

References

- Wang, Jun; Liu, Henan; Richard, Murielle; Etienne, Paul; Odeh, Christopher; Wang, Xiangming; Fang, Bo; Yang, Ming; Liu, Xuefeng; Li, Peng. (2019). Reduced Order Model for System Dynamics Simulation. *Journal of Mechanical Design*, 141(2).
- Zhang, Jun; Li, Yong; Zhou, Yuhua; Guo, Bin; Zhang, Shuai. (2018). Application of ROM in Power System Frequency Regulation. *Journal of Electrical Engineering*, 119(1), pp. 118–127.
- DELMAR AVILA, Pedro | Scopus: Forecasting power system dynamics using a reduced order model: [https://www.semanticscience.org/resource/86510426](#).
- Dominguez, Juan; Hernandez, Ricardo. (2018). Application of ROM in Power System Frequency Regulation. [https://www.semanticscience.org/resource/86510426](#).

(ENGR 499.34) High Fidelity "Faster than Real-Time" Simulator for Predicting Power System

Faster than Real Time Dynamic Simulations for Large Scale Power Systems – SCRX
Leonardo Alves Moreira de Melo; Alexander Flocke, Ph.D.
Armour College of Engineering, Illinois Institute of Technology

Introduction
Electricity is essential to humans life. The electric power system grid must be satisfactorily, but also new energy quantity can be improved, the smart and reliable systems are needed to solve problems in power systems. For example, it can detect failure in electrical grids, and prevent the system from collapse. Smart grid is an excellent technology, however, it is hard to develop and implement. Therefore, the real-time dynamics simulation project covers a lot of difficult steps to build a better smart grid. In this poster, we present some of this project can be explained showing the goal that it is hard to receive a better conclusion.

Results
The models have been studied in the literature, then “real-time” dynamics simulations programs are classified as: Numerical Computation, Control and Optimization, through Siemens tools and open-source. The following block diagram was analyzed, and the following block diagram was built using simulink and Matlab.

Conclusion
The output de-synchronization is matching with a maximum error. Therefore, it proves the modeling of SCRX model is correct and the results are acceptable.

For simplicity, just two blocks were used: PSIM and SCRX. PSIM can and will be applied in more complex power systems with thousands blocks.

Method

- Model Analysis
- Block Diagram
- Variable Selection
- Simulation and Benchmarking
- C Code
- Compiling and Run in MATLAB Repository

Figure 1: SCRX Block Diagram
The input diagram block, the variables can be defined. The vector SCRX is ELMAP as an input signal. ELMAP shows on the following figure:

Figure 2: Output Benchmarking
After the results, the C code can be used. Residual Function was developed. Then C codes were developed using Matlab. The results are shown in the following figure:

Figure 3: Output Benchmarking
The transfer function Lead-Lag is used to improve transient response, stability, and steady-state error.

(ENGR 499.34) Faster Than Real-time Dynamics Simulator for Large-scale Power Systems

Faster than The Real-time Dynamics Simulator for Large-scale Power Systems
Josias Rufino Letts Neto; Alexander Flocke, Ph.D.
Armour College of Engineering, Illinois Institute of Technology

Introduction
First of all, is common knowledge that the society need more and more energy efficient systems, mainly in the industry. For that reason, the need to research about power systems is increasing. The main problem of energy producing enough computer intelligence to make the system work is the cost. It is not the cost matter, where the energy comes from such as solar, wind, or other source of energy. In this case, the goal for this project is to make the system faster, which can improve the usage of power supplies.

Methods
In this project, some tools were used to implement and simulate the control systems developed. Such as:
 - ANSYS PSCAD: A software that works with the PSIM and SCRX models. It is used to calculate the simulation time and to run the simulation. It is used to calculate the estimation of the results, and to help the implementation in C language.
 - MATLAB: A software that runs the control system. It is used to implement the control system and to analyze the simulation. It is used to help the team to debug the code and to help a lot as partners and friends.

Acknowledgments
I would like to say that I am grateful for the opportunity that I received to work in this project. I would like to thank the faculty of the Armour College of Engineering at IC, especially Dr. Alexander Flocke, for his support, guidance, help and share his knowledge. I thank also for the doctoral government through CNPq/CAPES that made possible my studies in the United States. I would like to thank the company STAB4 for the support to my work. I would like to thank to my family for their support. I would like to thank to my colleagues involved in this project. I thank you all of my colleagues involved in this project.

Conclusion
It is possible to realize that the waveforms has the same shape, and thus match many well. the benchmarking was done in the PSIM and SCRX. The main idea is explained in the methodology.

References

- [1] Siemens Industry, Inc., “Dynamic Models Package” Version 2014, 1 October 2014.
- [2] Siemens Industry, Inc., PSCAD 3.3 Model Library.
- [3] T324h Book Library Conversion Guide, Summa, Admin, 2014, Version 1.0.
- [4] T324h Book Library Conversion Project Instructions Part 2: Conversion of Block Diagrams to the Space Formulation.
- [5] Siemens Industry, Inc., Application Program Interface (API), September 2012.

Acknowledgments
I would like to say that I am grateful for the opportunity that I received to work in this project. I would like to thank the faculty of the Armour College of Engineering at IC, especially Dr. Alexander Flocke, for his support, guidance, help and share his knowledge. I thank also for the doctoral government through CNPq/CAPES that made possible my studies in the United States. I would like to thank the company STAB4 for the support to my work. I would like to thank to my family for their support. I would like to thank to my colleagues involved in this project. I thank you all of my colleagues involved in this project.

Figure 1: Block Diagram from Simulation of the exciter EX01
After this, the simulator ran, then, the benchmarking was done in the PSIM and SCRX. The main idea is explained in the methodology.

Figure 2: Plot of the simulation in MATLAB and PSCAD
Figure 3: Plot of the simulation in MATLAB and PSCAD

(ENGR 499.34) Faster Than Real-time Dynamics Simulator for Large-scale Power Systems

Faster than Real Time Dynamic Simulations for Large Scale Power Systems – STAB1
Diego Bebera; Alexander Flocke, Ph.D.
Armour College of Engineering, Illinois Institute of Technology

Introduction
In this days when electricity has a fundamental role to the society and the time is very important, the need to have a real-time power system working as much time as possible is increasing. The real-time dynamics simulator is a tool that can help to solve this problem. Dynamics simulator for large scale power systems (STAB1) is making this goal adjusted to conditions of the power system, without affecting the efficiency way to ensure the desired levels.

The code is now available for the real-time power system computers modeling. In this part we have to reverse the model for Gensets, Loads, and Control Systems. Governor, and System Excitation working in series. The code is now available for the user can get the faster and easier resource for the simulations.

Method

Initially, we are performing simulation with the commercial program PSCAD (from Siemens/PFT) and MatLab/Simulink developed for the real-time power system. After that, evaluate the results and make the necessary modifications. Then, evaluate if the results are acceptable, and if not, continue the process until achieving the efficient way to ensure the desired levels.

After the simulations, we create the model using C language (numerical functions and others) and then convert the code to the Matlab, and then convert the Matlab code to the PSCAD program. Which the user can use the Matlab code to run the program and allow the program to be faster. Due to the PSCAD allows user define algorithms to solve the equations.

Figure 1: STAB1 General Block Diagram
After that, the diagram is converted to Matlab and then converted to PSCAD. The results are shown in the following figure (Figure 2).

Figure 2: Absolute Error
The residual function, control in C language is converted within Matlab to check the simulation results. The results are shown in the following figure (Figure 3).

Figure 3: Absolute Function complete with PSCAD
After the simulation, we create the model using C language (numerical functions and others) and then convert the code to the Matlab, and then convert the Matlab code to the PSCAD program. Which the user can use the Matlab code to run the program and allow the program to be faster. Due to the PSCAD allows user define algorithms to solve the equations.

(ENGR 499.34) Faster Than Real-time Dynamics Simulator for Large-scale Power Systems

Faster than Real Time Dynamic Simulations for Large Scale Power Systems – STAB4
Eduardo Steffens; Alexander Flocke, Ph.D.
Armour College of Engineering, Illinois Institute of Technology

Introduction
The first way to understand the effects of a disturbance in power systems is analyzing the transient response of the system. The Real-Time Dynamics Simulator (RTDS) is a device that can perform real-time simulations for large-scale power systems. It provides guaranteed performance. MatLab/Simulink and Siemens PSCAD graphs are being used. The following figure shows the flowchart of the analysis and its implementation for the implementation.

Results
Based on Siemens PSCAD documents, the absolute error of the control variables diagram was created on Matlab.

Conclusion
To analyze how good the results is, it is necessary to compare the results obtained by the RTDS and the results obtained by the Siemens PSCAD. After that, we can see in the following figure, notice that the signals are almost superposed.

Method
To develop this research, the following steps were followed: literature review, mathematical resources, and numerical methods.

Figure 1: STAB4 Block Diagram
After that, the diagram is converted to Matlab and then converted to PSCAD. The results are shown in the following figure (Figure 2).

Figure 2: Absolute Error
Using Matlab, we can find the Absolute Error between Siemens and Siemens PSCAD. The results are shown in the following figure (Figure 3).

Figure 3: Absolute Error
Table 1: Absolute Error and Control

(ENGR 499.34) Faster Than Real-time Dynamics Simulator for Large-scale Power Systems

Event Detection and Data Compression Using Discrete Wavelet Transform
Frederico José da Oliveira and Dr. Alexander Flocke, ENGR 499.35

Overview
The objective of this project is to generate a signal processing technique for automatic event detection and data compression. The event detection is based on Discrete Wavelet Transform (DWT) using Radon's algorithm in the wavelet mother.

Figure 1: Event detection and data compression
A method to compress steady state data and keep original data characteristics is presented. After decomposing the signal into several subbands, the algorithm selects the most significant subbands and retains only the synchrophasor data. These subbands are characterized as an integration and a voltage swell. As expected, the algorithm keeps original data around events, and compresses the steady-state data using new I.

Figure 2: Event detection and data compression
Fig. 1 shows examples of event detection and data compression. The algorithm detects the event, retaining the most significant subbands and removing the synchrophasor data. The original steady-state data is compressed, and the event data is retained.

Results
The algorithm presents 100% of accuracy based on the event detection and data compression. The classification and data compression will be detected immediately after detecting the threshold value. The cost associated with the proposed algorithm is low, since the data acquisition system up to 120 samples. The data acquisition system is able to detect the event and the data acquisition, the size of the data files will be reduced by roughly 95%, saving space on data storage systems. Continuing on, the algorithm will be able to detect the event in real time power system and create an automatic threshold selection.

References

- [1] Y. Park, J. H. Kim, D.-H. Lee, J.-B. Lee, J.-B. Kim, and S. H. Cho, “A Novel Real-time Event Detection and Associated Data Compression Method Based on Synchrophasors,” *Journ. IEEE Trans. Power Syst.*, vol. 28, no. 1, pp. 1–6, Mar. 2013.
- [2] A. L. Almeida, L. R. Sampaio, L. Sampaio, and M. M. Graça, “Algorithm for screening PSCAD data for power system event detection and data compression,” in *2012 International Conference and Exhibition on Innovative Smart Grid Technologies (ISGT Europe)*, Oct., pp. 1–6.

Acknowledgments
CNPQ-Brazilian Science Mobility Program
IEPS-BSMP - Brazilian Science Mobility Program
IEPS - Institute of Electrical Engineers
IIT - Armour College of Engineering
Special thanks: Christopher Tsai

(ENGR 499.35) Automatic Event Detection and Data Compression Using Discrete Wavelet Transform Based on Synchrophasors

Principal Component Analyses Applied to Event Detection
Flávio Augusto Souza Oliveira and Dr. Alexander Flocke, ENGR 499.35

Introduction
Numerous systems who use an electronic device looks for a way to make it as efficient as possible. Power systems are not different. It is desired to have a system that can detect the event in real time and use less power using only the least amount of resources. The necessity of having a reliable and efficient system makes the Principal Component Analysis (PCA) a good candidate to solve this problem. The Principal Component Analysis (PCA) is used to collect synchrophasor data from where they are available and use the PCA to detect the event of the system and make them more available and efficient.

Results
The calculation was implemented in MATLAB and it gives us a plot of the power series and PCA points. The PCA calculations are used to detect the event by comparing the data of the event with the average data and each axis of the PCA. The following figure shows the original data compared to PCA.

Conclusion
The event detection using PCA is a great tool that can be used in power systems. It can help to improve the reliability of the system and reduce the cost of the system. This will be very helpful to provide network that are more reliable and efficient, increasing how to apply this method to other applications and to use it in other areas would be a unique advantage. If we combine it with an algorithm capable to reduce the acquired data, we can make the algorithm run faster.

References

- [1] Y. Park, J. H. Kim, D.-H. Lee, J.-B. Lee, J.-B. Kim, and S. H. Cho, “A Novel Real-time Event Detection and Associated Data Compression Method Based on Synchrophasors,” *Journ. IEEE Trans. Power Syst.*, vol. 28, no. 1, pp. 1–6, Mar. 2013.
- [2] A. L. Almeida, L. R. Sampaio, L. Sampaio, and M. M. Graça, “Algorithm for screening PSCAD data for power system event detection and data compression,” in *2012 International Conference and Exhibition on Innovative Smart Grid Technologies (ISGT Europe)*, Oct., pp. 1–6.

Activities
I am thankful to IIT giving me the opportunity to develop this research here. I also want to thank CAPES for the financial support to my research. I would like to say thank to Christopher Tsai who helped me in this research showing my question.

Figure 1: Event Analysis and Power Detection
Figure 2: Detects as the event

(ENGR 499.35) Data Compression and Event Detection Using Principal Component Analysis

Posters

Event detection using PCA analysis based on synchrophasor data.

Authors: Aranyson Alves, Dr. Alexander Flueck, ENGR499.35

Objectives

The main objective of this research is to develop computational tools that are able to analyze, identify and characterize events from synchrophasor data.

The following diagram illustrates the algorithm developed in this research:

Introduction

Nowadays, given strong and the development of new technologies, there is a great demand for energy. The increase in the demand requires that the power grid increase its capacity to guarantee reliability, availability and quality of service. The connection of renewable energies such as solar and wind power to the grid, however, it is known that the system must be able to handle the variability of the grid, based on statistical methods and their derivatives. In this research, we propose to develop a methodology to predict the occurrence of events such as anomalies and extract events without knowing the source of the system [1][2].

The results demonstrate that the algorithm successfully detected the presence of the event in the data. When the PCA predicted anomalies were different from the power data, the point was marked in the diagram. The diagram also shows the report displayed at the abnormalities in a set of data. The identification of these abnormalities is important for the management of the grid.

Results

Figure 1 illustrates the algorithm for the detection of events in a set of data.

Acknowledgments

CAPES/Brazil - Brazil Scientific Mobility Program.
IIT Armour College of Engineering.
IIT - Institute of Technology Education.
Special thanks to: C. Chilko, I. Alves, R. D. K. Klein, D. S. Power System Real-time Event Detection and Monitoring (SMA) Project, Illinois Institute of Technology.

Methods

The Principal Components Analysis (PCA) is applied to analyze the data and detect anomalies. The use of study case of the IIT has several sets of data that is analyzed by the PCA algorithm implemented in this research [3].

Conclusion

In this poster, we propose a methodology to detect events in a set of data. The results show that the PCA algorithm is capable of detecting anomalies in a set of data.

Smart grid synchrophasors - Event-Oriented Method for Load Modeling Based on Synchrophasor Data

Authors: Jose Felipe Conde Furtado de Lima and Dr. Alexander J. Flueck, ENGR499.35

Introduction

In terms of electric generation, synchrophasor data can provide the needed information to improve the reliability, voltage control, quality and efficiency of the power system. The Power Measurement Unit (PMU) is GPS that provides the synchronization of all data collected by the PMU. The data is converted into a PMU message, which can be used by any device of any type. For power systems, detection is made in the time domain, using the Principal Component Analysis (PCA) method, which is a set of data that is compared with the actual data.

The results demonstrate that the algorithm successfully detected the presence of the event in the data. When the PCA predicted anomalies were different from the power data, the point was marked in the diagram. The diagram also shows the report displayed at the abnormalities in a set of data. The identification of these abnormalities is important for the management of the grid.

Results

Figure 2 illustrates the algorithm for the detection of events in a set of data.

Conclusion

and the load model estimation (load and power) and the event detection (synchrophasor data). The results show that the PCA algorithm is capable of detecting anomalies in a set of data.

Discussion

[1] De V. Pham, J. J. Kim, D. K. Klein, R. J. Lewis, J. D. Klem, D. S. Power System Real-time Event Detection and Monitoring (SMA) Project, Illinois Institute of Technology.

[2] J. J. Alves, S. R. Jose, J. S. Simoes, and M. A. "grau," "Machine Learning and Data Mining PMU data for power system events," 1981 3rd IEEE International Conference and Exposition on Innovative Smart Grid Technologies (EST), Everett, wa, 2012.

Acknowledgments

This work was funded by the National Science Foundation (NSF) under grants EEC-0335065 and EEC-0335066.

Methods

This poster presents a methodology to detect events in a set of data. The results show that the PCA algorithm is capable of detecting anomalies in a set of data.

Conclusion

The results demonstrate that the algorithm successfully detected the presence of the event in the data. When the PCA predicted anomalies were different from the power data, the point was marked in the diagram. The diagram also shows the report displayed at the abnormalities in a set of data. The identification of these abnormalities is important for the management of the grid.

(ENGR 499.35) Event Detection Using PCA Analysis Based on Synchrophasor Data

Stock Market Analysis for Event Detection in Power Grid Using SMA

Authors: William Esteves Lobo and Dr. Alexander Flueck, ENGR499.35

Overview

In power grids, it's of great importance to provide very reliable services to the society. As the society is rapidly increasing with several new devices being connected to the grid, the reliability of power systems becomes more and more important. This research is focused on how to efficiently plan and manage the grid, so that planning and management can now be much easier and demands less.

Keywords: Smart Grid, Event detection, simple moving average (SMA), Power Grid, Electrical Engineering.

Objective

The objective of this study is to come up with new methods to efficiently detect disturbances, known as "events", in power systems.

Conclusion

The Stock Market Simple Moving Average technique is a good way to detect events in power systems. It is a good way to detect events in power systems if used with the correct threshold and window size for each studied case.

Future Work

The suggested future work will be to apply this method for real power and current analysis. However, applying the techniques to real time data will be more difficult than the simulated data. We will use the deviation in the data in order to determine whether an abnormal behavior can be considered an event. In this method, we need to determine the threshold either lower or higher than the threshold limit.

Results

Figure 3 illustrates the algorithm for the detection of events in a set of data.

Reference

[1] G. Y. Flueck, J.J. Kim, D. K. Klein, J. R. Lewis, R. J. Lewis, D. S. Power System Real-time Event Detection and Monitoring (SMA) Project, Illinois Institute of Technology.

Acknowledgments

I would like to acknowledge the Illinois Institute of Technology for providing the resources and environment for this research. I would like to thank my advisor, Dr. Alexander Flueck, for his support and guidance throughout this research. I would like to thank the funding support. Moreover, I would like to thank my research partners for the motivation and help.

Stock Market Analysis for Event Detection in Power Grid using SMA

Authors: William Esteves Lobo and Dr. Alexander Flueck, ENGR499.35

Project Objective

This project focuses on the new technologies in the next generation multi-channel wireless communication networks. Specifically, we investigate a implementation of IEEE 802.11n standard in a multi-cell network. We implement [1] operating over multiple unlicensed spectrum bands. As a first step, we study the multi-cell IEEE 802.11n standard in a small cell network [2]. To evaluate the throughput performance of a small cell in a multi-cell IEEE 802.11n standard, we use the IEEE 802.3 (MAC) to study the number of nodes in the network changing and the number of mobile users changing. We also study the IEEE 802.11n standard in an access point (AP), using the channel bonding protocol specified in IEEE 802.11n.

Conclusion

In the meantime, if the non-isochoric sub-channel is bonded AP, the user can then transmit over a wider bandwidth opportunity, as shown in Figure 2.

Results

Figure 4 illustrates the algorithm for the detection of events in a set of data.

Methods / Simulation

To simulate the multi-channel bonding protocol in small cell network, the discrete-event network simulation (DES) is used. The reference cell can simulate the users from the macro cell with direct connection to large scale internet. MCS include various parameters such as channel bandwidth, channel allocation, as well as the mobility of our code to aggregate to the IEEE 802.11n standard. The IEEE 802.11n standard is a multi-user IEEE 802.11 standard. The IEEE 802.11n standard has the characteristics of an early IEEE 802.11ac. It is about results discussing the new protocol efficiency, e.g. higher throughput.

Conclusions and Next Steps

The new standard multi-channel bonding protocol for small cell network, we use MC-1 to evaluate the performance of the protocol in a single cell with three sub-channels. We will continue the simulations in a heterogenous network with multiple APs.

References

[1] H. Zhang, "Testbeds towards small cell and HetNets", *Recent Wireless Network Trends*, Global 12 Institute, March 2012;

[2] IEEE 802.11n-2009: IEEE Standard for Information and Communications, "Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications, Amendment 3: High Efficiency WLAN", IEEE, Nov. 2009;

[3] "Project 15: Small-cell Capacity, Mobility and Energy Efficiency Interactions", Sydney, Australia, June 2013";

[4] "Project 16: Multi-User IEEE 802.11n", IEEE, Mar. 2014;

[5] Square Solutions, "An innovation in 802.11ac", Qualcomm Communications, September 2011.

(ENGR 499.35) Event-Oriented Method for Load Modeling and Estimation Based on Synchrophasor Data

Resource Management in Green Hetnets

Students: Eric Peter Janice Lobo Moreira and Daniel Luis Lima da Silva
Professor: Dr. E. Lin (Cal), ENGR499.38

Project Objective

This project focuses on the new technologies in the next generation multi-channel wireless communication networks. Specifically, we investigate a implementation of IEEE 802.11n standard in a multi-cell network. We implement [1] operating over multiple unlicensed spectrum bands. As a first step, we study the multi-cell IEEE 802.11n standard in a small cell network [2]. To evaluate the throughput performance of a small cell in a multi-cell IEEE 802.11n standard, we use the IEEE 802.3 (MAC) to study the number of nodes in the network changing and the number of mobile users changing. We also study the IEEE 802.11n standard in an access point (AP), using the channel bonding protocol specified in IEEE 802.11n.

Conclusion

In the meantime, if the non-isochoric sub-channel is bonded AP, the user can then transmit over a wider bandwidth opportunity, as shown in Figure 2.

Results

Figure 5 illustrates the algorithm for the detection of events in a set of data.

Methods / Simulation

To simulate the multi-channel bonding protocol in small cell network, the discrete-event network simulation (DES) is used. The reference cell can simulate the users from the macro cell with direct connection to large scale internet. MCS include various parameters such as channel bandwidth, channel allocation, as well as the mobility of our code to aggregate to the IEEE 802.11n standard. The IEEE 802.11n standard is a multi-user IEEE 802.11 standard. The IEEE 802.11n standard has the characteristics of an early IEEE 802.11ac. It is about results discussing the new protocol efficiency, e.g. higher throughput.

Conclusions and Next Steps

The new standard multi-channel bonding protocol for small cell network, we use MC-1 to evaluate the performance of the protocol in a single cell with three sub-channels. We will continue the simulations in a heterogenous network with multiple APs.

References

[1] H. Zhang, "Testbeds towards small cell and HetNets", *Recent Wireless Network Trends*, Global 12 Institute, March 2012;

[2] IEEE 802.11n-2009: IEEE Standard for Information and Communications, "Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications, Amendment 3: High Efficiency WLAN", IEEE, Nov. 2009;

[3] Square Solutions, "An innovation in 802.11ac", Qualcomm Communications, September 2011.

Resource Management in Green Hetnets

Students: Eric Peter Janice Lobo Moreira and Daniel Luis Lima da Silva
Professor: Dr. E. Lin (Cal), ENGR499.38

Project Objective

This project focuses on the new technologies in the next generation multi-channel wireless communication networks. Specifically, we investigate a implementation of IEEE 802.11n standard in a multi-cell network. We implement [1] operating over multiple unlicensed spectrum bands. As a first step, we study the multi-cell IEEE 802.11n standard in a small cell network [2]. To evaluate the throughput performance of a small cell in a multi-cell IEEE 802.11n standard, we use the IEEE 802.3 (MAC) to study the number of nodes in the network changing and the number of mobile users changing. We also study the IEEE 802.11n standard in an access point (AP), using the channel bonding protocol specified in IEEE 802.11n.

Conclusion

In the meantime, if the non-isochoric sub-channel is bonded AP, the user can then transmit over a wider bandwidth opportunity, as shown in Figure 2.

Results

Figure 6 illustrates the algorithm for the detection of events in a set of data.

Methods / Simulation

To simulate the multi-channel bonding protocol in small cell network, the discrete-event network simulation (DES) is used. The reference cell can simulate the users from the macro cell with direct connection to large scale internet. MCS include various parameters such as channel bandwidth, channel allocation, as well as the mobility of our code to aggregate to the IEEE 802.11n standard. The IEEE 802.11n standard is a multi-user IEEE 802.11 standard. The IEEE 802.11n standard has the characteristics of an early IEEE 802.11ac. It is about results discussing the new protocol efficiency, e.g. higher throughput.

Conclusions and Next Steps

The new standard multi-channel bonding protocol for small cell network, we use MC-1 to evaluate the performance of the protocol in a single cell with three sub-channels. We will continue the simulations in a heterogenous network with multiple APs.

References

[1] H. Zhang, "Testbeds towards small cell and HetNets", *Recent Wireless Network Trends*, Global 12 Institute, March 2012;

[2] IEEE 802.11n-2009: IEEE Standard for Information and Communications, "Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications, Amendment 3: High Efficiency WLAN", IEEE, Nov. 2009;

[3] Square Solutions, "An innovation in 802.11ac", Qualcomm Communications, September 2011.

(ENGR 499.38) Resource Management in Green Hetnets Research

School Garden as a Tool for Sustainable Development

Authors: Dúlio Hellensten & Karen Silva - Students, Amber Autumn - Mentor: ENGR 499.42

The Green Ribbon Foundation

Green Ribbon Foundation is a non-profit organization that is the catalyst for connections and change, inspiring business, teachers, students and individuals.

The Outdoor Classrooms

During the 2012 summer, the human beings have been becoming aware about the need to develop a sustainable way. The implementation of the outdoor classrooms are available and unlimited. There is a need to make, reuse and recycle. The outdoor classrooms are a key factor to reach these goals. Today, teaching sustainability means making a better world for the future. The outdoor classrooms have played an important role in this process. Kids are trained to do their part for the humanity, health, and the environment. The outdoor gardens are also an outdoor classroom type.

The Benefits and Outcomes

The implementation of a School Garden has innumerable benefits that have been proven by researches:

- Increases interest in eating fruits and vegetables;
- Improves nutrition awareness;
- Encourages science, science achievement scores;
- Improves self-esteem, attitudes and participation in school;
- Increases interest in mathematics;
- Improves sense of responsibility;
- Improves social skills;
- Increases interest in green areas;
- Increases physical and psychologic health;
- Increases sense of sustainability;

The Prospect Project

Figure 7 illustrates the algorithm for the detection of events in a set of data.

School Garden as a Tool for Sustainable Development

Authors: Dúlio Hellensten & Karen Silva - Students, Amber Autumn - Mentor: ENGR 499.42

The Green Ribbon Foundation

Green Ribbon Foundation is a non-profit organization that is the catalyst for connections and change, inspiring business, teachers, students and individuals.

The Outdoor Classrooms

During the 2012 summer, the human beings have been becoming aware about the need to develop a sustainable way. The implementation of the outdoor classrooms are available and unlimited. There is a need to make, reuse and recycle. The outdoor classrooms are a key factor to reach these goals. Today, teaching sustainability means making a better world for the future. The outdoor classrooms have played an important role in this process. Kids are trained to do their part for the humanity, health, and the environment. The outdoor gardens are also an outdoor classroom type.

The Benefits and Outcomes

The implementation of a School Garden has innumerable benefits that have been proven by researches:

- Increases interest in eating fruits and vegetables;
- Improves nutrition awareness;
- Encourages science, science achievement scores;
- Improves self-esteem, attitudes and participation in school;
- Increases interest in mathematics;
- Improves sense of responsibility;
- Improves social skills;
- Increases interest in green areas;
- Increases physical and psychologic health;
- Increases sense of sustainability;

The Prospect Project

Figure 8 illustrates the algorithm for the detection of events in a set of data.

(ENGR 499.42) Green Commercial Construction, Green Ribbon/ Summit Design

90 Armour College of Engineering
ILLINOIS INSTITUTE OF TECHNOLOGY



Facilities, Operations & Project Management

Campus Security – Android App Implementation
David Silva, Felipe Paiva, Marcello Souta, and Mariana Borges. Dr. Anatoli Longinow, ENGR498.07

Motivation and Goals

The IT Campus Security is assisted by the Public Safety Department which is responsible for security on Campus and for several parts of research or academic activities through the IT Alert. In fact, the need to have a mobile application for the students and to have a quick response is extremely large, because developing an internal one could help to improve the security of all currently on Campus.

Survey Results:

HOW SAFE DO YOU FEEL ON CAMPUS? [0-10]

The App: UT Hawks Defender

Android App Development

- App Development Projects
- Android Studio
- App Functions:
 - Login
 - Protected by biometric prints
 - Where am I
 - Alerts
 - Plans Coming
 - Beach Map
- Android Development Language

Quality Assurance

- Automation: develops a process of automated tests for the application.
- Staged Roll Out: Release the app to a small group.
- Acknowledgements: acknowledge bugs that took of the user's time.
- Don't let users run the phone: do not use the option at our visitors for the app.
- Checklist: bug and fixed mistakes must be classified
- Test, Test, Test: frequently use the app for bugs and issues.
- Manage customer expectations: prevent the customer from requesting new features that cannot be ready by the time.

Acknowledgment and References

Since October 2014 the Armour College of Engineering has more positive feedback about the app. The app has been used by many students and faculty members. Many thanks to all who have used the app.

Wiley Law, 2013. *Android Application Development*. [SAGE]

Android Developers. 2013. *Android Developers Guide*. [PDF]. Available online at: <http://developer.android.com/guide/index.html>

(ENGR 498.07) Implementation of an Android App for the Campus Security

The Use of Software in the Construction Cost Estimating
William Blos de Oliveira and Raymond Lemming, ENGR498.11

Introduction

Construction cost estimating is the country and industry's most important activity. It is a complex project. It involves a study of all conditions of bidding and construction teams, as the materials, employees, changes in weather, and other factors that may affect the cost of the project during the construction period. Some of these are from the United States, as the Microsoft, IBM, Intuit and Autodesk, among others. These companies have developed, either free or paid, software applications for the method of applying expenses.

Following the increase of the software market, there is a great demand for the use of software in the most part of the civil engineering, mainly in the design with the help of computers. This is due to the fact that the software is much faster than the manual work, especially the first. The construction field has software to solve its problems. One of them is the Primavera P6, the legal owner of the software. Another is the EDISON's Interactive Cost Model. It has a big number of users and operation of construction projects. The Interactive Cost Model is used in the Understudies of ISB at the University of Southern California, currently it is in its second version. The software has a lot of features, which none of them stand out in the present industry, because of them have a better efficiency in general.

Results

After detailed research about the software programs used in the construction cost estimating, another one has a great appeal from the user. It is the EDISON's Interactive Cost Model. It has a big number of users and operation of construction projects. The Interactive Cost Model is used in the Understudies of ISB at the University of Southern California, currently it is in its second version. The software has a lot of features, which none of them stand out in the present industry, because of them have a better efficiency in general.

Conclusion

With the study of the software programs and the needs of the field was observed by the user that the software is not very expensive or problematic to use in the software. It can be easily perceive that the EDISON has the best features for the construction cost estimating industry and the developers of the specific construction estimated software programs should develop their own software with the same strengths for this and will bring the best options to the user.

References

- Caugh, Richard H., and Glenn A. Savan (1996). *Construction Cost Estimating*, 6th ed. New York: Wiley.
- Qian, X., & Feng, M. (2013). *Substitutional AI for Construction Cost Estimation*. *Proceedings of Engineering, 2013*.
- Nezad, H., Alirezai, L., & Shabot, Y. (2012). *Practical Construction Cost Estimating Using Data-Based Techniques*. *Journal of Construction Engineering and Management*, 138(1), 1-10.
- Abdullah, M. (2011). *Organizational Software Cost Estimation Model Based on Historical Data*. *SEIM (Edmonton)*, 419-424.
- Abdullah, M., & Al-Hajri, M. (2005). *Methodology on construction management for integrated information systems in construction cost estimation*. *Arabian Journal of Management Sciences*, 18(2).
- Qutubuddin, Qasim, Fawaz (2014). *Engineering Cost Estimation Using UAVs*. *Undergraduate Research Project in Civil Engineering*, 1-6.

QR Code for Paper:

(ENGR 498.11) The Use of Software in the Construction Cost Estimating

High-Tech Way to Change Order in a Civil Construction
Luisa Fairreira Ribeiro, Prof. Raymond Lemming, ENGR498.11

Background

Engineers have a multitude of high-tech equipment and software to construction before the project begins, but there are some situations where there are changes in the construction that require additional work. When these unexpected problems occur, then a procedure called change order (CO) is used. Change orders are a major source of delay in construction projects.

COs can influence changes on the number of employees, the quantity of material and the final time of the project.

For the changes to be made, all the person involved, such as the owner and the contractor, must agree to the changes.

Any requirements to the Change Order process, including estimating and negotiation, can reduce the overall project duration.

Objective

- Identify "best practices" methods to improve change order management.
- Establish high-tech methods to change orders.

Methods

- This project had initial military review in order to find better ways to change orders.
- Materials of the area were reviewed to discuss how change order can be applied.

Results

- Face-to-face Negotiation
- Paper Negotiation
- Software

Paper Negotiation Process:

- Request for Change Order
- Change Order Form
- Change Order Response
- Change Order Approval
- Change Order Response
- Change Order Response

Software System:

Futures Works

- The next step is to collect more information to verify the efficacy of the CO software in civil construction.
- To investigate the possibility of developing a change order management system.

Acknowledgements

- Armour College of Engineering for funding the Engineering Immersion course (ENGR 498).
- Intel Scientific Mentorship Program for giving us the Intel Developer Opportunity.

Best Practices for Change Orders

- Make it easy to communicate in your engineering change process.
- All documentation should be stored in the project database [12].

References

- Liu, L. Challenges in Cost Estimating with Building Information Modeling. *Design + Construction Strategies*, 2008.
- Yao, J. How to Manage Change Order Management in Construction Projects. Available at: <http://www.enrconstruction.com/>.

(ENGR 498.11) High-Tech Ways to Change Orders in a Civil Construction

Uses of UAVs for Construction Estimate Tasks and Further Activities
Diosgo Willian de Witte, Ray Lemming
Armour College of Engineering, ENGR498.11, Chicago, IL
July 8th, 2015

Objective

- To study the applications of UAVs (Unmanned Aerial Vehicle) over the construction site to estimate the costs and losses and their benefits for their application.
- To describe new possible tasks which UAVs can optimize considering costs, time, and quality.

Intended Learner

Over the years many technologies have been used to support the estimator's work by making it faster, and improving the accuracy of a work. The latest technology is the software, new measurements tools, photogrammetry, and laser scanners.

UAVs are an emerging tool which have been used to support the estimator's work by making it faster, and improving the accuracy of a work. The latest technology is the software, new measurements tools, photogrammetry, and laser scanners.

The latest innovation resulting from the software is the use of the construction field. Previously, these tools were being performed by the estimator manually, which was more time-consuming with higher costs, in longer time, and less efficiency.

Surveying Activity - 3D Modeling

- The primitive is to perform a survey using a laser scanner to obtain a photogrammetric point cloud with a resolution of 1 cm.
- The point cloud is used to overlap the adjacent images to form a panoramic image. When this procedure is done the software generates the 3D model.

3D Scan

After the 3D model is generated, it can be transferred and edited on a CAD software such as AUTOCAD 3D or AutoCAD.

Other Construction Tasks Being Used

- Overhead and underground pipelines as modeling tool.
- Construction safety application.
- Construction management and other structures.
- Inspection of energy losses across the construction site.
- Traffic monitoring.
- Inspection of highway construction.
- Construction site monitoring.
- Dense terrain investigation.

Conflict

dwitte@uic.edu | Phone: 312/996-3999

Acknowledgments

(ENGR 498.11) Uses of UAVs for Construction Estimate Tasks & Further Activities

Posters

The Use of Building Information Modeling (BIM) in Cost Estimating
Marcos Tomim, Mikael Macamiro, Prof. Raymond Lemming, ENGR498.11

Introduction

Cost estimates for building projects are usually a hard and time-consuming process. Nowadays, the quantification of building projects is done through the use of estimating software, taking measures from 2D-CAD drawings, which other estimating tools or the estimator's own knowledge and experience are used. This process can take up to 30% to 80% of the time required to create an accurate cost estimate.

According to the National BIM Standard, the BIM technology is a digital representation of physical and functional characteristics of objects in the form of shared information. It is possible to take quantities from the model, creating an accurate takeoff automatically. From this perspective, the use of BIM in cost estimating is a great advantage, as it allows prices through different software connected with the model.

This paper intent to discuss more about this alternative, bringing a review about BIM and how it can be used in cost estimating. In addition, the main aspects that need to be considered when using BIM in cost estimating will be explored. The future role of the cost estimators were investigated. To conclude subjects like the following was performed:

- Interview with BIM consultants
- Literature review
- Cost estimating software analysis.

Results

There are three methods to use BIM in estimating:

- **Using BIM estimating software to estimate costs**: In this case the BIM software provides the cost estimates, making easier to estimate the cost of the project. It also provides support of a BIM tool, the quantities are generated automatically, saving time and effort.
- **Link the BIM directly to the estimating software**: The process of this type is the same because the BIM model is used to generate the quantity and then change the computer estimate by itself. The industry has shown that it works better with the support of cost estimating software.
- **Use BIM as a tool to estimate costs**: This alternative is the most difficult among all possibilities. In this case the quantity is generated by a specialized company like off-the-shelf estimating software.

Other Findings:

- BIM improves visualization to the estimator and can easily identify errors.
- BIM estimates most of the quantification effort and can quickly update the quantities when the model changes.
- BIM is a great tool to store the data in a central location, integrating the quantification to the cost database.
- There are legal concerns regarding who has the right to use the BIM model.
- Difficulty to find a project where every stakeholder uses BIM.
- A model will automatically produce an estimate. This is a misconception about BIM.

(ENGR 498.11) The use of Building Information Modeling (BIM) In Cost Estimating

The Evolution of Construction Scheduling Methods, Technologies, and Practices
Construction Scheduling Methods Analysis
Carolina Martins, Letícia Lemos, Luis de Souza, Professor Lee Welsh - ENGR498.13

Introduction

The construction schedule has always been a key element for successful projects. Projects to be completed on time and within budget are the main goal of any construction project. The evolution of scheduling methods over the last century has been significant, moving from simple hand-scheduling to complex computer-based systems.

Methods

- Bar Chart
- Network Diagram Method
- Area Diagram Method
- Program Evaluation Review Technique (PERT)
- Monte Carlo
- Procedure Diagram Method (PDM)
- Liner Scheduling Method
- 4D Scheduling (4DS)

Discussions

The results obtained by reviewing references and analyzing each method after exploring case studies and applying them to real-life situations are presented, along with its pros and cons.

For more accurate results we need to test each method and the results for analysis.

Acknowledgements

- ITA Armour College Engineering for funding of the research
- Prof. Lee Welsh for supervising this research
- Professor E. Anne Green sharing his BIM experience

(ENGR 498.13) The Evolution of Construction Scheduling Methods, Technologies, & Practices - Group 1

The Evolution of Construction Scheduling Methods, Technologies, and Practices
Construction Scheduling Software and Mobile Apps
Gabriela Sayuri Mizushima Nakagawa, Guilherme Pele de Moura, Professor Lee Welsh, ENGR498.13

Introduction

Today competitive construction companies must adapt their business to the market. This is why construction scheduling software and mobile applications are important.

And the use of mobile devices is one important technology being tried to increase efficiency and cut costs. Mobile devices are currently being used to keep track of the workable installation while the work is scheduled. This result in less time required updating schedules and more accurate reporting of progress.

Methods

A project schedule example was used to compare the quality of scheduling software and mobile apps.

The example is a construction project in which the project manager was assigned to the construction team "Construction Planning and Scheduling" by Jimmie.

Specifications for the scheduling software and app, published on the developer's website, were recorded. The mobile devices and construction scheduling software and app written by customers were analyzed.

Articles related to scheduling software and technologies were reviewed.

Discussions/Future Work

A chart comparing the performance of the scheduling software and mobile applications was created.

The comparison was based on the following criteria: ease of use, functionality, compatibility, and cost.

Comparisons between software and mobile applications showed that third-party solutions and the mobile application "Construction Planning and Scheduling" by Jimmie had the best performance.

Mobile devices and construction scheduling software and app written by customers were analyzed.

Articles related to scheduling software and technologies were reviewed.

(ENGR 498.13) The Evolution of Construction Scheduling Methods, Technologies, & Practices - Group 3

Delay Analysis in Construction Projects
Catalina Diaz, Guilherme Brugge, Júlio Moreira, Lucas A. P. Forest, Vitor Ovini, Andris Dzintars, ENGR 498.12

Introduction

Delay is one of the major issues problems in the construction industry. Delay in a construction project have severe consequences on cost and profits. Knowing the probability of the construction delays with a timely manner can help to reduce the risk of delays and increase the profit of the project. The goal of this research is to identify the causes of delay in construction projects and to identify the relationship between the causes of delay and the effects.

METHODOLOGY

The methodology of the current study was a literature review and analysis of 81 scholarly articles. The main objective of this research is to identify the causes of delay in construction projects and to identify the relationship between the causes of delay and the effects.

(ENGR 498.12) Delay Analysis in Construction Projects

The Evolution of Construction Scheduling Methods, Technologies, and Practices
History and Trends of Construction Scheduling
Danielle Rosa Battista Lima, Marcos Rafael Silva Rodrigues, Professor Lee Welsh - ENGR498.13

Introduction

The history of scheduling begins just after the Industrial Revolution in 1938 with the development of the Bar Chart by Henry Gantt. Today, construction scheduling consists of complex processes involving many different steps. The methods and practices of scheduling have also evolved as a result of the technologies available. The purpose of our research is to identify the trends throughout the history of scheduling, the evolution of the scheduling technologies in construction planning and scheduling that can help make a more accurate scheduling satisfying the three main keys in a construction project: quality, time, and cost.

Results

The Gantt chart is a graphical representation of the tasks of a project, showing the start and end times of each task and their dependencies. The PERT chart is a network diagram that shows the activities and their dependencies. The 3D model made with cloud could be implemented in the scheduling software to track the construction progress.

Discussion/Future Work

The technologies available today can be integrated into the scheduling process in order to make a more accurate schedule. In this context, a new technology that could be used to update the schedule is the laser scanner.

The Monte Carlo simulation is a powerful tool for solving problems that involve uncertainty. It is a statistical technique that generates multiple random samples of the input variables to predict the outcome of the process.

Acknowledgements

- Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and Institute of International Education (IEI) for financing the (BSMP).
- Illinois Institute of Technology and Armour R&D College for funding the 2015 Summer Egg.
- Ray Lemming of Illinois Institute of Technology, Robert Bivin of Coordinated Construction Project Control Services, and Dennis Kailof of Context Consultants for sharing their knowledge with us.

(ENGR 498.13) The Evolution of Construction Scheduling Methods, Technologies, & Practices - Group 2

Using Monte-Carlo Simulation to Support Decision Making
In Career Path Selection
Klara, Mariana, Silvia, Larissa, Da Durango Corrêa, Elizabeth, ENGR498.33

Introduction

Nowadays, many young people face the challenge of choosing a career path to follow for the rest of their lives. With all the uncertainties present in the current market, it is increasingly difficult to make a decision that will bring long-term stability. Therefore, various metrics and financial analyses are used to support the decision-making process. These metrics are applied to financial aspects present in a project, such as money or risk.

The "Monte-Carlo Simulation" applies the situation faced by the MBA student Silvia Thomas, decide which career path she should follow. She has two options: become a computer engineer or become a entrepreneur and start her own business. Silvia Thomas, a second year MBA student, just started an entrepreneurial project, called "Sally's Kitchen". Sally's Kitchen is a new sandwich shop, even though she has no prior experience in the food industry. She is looking for a different career path.

Methods

Monte Carlo simulation is a computational method that generates sample values, drawn from defined probability distributions to estimate the sample distribution of outcomes, as shown in the figure below.

Results

After running all the necessary simulations and financial results which represent the financial annual return rate each year, the following graph was obtained:

Model Assumptions

Monte Carlo Simulation allows to simulate any process where there is uncertainty. In this case, the initial capital (the initial investment in Sally's Kitchen) was \$300,000.00. The number of Model Sales per the Revenue per Model Sale was set to 1000. The number of years in the analysis was set to 10 years. The data used can be seen below:

Year	Model Sales	Revenue per Model Sale	Total Revenue
1	1000	\$100	\$100,000
2	1000	\$100	\$100,000
3	1000	\$100	\$100,000
4	1000	\$100	\$100,000
5	1000	\$100	\$100,000
6	1000	\$100	\$100,000
7	1000	\$100	\$100,000
8	1000	\$100	\$100,000
9	1000	\$100	\$100,000
10	1000	\$100	\$100,000

Conclusions & Discussion

The financial implications of the two alternatives are very similar. The expected annual return rate for the first alternative (Sally's Kitchen) was 10.7%, and for the second alternative (Sally's Kitchen) was 10.6%. Both alternatives have a standard deviation of 10.7%.

Financial returns in Sally's Kitchen, the partnership offer, always will have more variability than the responsibility of a computer engineer. The annual return rate for the first alternative is a range of not very high, as shown in the graph above. The annual return rate for the second alternative is a range of not very high, as shown in the graph above. But, besides the numerical results, was concluded that this model supports the structuring of not consider the future scenario, as well as the variation of the revenues range could have in the Consulting Firm.

(ENGR 498.33) Quantitative Models for Operations Management - Group 1

Pricing Surplus Inventory
Paula Carneiro Marins, Regis Fernandes Silva - Dr. Elizabeth Durango-Cohen, ENGR498.33

Introduction

In this poster an internet case study on Pricing Surplus or Leftover Inventory. A larger retailer of kitchen appliances who sells espresso machines, must answer:

- How much to order [R]
- How to price any leftover products [P]

In this scenario the company orders units from a supplier. The company's objectives is maximize profit, the main constraint is that there is a lot of uncertainty about demand [D] over the selling season.

Method

Monte Carlo Simulation is a problem solving technique used to find the probability of certain outcomes by running multiple simulations. Success rates can be set for each simulation. This allows the user to run a system that deals with uncertainty. Allowing the development of plans to mitigate and/or cope with risks.

Results

Instance 1: Setting $D = 2000$, $R = 325$, Setting the table below

Instance 2: Setting $D = 2000$, $R = 325$, follow the table I

Instance 3: Setting $D = 3000-3400$, follow the table I

Instance 4: Joint Optimization, p_1 and p_2

Process

Setting $D = 3250$, $R = 325$, $p_1 = 40$, $p_2 = 10$

References & Acknowledgments

• Assessment and Development Guide for Sustainable Design Series – Second Edition
 • American Consulting Engineers Council
 • ASCE 7-16 Seismic Provisions for Buildings
 • ASCE 31 Residential Building Seismic Provisions

(ENGR 498.33) Quantitative Models for Operations Management - Group 2

TO HEDGE OR NOT TO HEDGE?
Carolina G. F. Dely, Thiago L. Santos and Elizabeth J. Durango-Cohen
ENGR498.33 - Quantitative Models in Operations Management

Introduction

Imperial, Inc. is a large corporation company based in Massachusetts. 90% of Imperial's sales are from exporting outside the U.S. and 10% are from domestic sales. Imperial has a large number of employees in the U.S. (1000 workers) and 1000 workers in Brazil. The company wants to diversify its market and increase its sales in Brazil. The company wants to know if it is better to hedge or not hedge its sales in Brazil.

Model

As the sales will change with the exchange rate, we believe a risk analysis chart would be more appropriate than a normal distribution. We used the Monte Carlo simulation to calculate the expected profit and the probability that the profit will be higher or lower than the expected value. The following table shows the results of the Monte Carlo simulation.

Results

The revenue calculated in the sum of the Profits and Losses.

Conclusion

We believe the company should not hedge its sales in Brazil because all the scenarios have sales of 100% of the expected sales. The following table shows the comparison in the revenue distribution for the different scenarios and the time when the company should not hedge its sales.

Monte Carlo Simulation

In monte carlo simulation, we have samples drawn from real distributions and very often we have a normal distribution. In our case, we have a uniform distribution. The following figure shows the probability distribution function of the profit.

References & Acknowledgments

• Hedging: An Overview of Hedging Techniques Using Monte Carlo Simulation
 - Optimal number of contracts to hedge

(ENGR 498.33) Quantitative Models for Operations Management - Group 4

ENGR 498.37 - Chilled Water System Optimization
Ana C. S. Soave, Lucas D. S. Silva, Instructor(s): Jeffrey Barrie, Kevin Gallagher

INTRODUCTION

Chilled water systems are one of the largest energy consumers in buildings. The goal of this research was to analyze the current system and propose a more efficient system.

METHODS

Firstly, we analyzed the current system and identified the inefficiencies. Then, we proposed a new system that would reduce the energy consumption and increase the efficiency of the system.

RESULTS

The new system was able to reduce the energy consumption by 10% compared to the current system. The new system also reduced the peak load by 20%.

SUGGESTIONS

Further optimization can be achieved by reducing the peak load even more.

REFERENCES

• Chilled Water Systems: A Critical Review of Current Practice and Future Prospects
 - Chilled Water Systems: A Critical Review of Current Practice and Future Prospects
 - Chilled Water Systems: A Critical Review of Current Practice and Future Prospects

ACKNOWLEDGEMENTS

• Ana C. S. Soave, Lucas D. S. Silva, Instructor(s): Jeffrey Barrie, Kevin Gallagher

(ENGR 498.37) Chilled Water System Optimization

Hiring System Using Monte Carlo Simulation
Iabela Tavares, Bruna Roman - Elizabeth Duango-Cohen, ENGR498.33

Introduction

Monte Carlo simulation is a computational method used to estimate the distribution of a stochastic variable (x), $f(x)$, by generating samples of random numbers and applying them to the input variables that define the model. The distribution in each of the models is the number of often female.

Methods

Monte Carlo simulation is a computational method used to estimate the distribution of a stochastic variable (x), $f(x)$, by generating samples of random numbers and applying them to the input variables that define the model. The distribution in each of the models is the number of often female.

Results

We use the simulation to work the number of staff for each start date, giving back the solution that maximizes ABC reads. As a result we get the following:

Conclusion

A flexible start enables the company to supply the demand for analysis. Due to seasonal factors, the number of the fixed contracts and idle people is reduced.

Acknowledgements

This research project was supported by the Institute of International Education, USA and Instituto Tecnológico de Aeronáutica.

(ENGR 498.33) Quantitative Models for Operations Management - Group 3

Utilities Master Plan
Bruna Lourenco Ferrari, Juliana da Silva Ferreira, Jeffrey Barrie, ENGR498.36

Introduction

A Utilities master plan is a deep study of the actual consumption of energy in the University of São Paulo. This allows a better understanding of the issues Institute of Technology (ITI) faces to continue utilizing the available resources. The main objective of this project is to propose new technology for the campus' best purposes. The last goal is to propose a plan to the University to expand the infrastructure and equipment in buildings, dormitories, clinics, etc. that would help the campus consume and manage demands, and develop a plan for the short, medium, and long term.

Methods

Research and visits to power plants, universities, and other companies in the area of energy allowed to become familiarized with the subject. After this, a study about the current equipment in the University of São Paulo was made. This study was created and filled out with information about the current equipment and its usage. The data were used to justify the equipment according to their operation conditions. Also, it was determined which equipment could be replaced by more efficient ones and by other buildings or central plants. Using this data a spreadsheet containing the list of campus facilities and their respective energy needs was created.

Discussion/Future Work

Utilities master planning is a large and complex project. The research covered only a small part of the entire planning. Therefore, there is no final conclusion yet but researches set out researches and suggestions for future work. The next step is to analyze carefully the information contained in the spreadsheet to achieve a better campus energy consumption. This will allow for better teaching and plant needs. To make this information more visual, a website could be built showing all the data contained in the spreadsheet organized by building. This way, the user can easily see what is needed and what is available for each building. This will allow for better management of energy resources and better consumption in the future. Also, energy purchasing strategies are implemented there and new systems in a centralized manner.

Acknowledgements

The authors would like to thank CAPES and the Institute of International Education (IEI) that sponsored this research project. We would also like to thank the Department of Facilities and Maintenance Management of the University of São Paulo (USP) for its full support provided during the research.

References

• UMEP: Univer. Mainer. Univ. of Maryland. Dept. of Energy. <http://www.doe.maryland.edu/umep/umep.html>.
 • University of Wisconsin-Madison. <http://www.ses.wisc.edu/~mcmillan/umep.htm>.
 • University of Wisconsin-Madison. <http://www.ses.wisc.edu/~mcmillan/umep.htm>.
 • University of Wisconsin-Madison. <http://www.ses.wisc.edu/~mcmillan/umep.htm>.

(ENGR 498.35/498.36) Utility Master Planning

Sustainability of Campus Utilities Production
Hein Alverang, Belice Marinho and Silv Morey
ENGR498.41

Introduction

Our research is based on the development of the Urban Green Loop project that has been started by students from ITI's Street School. The project aims to collect organic waste from the campus, turning it into energy and reducing the amount of organic waste sent to landfills. The project proposes the implementation of a sustainable closed loop in the ITI neighborhood, by the use of organic waste, biomass and compost for growing organic waste. It has been developed since the beginning of the year, involving the construction of an organic waste collection point, a digester (EAF) and a Combined Heat and Power system (CHP) at facilities.

Results

We had to estimate the amount of organic waste available in the project area. We collected data from local restaurants and food establishments to estimate the amount of organic waste generated per day. The amount of land available for growing organic waste was estimated by the use of Google Earth.

Methods

Initially, we researched the land from previously given to obtain more information about the project. We also searched on different sources to check if the data were accurate and reliable for our research purposes. Furthermore, we learned how an AD works to proceed with the plan.

Discussion/Future Work

After checking the costs for the whole project, it is noticed that it has no high investment. We realized that the cost could be reduced by using a smaller CHP system. One of the modifications would be adapt a more recycling system to supply the organic waste to the CHP system. Another change would be instead of using a CHP system, we could connect the AD to the street grid. This way, the university can not necessarily have to focus on the costs for this new proposal and find the specific location for the AD.

References

• Campus Energy and Sustainability Department. <http://www.iepa.gov/>
<http://www.ses.wisc.edu/~mcmillan/umep.htm>
<http://www.ses.wisc.edu/~mcmillan/umep.htm>
<http://www.ses.wisc.edu/~mcmillan/umep.htm>

Acknowledgements

We would like to thank the International Institute of Education, CAPES and Illinois Institute of Technology Facilities Center and Campus Energy and Sustainability Department.

(ENGR 498.41) Sustainability of Campus Utilities Production: Urban Green Loop Project

Posters

Life Science Proposed Security System
Date: Felipe Morellos Alvaro (Ibn), Gregory Matamoros and Art Martinez
ENGR 498.43

Introduction
The Illinois Institute of Technology main campus consists of 36 buildings that serve a variety of functions, including academic, residential, research, and administrative. I have conducted research in the various colleges of the university. I have studied the security system in each college and found the gaps in the current security technology system and develop a set of recommendations to minimize the gaps.

References
• Illinois Institute of Technology Facilities & Maintenance
• Current data provided by Public Safety Department
• List of equipment provided by IIT's Facilities Center

Methods
For all of my research, I have studied each different building and its security system. I have also studied the security system implemented and how it compares to what is currently in place. After the survey was completed, I have made a recommendation of each equipment we need to implement in each of the different areas of the building.

Acknowledgments
I would like to thank the International Institute of Education, CARS/PSA and Illinois Institute of Technology Facilities Center and Public Safety Department.

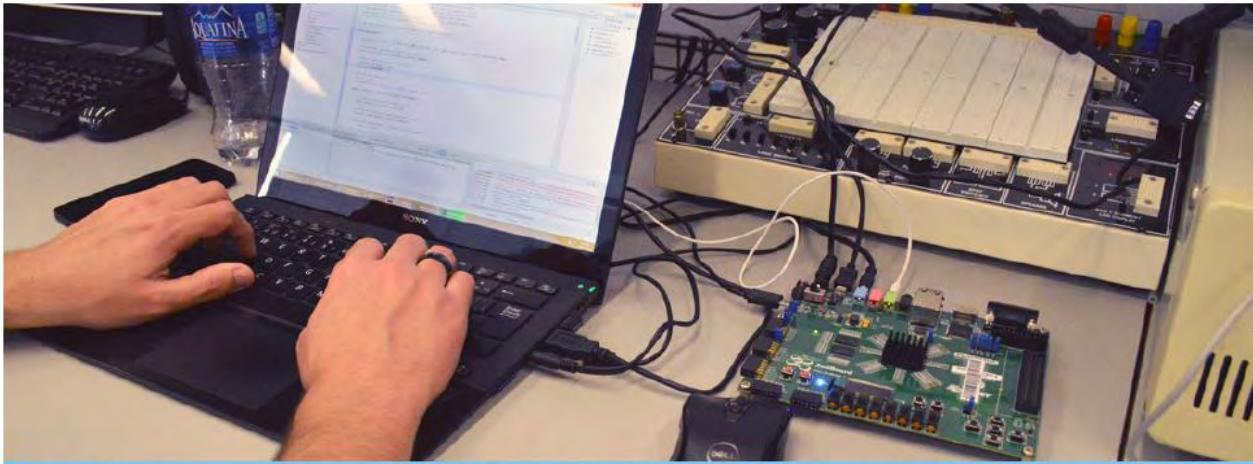
Discussions/Future Work
After the survey and studied each different piece of the security system, I notice that the Life Science needs more attention to their security. I would like to see the system implemented.

Results


On-Going project (There standardize some security aspects ex:

- All entrances must have cameras and access control
- All Research Labs must have access control with the IIT Card
- All Research Labs must have fire alarms
- All Research Labs must have heat alarms
- Emergency phones per floor
- Emergency phones must be connected with the IIT Card

(ENGR 498.43) Life Science Proposed Security System



Hardware, Software & Communications R&D

Real-Time Automated Target Tracking System
Student: Yan Curvinha
Instructor: Dr. Jafar Sarile
Department: Electrical and Computer Engineering

Abstract
 This project presents a system, integrating a real-time target tracking and a laser gun. The system includes following algorithm:
 - Color Segmentation
 - Objects Recognition
 - Motion Detection
 - Pattern Matching

Objectives

- Automated Target Detection
- Automated Target Tracking
- Automatic Gun Firing

Image Processing

- Acquiring in Matlab (OpenCV) algorithm in his book [2] Image processing is the first choice for this project. He can use OpenCV to preprocess the image and convert it into a frame suitable for further analysis.

Color Detection

System Working Process

Tools & Software
 MATLAB & OpenCV libraries, used to implement & programming images. OpenCV is library written in C++ with a strong focus on computer vision applications.

Conclusion
 After a lot of research, hard work and experiments, we successfully implemented techniques developed over a long time ago of how to track a target. Our system can detect and track a target in an environment with multiple objects and also able to shoot it accurately.

Future Work

- Improve the camera's memory
- Improve the sensor's memory
- Improve the tracking algorithm

References
[1] Zhang, G., "Graph-Cut Based Image Segmentation," in Graph-Cut Methods in Computer Vision and Computer Graphics, Springer Berlin Heidelberg, Berlin, Heidelberg, 2011.
[2] Orceau, Thomas. "OpenCV Project Report: Real Targeting System". ECASP-07
[3] Al-Jaroodi, J., et al. "A Real Time Optical Tracking Using OpenCV". YouTube webpage.

Acknowledgment

Project thanks to my Advisor Prof. Jafar Sarile, Department of Electrical and Computer Engineering at Illinois Institute of Technology for his support. Many thanks to Prof. Matheus Inoue for his help and supervision of this project.

Hardware of Tracking System
 The Tracking System Target Component:

- Small targets (helicopter, car, truck, bird, boat, person, etc.)
- Large targets (tanks, cars, tanks, etc.)

Tracking System Reference
 - Helicopter
 - Tank
 - Truck
 - Car
 - Boat
 - Person

Video Tracking
 - Helicopter
 - Tank
 - Truck
 - Car
 - Boat
 - Person

(ENGR 498.14) Real-Time Automated Target Tracking System

Real-Time Automated Target Tracking System
Student: Gleberon de Santana Oliveira
Instructor: Professor Jafar Sarile
Department: Electrical and Computer Engineering

Abstract
 This project aims to develop a system for recognition, tracking and neutralization of a mobile target colliding a projectile with a laser gun. It uses the following algorithms:
 - Image Processing applications

System Overview

The interface between the camera and the microcontroller is made by sending (UART serial)

Target Recognition

Each captured frame is processed using the following algorithm:

- Color Segmentation in HSV color space
- Target is selected in the hue range
- Background is removed by setting a threshold for the saturation.

Stepper Motor

To align the captured object made camera view the camera is mounted on a rotating base with a stepper motor.

Laser Gun and Tracking Calibration

The laser gun is controlled by two servo motors using commands from the microcontroller. As there is no feedback from servo motors, the position of the object on the image is measured using a proximity sensor of the servo motors.

Conclusion
 The overall function was realized. The communication, the stepper motor, the servo motors, and the shooting strategy were implemented as desired. Given the position of the object, the target can track and shoot it.

Acknowledgment

- Project Leader: Prof. Jafar Sarile
- Research Assistant: Priscilla Souza, Wagner Ysac, Wagner Yang
- Software developer: Hugo Oliveira, Rebeca Souza-Silva

References
 ITR Area, Faculty Report for the Development of a Self-Neutralizing Laser Gun, Department of Electrical and Computer Engineering, Illinois Institute of Technology, Chicago, IL, USA, March 2013. URL: <http://www2.itl.illinois.edu/~jafar/SelfNeutralizingLaserGunReport.pdf>, Last visited on March 1, 2013.

(ENGR 498.14) Real-Time Automated Target Tracking System

Real-Time Automated Target Tracking System
Student: Matheus Inoue
Instructor: Dr. Jafar Sarile
Department: Electrical and Computer Engineering

Abstract
 This project aims to develop a system that performs: recognition, tracking and neutralizing an incoming flying object. The system will be implemented on the Electrical and Computer area within the Electrical Engineering lead. Image Processing, Control and Communication areas will be involved. Some modifications can have several different applications.

Objectives

- Detect and track an incoming helicopter
- Arm the helicopter by moving the cameras
- Establish the best chance to shoot

Image Segmentation
 We used a specific color format called HSV (Hue, Saturation and Value), since it is more robust than the RGB format to detect an object.

Feature Detection

Hardware Setup

Conclusion
 All of the main algorithms for the Image Processing part are finished [Feature Detection, Image Segmentation and Frequency Analysis].

Future Work

- Improve feature detection
- Improve all of the algorithms together
- Implement CATCH22/CATCH3D library
- Adaptive threshold for a more robust tracking
- Usage the workflow on hardware

System Overview

References
 [1] Vents, Jean. "Robot Object Detection using a Fitted Model of Simple Features. [2] Nomer, M., Agulho, A.. Feature extraction for robot navigation using a neural network. [3] Venkateswaran, Raghav. Deep learning for autonomous vehicle navigation. [4] Visenti, R. [5] Venkateswaran, Raghav. Deep learning for autonomous vehicle navigation. [6] Venkateswaran, Raghav. Deep learning for autonomous vehicle navigation."

Acknowledgements

- The Brazilian Scientific Mobility Program (BRAZ).
- Graduate students: Thomas Gómez, Gleberon de Santana Oliveira, Geojun Yang, Bruno Nóbrega, Gleberon Oliveira, Vago Texeira, Van Curvinha.

Trajectory Prediction
 The trajectory prediction helps the system to a more efficient maneuvering and analysis of the object to be tracked.

(ENGR 498.14) Real-Time Automated Target Tracking System

Touch Screen Mini - Calculator
Student: Eduardo M. Frazão
Instructor: Dr. Jafar Sarile
Department: Electrical and Computer Engineering

Introduction
 Nowadays microcontrollers have many applications in different areas like home automation, industrial machines, smartphones, computers, etc. They are popular because they are low cost and easy to program. However, they are impractical to perform specific tasks.

This project aims to implement a mini calculator, using an ARM microcontroller and a TFT Touch Shield library.

This project can be expanded as a general purpose touch keyboard.

Algorithm

Objective
 Use a TFT Touch Screen (WAVES compatible) to create a mini - CALCULATOR.

The Hardware

RESULTS

DISCUSSION
 Touch screen needs to be perfectly calibrated to work as desired. Each touch screen needs to be calibrated individually, since they are manufactured to the same specifications.

The code to conduct a calibration with touch is complex, because it involves interaction between humans and touch screen.

CONCLUSION
 The board was constituted successfully and the TFT touch screen was calibrated and tested for its correct operation. After which, comes the implementation of the code to perform calculator functionalities.

FUTURE WORKS

- Implement a better layout.
- Improve the work of the calculator.
- Create other applications using touch keyboard

Acknowledgments

- Graduate Students:
- Thomas Gomez, Gleberon W. Souza-Silva
- Coordinator of the Research:
- Percival de Nóbrega Oliveira

References
<https://www.waveshield.com/calculator.html>
<http://www.mbed.org/armembed/Software/Software/Software.aspx?CategoryID=17&CategoryName=Software&PageNumber=1&PageCount=1>

(ENGR 498.14) Touch Screen Mini Calculator

Posters

Waypoint Tracking and Guiding System

Student: Leandro Biessak
Instructor: Dr. Jafar Sanei
Department of Electrical and Computer Engineering, Illinois Institute of Technology

ABSTRACT
This project presents a system that integrates sensors, software and hardware to create and track waypoints. The Waypoint Tracking and Guiding System (WTGS) utilizes implementing open-loop.

OBJECTIVE
• High tracking and guiding system
• High reliability
• Low power consumption

THE CONCEPT IDEA

THE HARDWARE
Sensor Modules:
- Ultrasonic Sensors
- GPS Antenna
- Gyro
- Accelerometer
- Infrared Sensors
- DC Motor
- FRT Board
- 16x20x32 LCD touchscreen
- Integrated SD Card Module

SAT/ACTION
- GPS Antenna
- Ultrasonic Sensors
- Gyro
- Accelerometer
- Infrared Sensors
- DC Motor

DATA PROCESSING
- INTEGRATED SYSTEM
- Zynq-7000
- 80 MHz CPU Speed
- 1.2 GHz GPU Speed

SYSTEM IN CAPTURE AND STORAGE
FRT Board
- 16x20x32 LCD touchscreen
- Integrated SD Card Module

PROJECT TIMELINE
Project Phase 1: Research & Design
Project Phase 2: Implementation & Testing
Project Phase 3: Testing & Optimization

CONCLUSION
The project has been implemented:
- Digital interface with ADC Transceivers Block in Zynq-7000 (FPGA Section)
- Sensors Module driver
- Gyro, Microphone and Distance Measurement (DMS) Block
- Navigation data acquisition

FUTURE WORK
- Implement algorithm that uses stored data to generate waypoints
- Implement algorithm that uses stored data to generate waypoints using the recorded track

ACKNOWLEDGEMENT
- Baseline Scientific Mobility Project (BSMP)
- Prof. Dr. Jafar Sanei, Department of Electrical and Computer Engineering, Illinois Institute of Technology
- Prof. Dr. Jafar Sanei, Department of Electrical and Computer Engineering, Illinois Institute of Technology

REFERENCE
[1] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[2] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[3] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[4] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[5] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.

(ENGR 498.14) Waypoint Tracking and Guiding System

Real-Time Embedded Audio Signal Processing System

Student: William Jamir Silva, João Fidalgo and Thales Beraldo
Instructor: Professor Jafar Sanei
Department of Electrical and Computer Engineering, Illinois Institute of Technology

ABSTRACT
Analog digital processing is one important modification of the digital signals. With this processing method we can store, compress, analyze and process the digital signals. This project aims to implement an Analog signal filter using the Least Mean Squares (LMS) algorithm to desired the sound quality. This kind of filter is used in many situations where it is necessary to cancel a noise that is not originally from the source.

OBJECTIVE
• Get familiarized with the concepts of Digital Signal Processing.
• Learn the use of FPGA and system-on-Chip in Signal Processing.
• Implement an Analog signal filter using the LMS algorithm.
• Comprehension of development and design tools such as Vivado HDL, ModelSim and Matlab. And Simulink for prototyping of the algorithms.

THE DEVICE

DESIGN FLOW
- Generation of the filter coefficients
- Simulation
- Design in the Block Diagram
- Synthesis of the Filter
- Integration of the IP Core
- Control of the IP Core
- Filter Implementation

IMPLEMENTATION
- 100% additive filter that makes the input signal and compares with the desired signals, cancel the unwanted components of the input signal.

REFERENCE
[1] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[2] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[3] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[4] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[5] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.

DESIGN FLOW
- Device and guitar to implement a guitar effects processor.
- Effects such as Delay, Reverb, Distortion, Reverb and Echo.
- The effects can be combined to create new kinds of tone.

IMPLEMENTATION
- Using 100% with used Least Squares (LMS) algorithms we can reduce the unwanted elements are sound.

CONCLUSION & FUTURE WORK
We have designed a system that can store and modify. After hours of work, we decided to use the FIR instead to its stability and its low power consumption.

ACKNOWLEDGMENT
This study was funded and supported by CAPES:
- Coordination for the Improvement of Higher Education Personnel
- Thomas Bernal, Peleggi Wic, Adriano Silveira

(ENGR 498.14/499.17) Real-Time Embedded Audio Signal Processing System - Group 1

Real-Time Embedded Audio Signal Processing System

Student: William Jamir Silva
Instructor: Professor Jafar Sanei
Department of Electrical and Computer Engineering, Illinois Institute of Technology

ABSTRACT
Analog digital processing is one important modification of the digital signals. With this processing method we can store, compress, analyze and process the digital signals. This project aims to implement an Analog signal filter using the Least Mean Squares (LMS) algorithm. This implementation was designed for audio processing. The main idea is to implement a guitar effects processor. The algorithm used for this application is the Least Mean Squares (LMS) algorithm. This kind of filter is used in many situations where it is necessary to cancel a noise that is not originally from the source.

OBJECTIVE
• Get familiarized with the concepts of Digital Signal Processing.
• Learn the use of FPGA and system-on-Chip in Signal Processing.
• Implement an Analog signal filter using the LMS algorithm.
• Comprehension of development and design tools such as Vivado HDL, ModelSim and Matlab. And Simulink for prototyping of the algorithms.

THE DEVICE

DESIGN FLOW
- Generation of the filter coefficients
- Simulation
- Design in the Block Diagram
- Synthesis of the Filter
- Integration of the IP Core
- Control of the IP Core
- Filter Implementation

IMPLEMENTATION
- On the event a Zynq block was used to implement a FIR structure (filtering algorithm). This implementation was designed for audio processing. The main idea is to implement a guitar effects processor. The algorithm used for this application is the Least Mean Squares (LMS) algorithm. This kind of filter is used in many situations where it is necessary to cancel a noise that is not originally from the source.

REFERENCE
[1] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[2] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[3] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[4] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[5] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.

(ENGR 498.14/499.17) - Real-Time Embedded Audio Signal System - Group 1

Real-Time Embedded Audio Signal Processing System

Student: João Fidalgo
Instructor: Professor Jafar Sanei
Department of Electrical and Computer Engineering, Illinois Institute of Technology

ABSTRACT
Analog digital processing is one important modification of the digital signals. With this processing method we can store, compress, analyze and process the digital signals. This project aims to implement an Analog signal filter using the Least Mean Squares (LMS) algorithm. This implementation was designed for audio processing. The main idea is to implement a guitar effects processor. The algorithm used for this application is the Least Mean Squares (LMS) algorithm. This kind of filter is used in many situations where it is necessary to cancel a noise that is not originally from the source.

OBJECTIVE
• Get familiarized with the concepts of Digital Signal Processing.
• Learn the use of FPGA and system-on-Chip in Signal Processing.
• Implement an Analog signal filter using the LMS algorithm.
• Comprehension of development and design tools such as Vivado HDL, ModelSim and Matlab. And Simulink for prototyping of the algorithms.

THE DEVICE

DESIGN FLOW
- Generation of the filter coefficients
- Simulation
- Design in the Block Diagram
- Synthesis of the Filter
- Filter Implementation

IMPLEMENTATION
- Device and guitar to implement a guitar effects processor.
- Effects such as Delay, Reverb, Distortion, Reverb and Echo.
- The effects can be combined to create new kinds of tone.

REFERENCE
[1] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[2] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[3] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[4] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[5] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.

(ENGR 498.14/499.17) - Guitar Processor Effects - Group 1

Real-Time Embedded Audio Signal Processing System

Student: Thales De Lima Beraldo
Instructor: Professor Jafar Sanei
Department of Electrical and Computer Engineering, Illinois Institute of Technology

ABSTRACT
Analog digital processing is one important modification of the digital signals. With this processing method we can store, compress, analyze and process the digital signals. This project aims to implement an Analog signal filter using the Least Mean Squares (LMS) algorithm. This implementation was designed for audio processing. The main idea is to implement a guitar effects processor. The algorithm used for this application is the Least Mean Squares (LMS) algorithm. This kind of filter is used in many situations where it is necessary to cancel a noise that is not originally from the source.

APPLICATIONS
Filter Bank: An analysis circuit that modify the frequency of a signal as per requirements for use.

Block Diagram
Audio Codec
Zynq-7000 (FPGA Section)
Digital-to-Analog Converter (DAC)
Analog-to-Digital Converter (ADC)
Digital-to-Digital Converter (DDC)
Digital Signal Processor (DSP)
Digital-to-Video Converter (DVC)
Video Processor
Digital-to-Audio Processor (DAP)
Digital-to-Sound Processor (DSP)
Digital-to-Image Processor (DIP)
Digital-to-Music Processor (DMP)
Digital-to-Video Processor (DVP)

DESIGN FLOW
- Generation of the filter coefficients
- Simulation
- Design in the Block Diagram
- Synthesis of the Filter
- Filter Implementation

IMPLEMENTATION
- The filter bank, which is an input signal, can modify the frequency bands or certain frequencies. It is possible to do this by using a digital filter. This filter can be done in a digital domain or in an analog domain.

THE DEVICE

DESIGN FLOW
Figure 1: Solderless
Figure 2: Solderless
Figure 3: Solderless

(ENGR 498.14/499.17) - Real-Time Embedded Audio Signal Processing System - Group 1

Automated Sorting Machine using Video Processing and a Robotic Arm

Student: Luiz Bortolli, Vitor Gobbiardi, Laís Leonel, and Ivan Papai
Instructor: Professor Jafar Sanei
Department of Electrical and Computer Engineering, Illinois Institute of Technology

ABSTRACT
Automation is quickly becoming a key technology in many industries, especially in the industrial world. To contribute to this trend, we propose an automated sorting machine using video processing and a robotic arm.

IMPLEMENTATION
The project implements a camera to capture images of objects. These images are processed using morphological processing, applying structuring element to an input image, changing its output image of the camera. The output image is then processed using a neural network to identify the shapes of objects. After identifying the shapes of objects, the robotic arm moves the objects to their respective bins.

DEVICES
- Arduino Uno: Microcontroller that controls the robotic arm and the camera.
- IMU: Accelerometer, gyroscope and magnetometer that detect the orientation of the robotic arm.
- DC motor: A DC motor that drives the robotic arm.
- Servo: A servo motor that rotates the camera.
- Camera: A camera that captures images of the objects.

INTERFACE BETWEEN C/V AND ROBOTIC ARM
- The modelled motor that connects between the microcontroller and the robotic arm, through the serial port.
- The four motors of the inner kinematics of the robotic arm, which are controlled by the microcontroller through the serial port.
- The camera that is connected to the microcontroller through the serial port.

PROGRAMMING IN THE ROBOTIC ARM
- After finding the joint angles of the robotic arm, we imagine an equation that we convert these joint angles into a movement of the robotic arm. This movement is then converted into a shape of the object to be sorted.
- The four motors of the inner kinematics of the robotic arm, which are controlled by the microcontroller through the serial port.

ACKNOWLEDGMENT
- Baseline Scientific Mobility Project (BSMP).
- The All Programmable SoC (Zynq-7000).
- Components do Arduíno Uno e Módulo de Motor de Passo.
- Grateful assistance: Thomas Gobbiardi, Ivan Papai.

REFERENCES
[1] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[2] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[3] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[4] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.
[5] "Zynq-7000 All Programmable SoC," Xilinx, Inc., Tech Briefs, 2010.

(ENGR 498.14/499.17) Automated Sorting Machine Using Video Processing & A Robotic Arm - Group 2

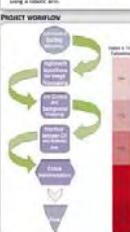
Automated Sorting Machine using Video Processing and a Robotic Arm

Student: Lucy Betaglio Bortolo
Advisor: Dr. Jafar Sanie
Department of Electrical and Computer Engineering

ABSTRACT
Automation is quickly becoming a key to decrease production cost and manufacturing time. In the scope of this work, we developed an automated sorting machine using video processing and a robotic arm. The project proposes the use of a robotic arm with computer vision to identify and sort objects based on their color and shape.

Objectives
 1. Acquire a real image and define (determine) each object's class.
 2. Identify each object and map its location.
 3. Design an algorithm to automate the action of moving the robotic arm to relocate classified objects using a robotic arm.

PROJECT WORKFLOW



HARDWARE DESCRIPTION
Robot: A KUKA II mini robot.
Components: Arduino Uno R3 microcontroller, Servo D900, 1024x768 resolution camera, DC motor, driver, breadboard, and various sensors.
Robotics Library: A ROS package for the KUKA II mini robot.

Software: OpenCV, ROS, Gazebo, MATLAB, Python, LabVIEW.

Stage 1: Implement Algorithms for Image Processing:
Image Segmentation: The process of partitioning a digital image into multiple segments or objects. It's a common technique in image processing and computer vision that allows for easier analysis and understanding of the image.
Background Subtraction: This step involves subtracting the background from the foreground to highlight the objects of interest.
Region Labeling: This step involves labeling each region with a unique identifier to facilitate further analysis.

Stage 2: Arm Control and Background Mapping:
ARMER R&D: ROS interface for the KUKA II mini robot.
Background Mapping: Creation of a gripper map that identifies the positions of the colored objects to move them to the right place.
Robot Control: Control of the KUKA II mini robot using ROS.

Stage 3: Interface Between Computer Vision and Robotic Arm

- Given the endpoint of a robot, the video modules interface gets the joints' head label to achieve the end point.
- The project consists of two main parts: the video module and the robot arm control module.
- The first part of the project is to obtain the position of the colored objects.
- The second part of the project is to map the position of the colored objects and move the robot arm to the position of the colored objects.
- For each colored object, we calculate the average position of the colored objects.
- These objects are mapped with the position of the colored objects.
- The last step is to move the robot arm to the position of the colored objects.
- The gripper map is used to move the robot arm to the position of the colored objects.

REFERENCES
 [1] "Autodesk Inventor Professional", Autodesk, Inc., 2015.
 [2] "Image Processing Using OpenCV", D. M. Perez and R. Gonzalez, 2009.
 [3] "OpenCV Book", opencv.org/doc/3.1.0/ov_2.html, 2018.

(ENGR 498.14/499.17) Automated Sorting Machine Using Video Processing & A Robotic Arm - Group 2

Discriminator of Objects using Video Processing and a Robotic Arm

Student: Vitor Sabordi dos Santos
Advisor: Dr. Jafar Sanie
Department of Electrical and Computer Engineering, Illinois Institute of Technology

ABSTRACT
After finding the point angles of the robot, we developed an angle recognition system to determine the position of the objects. This project is based on the following:
 $\text{angle} = \theta_{\text{left}} + \theta_{\text{right}} - \pi/2$
 $\text{angle} = 2\pi - \theta_{\text{left}} - \theta_{\text{right}}$
 In which θ_i is in degrees.

IMAGE PROCESSING ALGORITHM DEVELOPMENT
 1. Given the frames at a specific point was used to develop a real-time image processing system to detect the colors red, green, blue and white.

VISION PROCESSING
 The original video was converted into a feature video (black or white to serve the beds and nodes discrimination).

ROBOTIC ARM LIBRARY
 A real-time library was implemented to decrease the pulses in the signals of the robot.

ALGORITHM
 1. Image Processing algorithm: Extract the pixels and map the colors.
 2. Recognition of the colors red, green, blue and white.
 3. Generating the angles from the colors.

TIME EXEC

COMPARISON BETWEEN COMPUTER VISION AND HARDWARE

- Given the last point of a structure, the inverse kinematics returns the status of the joints to move this point.
- The step taken that conversion between the mat tools and the robot procedures.
- The final result of the inverse kinematics is the equation of all the joint angles in the robot (joint coordinates x, y and z).

ACKNOWLEDGEMENTS
 - Brazilian Scientific Mobility Program (BEM)
 - Institute of International Education (IEE)
 - Capes Foundation (Agreement numbers: PR-0331-04-2013)
 - Graduate Assistant: Thomas Gomes

REFERENCES
 [1] "OpenCV 3.0.0 API", opencv.org/doc/3.0/ov_2.html, 2018.
 [2] "Wikibooks", en.wikibooks.org/wiki/Robotics, 2018.
 [3] "Python Robotics Examples", www.piotrอน.othree.com/python-robotics/.

(ENGR 498.14/499.17) Digital Signal Processing & Its Applications: Discriminator of Objects Using Video Processing & A Robotics Arm - Group 2

Robotic Arm Control Using Computer Vision

Student: Lais Domingues Leonel
Instructor: Dr. Jafar Sanie
Department of Electrical and Computer Engineering, Illinois Institute of Technology

ABSTRACT
This project presents a robotic arm that is able to identify objects using a camera and respond according to specific commands the user provides. The main goal of this project is to make the robotic arm to identify the color to identify the specific object. The user can identify the specific object by identifying the color of the object. The OpenCV library is used for image processing and the Arduino board is used to control the servos.

GOALS
 - Implement image processing algorithms to distinguish many different objects.
 - Create a control algorithm to move an object to a desired position.
 - Optimize the algorithm so it uses less memory.

THE ROBOTIC ARM
 - 300 Degrees of Freedom.
 - 43 cm Horizontal Reach.
 - 30 cm Vertical Reach.
 - Analog I/O microcontroller board.
 - DHT11 Humidity/Air Temp Sensor.
 - Arduino UNO microcontroller board.
 - AnHUB-Arduino interface board.

Image Processing

MORPHOLOGICAL OPERATION
 - Image processing algorithms were performed to remove noise, isolate specific objects and identify different objects.
 - The steps involved in this operation are dilation and erosion while the shape and size of these objects were identified with the opening operator.

FUTURE WORK
 - This morphological operations need to be improved to recognize the properties of each object.
 - Find better ways to identify the color and position of the object while the shape and size of these objects are identified with the opening operator.

THRESHOLDING OPERATION
 - This operation is used to separate the background from the objects in the background.
 - The steps involved in this operation are thresholding the image to prepare and then filtering desired pixels with 3 and others.

FACTORY TIMELINE

Phase 1:
 - The Phase 1 was focused on learning programming on Visual Studio using the language C++ and the library OpenCV.
 - Other small parts of image processing were developed.

Phase 2:
 - The Phase 2 was focused on programming the robotic arm to move a specific object. All the image processing was applied to control the position of the robotic arm.

Phase 3:
 - The Phase 3 was focused on controlling the robotic arm to receive a specific object and move to a specific position. After that, the object is controlled and applied in an algorithm to control the position of the robotic arm.

ACKNOWLEDGEMENT
 - Brazilian Scientific Mobility Program (BEM).
 - Institute of International Education (IEE).
 - Capes Foundation (Agreement numbers: PR-0331-04-2013).
 - Graduate Assistant: Thomas Gomes
 - Advisor: Dr. Jafar Sanie

REFERENCE
 [1] Saitoh, R. (2010). Segmentation, Computer Vision, Applications, and Human-Computer Interaction. *Handbook of Research on Image Processing and Machine Vision*. New York: IGI Publishing.
 [2] Saitoh, R. (2009). *Segmentation, Computer Vision, Applications, and Human-Computer Interaction*. New York: IGI Publishing.
 [3] Saitoh, R. (2009). *Segmentation, Computer Vision, Applications, and Human-Computer Interaction*. New York: IGI Publishing.

(ENGR 498.14/499.17) Image Processing - Group 2

Automated Methods for Finding and Separating Objects Using a Robot Arm

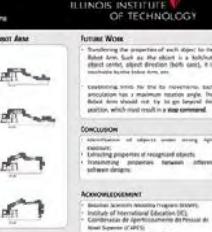
Student: Ivan Pagani
Instructor: Dr. Jafar Sanie
Department of Electrical and Computer Engineering

ABSTRACT
The project is intended as a real implementation of an automated method to identify objects and separate objects based on inverse kinematics. These objects will be divided in the following parts:

- Identification of objects.
- Thresholding.
- Arm configuration.
- Color segmentation.

THRESHOLDING
 - This part consists of creating a mask from grayscale images. Pixel threshold value will be learned in one and applied in the following parts.

DESIGN OF THE ROBOT ARM



Future Work
 - Improve the identification of objects with better detection methods such as the object detection in the field, depth camera, or sensor fusion. It is possible to improve the accuracy.

THRESHOLDING
 - The binary image might have small interconnected objects and several pixels due to noise, registration, light reflection, etc.

DIFFUSION OF THE ROBOT ARM

CONCLUSION
 - The identification of objects using image processing is a great tool to identify and separate objects.
 - Identifying properties of recognized objects.
 - Separating objects based on color without damage.

ACKNOWLEDGEMENT
 - Brazilian Scientific Mobility Program (BEM).
 - Institute of International Education (IEE).
 - Capes Foundation (Agreement numbers: PR-0331-04-2013).
 - Graduate Assistant: Thomas Gomes.
 - Advisor: Dr. Jafar Sanie.

REFERENCES
 [1] "OpenCV 3.0.0 API", opencv.org/doc/3.0/ov_2.html, 2018.
 [2] "Image Processing Learning Framework", www.cse.lehigh.edu/~leifer/teaching/courses/750/lectures/image-processing-learning-framework.html, 2018.
 [3] "Wikibooks", en.wikibooks.org/wiki/Robotics, 2018.

(ENGR 498.14/499.17) Digital Signal Processing & Applications: Image Processing - Group 2

Implementation of Software Defined Radio

Students: Ana Lopes, Raquel Nascimento, Alana Vidal
Instructor: Dr. Jafar Sanie
Department of Electrical and Computer Engineering, Illinois Institute of Technology

INTRODUCTION
Radio communication is defined as the process of transmitting information over a distance in space using radio frequency. The implementation of a software based radio communication instead of the traditionally hardware based radio communication has been an upgrade that eases the development process. This project aims to implement a Software Defined Radio (SDR). The design of blocks was conceived to ease the implementation of the system. The receiver, transmitter, modulator, demodulator and filter blocks are implemented using Matlab. The blocks implemented using Matlab so far include:
 - Receiver and Demodulator (error detection, Interleaving Encoder and Interleaving Decoder, Interleaving and Interleaver, Channel Estimator and Channel Decoder)
 - Constellation Mapper and Demapper
 - Block Diagram

METHODS
SOCIAL MEDIA DISCUSSIONS
 The Matlab forums, Stack Overflow, and GitHub are used to minimize interference by adjacent channels. The transmitter uses a Linear Feedback Shift Register (LFSR), a pre initialized 9 bit LFSR with a period of 511 bits. The receiver has a Linear Feedback Shift Register (LFSR) with a period of 1023 bits, where the bits are initialized by the bits of the transmitted sequence.
OBJECTIVE OF THE RECEIVER
 The objective of the receiver is to detect and demodulate the received signal. The receiver will receive the transmitted signal and then use an LFSR to regenerate the transmitted sequence. The blocks that are used are: Block-Delay, Adder, Slicer, Constant, Programmable Latency (PLAT), and FPGAs.

FUTURE WORK

 - The main goal for this project is to find the Matlab code to Verilog so that the blocks that were developed in Matlab will be implemented in FPGAs.
 - The blocks to be implemented are: Block-Delay, Adder, Slicer, Constant, and Programmable Latency (PLAT).
 - The receiver has the goal of detecting the transmitted signal and then demodulating it.
 - The transmitter has the goal of modulating the signal and then sending it to the receiver.

ACKNOWLEDGMENT
 - Brazilian Scientific Mobility Program (BEM).
 - Institute of International Education (IEE).
 - Capes Foundation (Agreement number: PR-0331-04-2013).
 - Graduate Assistant: Júlio Gomes, Thomas Gomes, Alana Vidal.

REFERENCES
 [1] S. Alotaibi, S. Abu-Hamdiyah, Implementation of 8PSK Transmitter and Receiver using FPGAs, June 2006.
 [2] E. L. Goranek, Software Defined Radio Project Report, Fall 2003.
 [3] E. L. Goranek, Software Defined Radio Project, Report, Fall 2003.

(ENGR 498.14/499.17) Implementation of Software Defined Radio - Group 3

Implementation of Software Defined Radio

Students: Ana Paula Lopes
Instructor: Dr. Jafar Sanie
Department of Electrical and Computer Engineering, Illinois Institute of Technology

INTRODUCTION
 On the implementation of the Benevenga Model, the data transmitted in serial address and carrier bit are transmitted to the receiver and carrier bit is removed. The particle numbers required with respect to the number of bits transmitted and the carrier bit will be calculated according with the Following Formula:

$$\text{bit_rate} = 40 \times 2^{\text{N}} - 1 - T$$

bit_rate	number of bits
40	1
80	2
160	3
320	4
640	5
1280	6
2560	7

HAMMING ENCODER
 The Hamming encoder is a serial address and carrier bit transmitter. The part of the system that receives the bits from the serial port and carrier bit is called Hamming Encoder.

CONCLUSIONS
 On the following weeks, it is intended to complete the construction of the Matrix code to Simulink and then to Verilog. Just after the project can be completed.

ACKNOWLEDGMENT
 - Student Scientific Mobility Program (BEM).
 - Institute of International Education (IEE).
 - Graduate Assistant: Thomas Gomes, Júlio Gomes.

REFERENCES
 [1] Richard. Solis, "Compiler, Vision, Applications, and Application", Microsoft, 2000.
 [2] "Image Processing Learning Framework", www.cse.lehigh.edu/~leifer/teaching/courses/750/lectures/image-processing-learning-framework.html, 2018.
 [3] "Wikibooks", en.wikibooks.org/wiki/Robotics, 2018.

(ENGR 498.14/499.17) Implementation of Software Defined Radio - Group 3

Posters

Implementation of Software Defined Radio
Student: Raquel Beatriz Silva do Nascimento
Instructor: Dr. Jafar Sanie
Department of Electrical and Computer Engineering, Illinois Institute of Technology

The Scrambler was based on the software defined radio block diagram. The implementation section shows the flow from transmitter to receiver through various blocks like modulator, oscillator, mixer, and down converter. The conclusions section discusses the project's completion.

Implementation of Software Defined Radio
Student: Alana Torres Vidal
Instructor: Dr. Jafar Sanie
Department of Electrical and Computer Engineering, Illinois Institute of Technology

The interleaver is the third block of the Software Defined Radio. The demultiplexer and its function to protect the sequence from burst errors are discussed. The conclusion section highlights the successful implementation of the project.

(ENGR 498.14/499.17) Implementation of Software Defined Radio - Group 3

ENGR498.17 Reconfigurable Hardware Design for Ultrasonic Signal Processing
Eric Barroca and Luis Antonio Kuhnen Ronsani
Professor Dr. Erdal Oruklu

The objectives include designing a reconfigurable code for ultrasonic signal processing. The operation section shows a flowchart from raw data to processed data. Results show waveforms and plots. Acknowledgments thank CAPES, CNPq, and IIT Armour College of Engineering.

ENGR498.17 - TRAFFIC LANE DETECTION USING FPGAs
Gustavo Jordao, and Marco Dall'Agnese
Prof. Erdal Oruklu

The architecture includes an IMU, camera, thresholding, line detection, RANSAC, and post-processing. Results show images of a road with detected lanes and a graph of lane detection accuracy over time.

(ENGR 498.17) Reconfigurable Hardware Design for Ultrasonic Signal Processing

Gate Level Power Reduction in Deeply Scaled CMOS Technology
David Freitas, Henrique Ribeiro, Karlosen T. D. de Lima,
Vitor Alencar, and Dr. Ken Choi (Adviser)

The methodology involves identifying power consumption hotspots and applying optimization techniques. Results show a 3D plot of power consumption and a graph of power reduction versus design parameters.

Leakage Power Reduction by Forced Stack and Power Gating at Circuit Level for Mobile Applications
Diego H. Carvalho Andrade, George Jesus Dias, Gustavo J. Bernardo (Undergraduates)
and Dr. Ken Choi (Adviser)

The methodology includes forced stack and power gating. Results show a graph of leakage current and static power consumption.

(ENGR 498.19) Gate Level Power Reduction in Deeply Scaled CMOS Technology

Posters

Register Transfer Level Power Reduction by Advanced Clock Gating Scheme

**III Army College of Engineering
ILLINOIS INSTITUTE OF TECHNOLOGY**
DFT Research Day 2015

Team: Jose Diaz, Elvira Alberdi, Lucas Nunez, Lucio Silva, Dr. Ken Choi (Adviser)

Scholarship: Electrical and Computer Engineering
Department of Electrical and Computer Engineering

Project Title: Register Transfer Level Power Reduction by Advanced Clock Gating Scheme

Abstract: The main objective of this research is to propose a new technique to reduce power consumption at the Register Transfer Level (RTL) of the digital design. The goal is to analyze and simulate of low power consumption techniques at the RTL level. In this study, the authors propose a new technique called "Advanced Clock Gating Scheme". This technique is used to save power during the switching activity in order to save power. This work is based on the previous work of other researchers in other technologies (dynamical power reduction).

Problem Description: A great design can be created but the hardware cost is still high. The important issue is how to reduce the cost and decrease the power consumption. The main idea is to find a way to reduce power consumption.

Design and Implementation: The authors are divided into two working groups: 1) Logic Design and 2) Verification. The logic design group is responsible for the implementation of the proposed scheme. The verification group is responsible for the validation of the logic design.

Conclusion: The authors have proposed a new technique to reduce power consumption. This technique is called "Advanced Clock Gating Scheme". The results show that the proposed scheme is effective in reducing power consumption.

Figures:

- Block Diagram: Shows the system architecture with Input, Encoder, Decoder, and Output.
- Timing Diagram: Shows the clock gating logic and its effect on power consumption.
- Power Consumption Graph: Shows the reduction in power consumption over time.
- Table: Comparison of power consumption between the proposed scheme and others.

(ENGR 498.19) Register Transfer Level Power Reduction by Advanced Clock Gating Scheme

Design of low-power circuits

**III Army College of Engineering
ILLINOIS INSTITUTE OF TECHNOLOGY**
DFT Research Day 2015

Team: Fabio Júnior Souza (Student), Dr. Ken Choi (Adviser)

Scholarship: Electrical and Computer Engineering
Department of Electrical and Computer Engineering

Project Title: Design of low-power circuits

Abstract: Since the invention of transistor in 1958 [1], power consumption has increased with each new technology developed. New chips are smaller and faster, but, on the other hand, they consume more energy due to heat generation.

Background: I studied the power consumption of some important microprocessors during the time

Figures:

- Block Diagram: Shows the circuit structure.
- Timing Diagram: Shows the clock and signal waveforms.
- Table: Comparison of power consumption.
- Graph: Power consumption over time.

Conclusion: Then, in the lab, we designed some simple logic like inverter, NAND and adder to know how to use the tools. Fig. 3 shows, from left to right, the schematic design, the testing circuit, layout design and post-layout simulation of an inverter.

Acknowledgements: INSTITUTO DE INVESTIGACIONES CIENTÍFICAS Y TECNOLÓGICAS (CITEC)
ARMED FORCES R&D
CNPq - Conselho Nacional de Desenvolvimento Científico e Tecnológico

References:

- [1] Traister, Who really invented the Transistor? Available at: <http://www.howstuffworks.com/big-pieces/bell-labs-transistor.htm>
- [2] Personal communication with R. Calzetti, Intel Corporation.
- [3] Examples ISPDICE. File test, available at <http://www.cs.yorku.ca/~soh/Verification/ISPDICE/Examples.html>.

(ENGR 498.19) Design of Low-Power Circuits

Multicoder coding with multidimensional coding

Research group: Augusto de Andrade, Francine Nóbrega, Júlio dos Santos, Matheus Araújo, Rafael Moreira, Silmar Nascimento, Yes Alcalá.
Research advisor: Guilherme Alvim. ENG 498.23

Introduction: The main objective of this research is to propose a new technique for multicoder coding with multidimensional coding.

Objectives:

- 1) Increase the number of users in the system.
- 2) Reducing the error rate of the system.
- 3) Reducing the complexity of the system.
- 4) Reducing the power consumption of the system.

Methodology: The methodology provides the following advantages:

- High Diversity.
- High Efficiency.
- Reduced Interference.
- Energy Efficiency.

System model:

Encoding:

Decoding:

Simulations / Results:

Conclusion/Future Work:

ACKNOWLEDGEMENTS:

References:

(ENGR 498.23) Multicoder Coding with Multidimensional Coding

Portable Wireless Health Monitoring System

Student: Eliza Amancio
Advisor: Dr. Jafar Saniie

ILLINOIS INSTITUTE OF TECHNOLOGY

ABSTRACT: The evolution in sensor technology and rapid progress in mobile devices have led to the fact that personal mobile phones are becoming more common every day. As a result, the mobile phone is considered a system to monitor personal health information such as anytime and anywhere for an affordable price.

PURPOSE:

- 1- Data collection
- 2- Data processing
- 3- Data transmission

DISCUSSION/FUTURE WORK:

ACKNOWLEDGEMENTS:

REFERENCES:

(ENGR 499.17) Portable Wireless Health Monitoring System

Remote Computer Networks Laboratory Design Tools

Student: Cláudio Manuel da Costa Silva
Instructor: Dr. Jafar Saniie

ILLINOIS INSTITUTE OF TECHNOLOGY

Project Title: E-Lab: Remote and Lab-based Learning Platform for Network Laboratory

Abstract: In the computer network, there is a need to have a good tool to manage the network and a good way to configure and control it. So, the main objective of this project is to propose a new technique to easily configuration and management of a network. It is also important to clearly differentiate that the user can manage the network and then, implementing the required functions in order to make easier the work with the network.

Objectives:

- 1. To propose a software to manage the network connections in the context of a computer networks.
- 2. To propose a software to manage the network connections in the context of a computer networks.

Work Flow Description:

Architecture:

Structure:

Future Work:

Conclusion:

Acknowledgment:

References:

(ENGR 499.17) Remote Computer Networks Laboratory Design Tools

Real-Time Automated Target Tracking System

Student: Yago Pacheco Teixeira
Instructor: Professor Jafar Saniie

Department of Electrical and Computer Engineering, Illinois Institute of Technology

Abstract: In this project, we are designing a tracking system, which consists of a camera, a laptop and a helicopter. The target is a helicopter equipped with a blower. The aim of the project is to be able to detect the target in real time using various image processing algorithms while position the laptop at it, and then track it. This project involves a set of different parts as image processing, Sees and Control and steering system. The most difficult part of this project can be implemented in many different ways.

Color Tracking:

Helicopter Tracking:

Programming:

Devices:

Conclusion:

Acknowledgments:

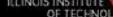
(ENGR 499.17) Real-Time Automated Target Tracking System

Posters



Sensor Data Collection and Database Management

Student: Victor Vilaca de Freitas
Instructor: Dr. Jafar Sanie
 Department of Electrical and Computer Engineering, Illinois Institute of Technology
 Embedded Computing and Signal Processing Research Laboratory



ABSTRACT

This project presents the connection of a data sensor through a smartphone and the transmission of the data to an online database. The user can access the data from anywhere in the world. The user needs to have the capability of accessing the data from wherever he is, through the internet.

PROCESS



```

graph TD
    Sensors[Sensors] --> Mobile[Mobile]
    Mobile --> Database[Database]
  
```

THE MOBILE APPLICATION SCREEN



The mobile application has a graph that shows the data measured by the sensor. The x-axis represents time and the y-axis represents the values corresponding to the coordinate system and sensor. You can tap and zoom some data points.

The screen below shows the data measured by the sensor. It displays the data in a table format. The table has columns for the timestamp, sensor ID, and sensor value. The user can scroll through the table to see all the data. There is also a button at the bottom right of the screen that says "Get Data". That is just an example of how you can use the mobile application.

OBJECTIVE

- Create a connection between mobile app and the database
- Create a new functionality for the user
- Integrate the existing user interface of the mobile application

THE HARDWARE



The sensor contains a temperature and humidity sensor. It also has a Bluetooth connection module and a microSD card slot to store data. It also has a WiFi module to connect to the internet. The mobile application will be developed with an iPhone.

THE SOFTWARE

The sensor collects data every 10 minutes and it transmits it to the cloud through the mobile application. The mobile application receives the data and stores it in a database. The database is connected to the mobile application, so it can be used to analyze the data. It is possible to use the mobile application as a web-based application or as a desktop application. Both options are available from anywhere using the Internet.

PROJECT TIMELINE

Phase 1:
 Focused on understanding how the sensor works and how to connect with the mobile application source code

Phase 2:
 Focused on programing a "User" interface to make the communication between sensor and mobile application. This phase will also include the creation of a database to store the data collected by the sensor or even create the mobile application with the help of the mobile application source code.

Phase 3:
 Focused on creating a new application for the sensor.

TOOLS/SOFTWARE

- Android Studio (3.0.1-3)
- XAMPP - Apache distribution
- Sencha - ExtJS
- Database - MySQL
- Tools - Jenkins
- phyphox - Hostinger

ACADEMIC DOCUMENTS

- Bluetooth Sensor Node Program (BSNP) - Illinois Institute of Technology (IIT)
- Generalized Data Aggregation for Wireless Sensor Networks - IIT
- Graduate Seminar - Thomas Gomez, Many-to-one Data Aggregation in Wireless Sensor Networks - IIT

CONFERENCE

Mobile application was created to facilitate communication between database and the mobile application. In this paper, we propose a mobile application that will allow users to interact with the sensor. The sensor is a mobile device that is able to access the data from anywhere using the mobile application.

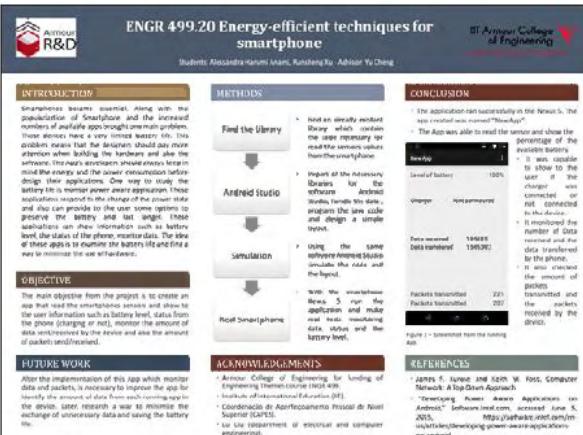
FIGURE INDEX

- To measure some functionalities of the mobile application, such as the Bluetooth interface.
- To explore some new application of the sensor, such as fall detection and gesture recognition.

REFERENCE

- [1] Wong, V.L., Garcia, J. "Smart Mobile Application Software Services," *Electro-Technology Conference and Exposition (ETC), 2012 IEEE*, pp. 203-210, 2012.
- [2] Wong, V.L., Garcia, J. "Design-Based Learning for Mobile Application Development," *Proceedings of the Annual Conference on Digital Government Research (ACDR), 2013 IEEE International Conference on Digital Government Research (ACDR), 2013 IEEE International Conference on*.

(ENGR 499.17) Sensor Data Collection and Database Management



ENGR 499.20 Energy-efficient techniques for smartphone

Students: Alessandro Hanafi Ismail, Kunsheng Xu, Advisor: Yu Cheng

INRODUCTION

Smartphones became essential along with the proliferation of mobile devices and the increased usage of mobile devices. In addition, these devices have a very limited battery life. This problem means that the developer should pay more attention to the energy efficiency of the software. This paper discusses several ways to limit the energy and the power consumption before the battery is fully exhausted. The first way is the letting off is minor power usage approaches. These applications respond to the change of the power state and the system state to reduce the power to preserve the battery and last longer. These applications can save more information such as battery level, signal strength, and location. The second way of these apps is to examine the battery life and find a way to increase the use efficiency.

OBJECTIVE

The main objective from the project is to estimate an app which can monitor the service and show the user information such as battery level, signal strength, and location. It also provides the amount of data transferred by the user and also the amount of packets sent/received.

METHODS

Find the Library

Android studio

Simulation

Root Smartphone

ACKNOWLEDGEMENTS

Armour College of Engineering by funding of Engineering Research Center (ERC) 499.
Institute of Educational Education (IEE) 499.
University of Pennsylvania Project Du-Nant SUPERIOR (X) 2015.
or US Department of Defense and Computer Engineering.

CONCLUSION

The application can monitor the battery life. The app created was named "RootApp".
The App was able to read the sensor and show the percentage of the available battery.
It was capable to show the user how much the battery was charged or not connected to the device.
It was also able to show the number of data received and the number of data transferred to the phone.
It also shows the number of packets transferred and the battery received by the device.

REFERENCES

Jamay S. Ismail and Islam M. Fost., Computer Networks: A Top-Down Approach
"Developing Power-aware Applications on Android" Software Engineering Journal, Vol. 36, No. 5, 2013, pp. 1-10, doi:10.1109/SEJ.2013.226100
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3750000/

(ENGR 499.20) Energy-Efficient Techniques for Smartphone

STEREOSCOPE-BASED multiple object detection and tracking

(Bachelor's thesis, Institute of Electrical Engineering, University of Regensburg)

Maria Klementzová (author) Dr. Jürgen Klaas (supervisor)

Department of Electrical and Computer Engineering, Institute of Electrical Engineering, University of Regensburg, 93040 Regensburg, Germany

Research Goal:

- ✓ Extraction of feature descriptors
- ✓ Implementation algorithm (feature extraction, matching, tracking)
- ✓ Evaluation extraction, matching, tracking
- ✓ Evaluation extraction, matching, tracking
- ✓ Problem Description
- ✓ Extraction features and feature extraction
- ✓ Extracted background
- ✓ Feature extraction, matching, tracking
- ✓ Algorithm
- ✓ MIT
- ✓ Difference of Gaussian (DoG)
- ✓ Edge detection
- ✓ Recovering edges and low contrast features
- ✓ Difference of gradients (DoG)
- ✓ A Gabor filter is used in the stage 1 (filter bank) to extract features from the input image for the extraction of fine-grained features.
- ✓ (a) Original image, (b) observation the weak image, (c) observation the strong image, (d) observation the image with noise.
- ✓ Location of background

Implementation:

Include it if your work has been released or at least one part of your work has been published in a journal or conference.

- ✓ Monocular vision and stereo vision
- ✓ To get good results, the quality of such pairs must be as good as possible. The following figure shows two images of a person with different distances.

(a) (b)

Algorithm:

Each step will be described in detail. Although the steps are numbered, they do not have to be executed sequentially.

- ✓ Feature extraction
- ✓ A regular initial search window is used to track the target. If the target is lost, the search window is recentered, so that the target can be tracked again.
- ✓ ROI
- ✓ DoG image on blocks and blocks
- ✓ Gabor filter on each block
- ✓ Normalization and score computation
- ✓ Detection
- ✓ The image is divided into small blocks. Each block with size $n \times n$ has m^2 pixels, each pixel contains information about the image.
- ✓ Generate a histogram with block:

For each block in the image, a 1-D histogram is generated based on pixel intensities. The generated histogram is then compared with the histograms generated by the algorithm on the basis of the image.

Results on Pedestrian Detection

Experiments:

The dataset used to test the algorithm (Pedestrian Detection in Image Sequences) was provided by the University of Massachusetts Amherst. It consists of two sequences: a sequence of 100 frames from a video of a pedestrian walking across a street, and a sequence of 100 frames from a video of a pedestrian walking across a street.

For both sequences, the ground truth bounding boxes are provided. The algorithm's performance is evaluated by calculating the Intersection over Union (IoU).

Evaluation:

For each frame, the algorithm generates a bounding box for the pedestrian. The ground truth bounding box is also provided. The algorithm's performance is evaluated by calculating the Intersection over Union (IoU).

Conclusion:

The algorithm's performance is evaluated by calculating the Intersection over Union (IoU). The algorithm's performance is evaluated by calculating the Intersection over Union (IoU).

Future Research:

The future research will focus on improving the algorithm's performance by using more advanced feature extraction methods and better tracking algorithms. The algorithm's performance is evaluated by calculating the Intersection over Union (IoU).

MM COM

(ENGR 499.25) Stereovision-Based Multiple Object Detection & Tracking



Web Server Architecture for Body Sensor Data Management

Student: Marcus Vinícius Silva **Instructor:** Dr. Jafar Sanie
Department: Electrical and Computer Engineering, Illinois Institute of Technology



Abstract:

This project presents a web server architecture to manage body sensor data. The data is collected and stored in a database. It provides physical visualization of the data and allows the user to edit basic measurement parameters.

Objectives:

- Web architecture for remote data access
- Data Organization for body sensors
- Data processing for enhancing health monitoring and analysis

The Concept Idea:



Project Timeline:

- Week 1: Server architecture and HTTP
- Week 2: Database design
- Week 3: Sensors interface and API
- Week 4: Using frameworks
- Week 5: Frontend
- Week 6: Backend connection
- Week 7: Data processing
- Week 8: Mobile pages
- Week 9: Backend API
- Week 10: Sensors page was developed
- Week 11: Backend was developed
- Week 12: Frontend was developed
- Week 13: Mobile pages were developed
- Week 14: Final report was presented

The Application Design:



Chart functionality:



Future Work:

- Web application for data visualization, handles to enable stock analysis and statistical studies
- Implement location and usage of geographic coordinate system information, and study the importance of this data to live analysis processes.

Conclusion:

- Web architecture was implemented and has visual presentation capabilities for health. Very good results were obtained.
- The server project model can be applied for maintaining an organized management of data. It is a functional way that can bring more efficiency.

Acknowledgment:

- Department of Industry, Ministry of Science and Technology
- International Institute of Education (IIE) - Coordenador de Apoio à Pesquisa (CAPES);
- Graduate Institute
- Mario Gómez

References:

- T. Tolosa, "Body Sensor Network for Health Monitoring," MSc Thesis, Univ. of Zaragoza, 2007.
- S. R. Das, "Mobile Framework for a Sensor Network," MSc Thesis, Univ. of Zaragoza, 2007.
- M. H. Alavi, "Lunar Energy Harvesting for a Sensor Network," MSc Thesis, Univ. of Zaragoza, 2008.
- M. A. Hernandez, "A Sensor Network for Monitoring and Interacting with Objects in Urban Environments," MSc Thesis, Univ. of Zaragoza, 2005, p. 4.

(ENGR 499.17) Web Server Architecture for Body Sensor Data Management

Real-Time Traffic Sign Recognition for Advanced Driver Assistance Systems

Federico Ulises Soto Pinto, Patricio Colomé Latorre and Professor Dr. Erdal Ozkale

Introduction

Summary: This paper presents a real-time traffic sign recognition system for advanced driver assistance systems. The system is designed to identify traffic signs in real-time, providing information such as its alphanumeric string or its hazard level. The system uses a deep learning approach based on a convolutional neural network (CNN) trained on the COCO dataset. The system is implemented on a BeagleBoard and can be used in real-world scenarios.

Keywords: traffic sign recognition, CNN, BeagleBoard, real-time processing.

System Framework for Development

The proposed system is implemented as a single software application running on a BeagleBoard. The system consists of three main components: a camera module, a BeagleBoard, and a display module. The camera module captures images of the road ahead, which are then processed by the BeagleBoard's embedded computer vision library. The BeagleBoard performs real-time traffic sign recognition using a pre-trained CNN model. The results are displayed on the screen, providing the driver with important information such as the speed limit or a warning message. The system also includes a user interface for configuration and monitoring.

Results and conclusion

The experimental results show that the proposed system is able to correctly identify traffic signs in real-time, even in challenging conditions such as low light or poor visibility. The system is able to detect and recognize various types of traffic signs, including speed limit signs, yield signs, and stop signs. The system's performance is evaluated using a standard accuracy metric, and the results show that the system achieves a high level of accuracy, even in difficult lighting conditions. The system's real-time processing capability allows it to provide timely information to the driver, which is crucial for safe driving. The proposed system represents a significant step forward in the field of advanced driver assistance systems, providing a reliable and efficient way to detect and recognize traffic signs in real-world scenarios.

(ENGR 499.21) Real-Time Traffic Sign Recognition for Advanced Driver Assistance Systems

(ENGR 499.26) Real-time 3D Reconstruction Using Depth Cameras for Augmented Teleoperation

Posters

Test Bed for Direct Current Microgrids
Andre Antônio, Cláudio Fernandes, Hugo Santos, Luís Bremer, Martins Galindo, Instructor: Prof. John Shen, ENGR499.36

Direct Current (DC) Microgrids

Cables, Busbar and PCB Board

Capacitors

PCB LOAD

Power losses

Prelays

(ENGR 499.36) Development of a Test Bed for Direct Current Microgrids - Poster 1

Test Bed for Direct Current Microgrids
Andre Antônio, Cláudio Fernandes, Hugo Santos, Luís Bremer, Martins Galindo, Instructor: Zheng Shen, ENGR499.36

Schematic and Prototype

Future Work

No actual results have been obtained as of yet. The focus of this project was to evaluate equipments based on initial desired specifications. All equipments have been ordered and some equipments arrived already. As per the testing phase can be started. Each equipment was obtained in large quantities to experiment different configurations.

Acknowledgements

Special thanks to implementation institution: CNEA - Comitê de especificações técnicas da Real Companhia Portuguesa de Minas e Chemins de Ferro, Sociedade de Minas de Viseu.

References

(ENGR 499.36) Development of a Test Bed for Direct Current Microgrids - Poster 2

Virtual.PYXIS Optimization
Caio Freitas, Gabriel Rodrigues, João Matti, Valmir Fleischmann, ENGR499-43.1SM

What is Virtual.PYXIS?

How Virtual.PYXIS works

Virtual.PYXIS Examples

(ENGR 499.43) Virtual.PYXIS Optimization

Software Engineering
Instructor: Andre Antônio
Students: Lucas Dário Pedroso and Raíl Ferreira de Souza
ENGR499.44

Abstract

An individual user needs to create a new website for one of Rightmark's clients. We had to learn how to use a new framework and program some functions to make a project that meets the client's needs and expectations.

The platform we used for this project is called WordPress, which has multiple tools and features that helped us in this project.

WordPress

WordPress is a popular open source Content Management System that is used by millions of websites around the world. With it, developers are able to use and create plugins that facilitate the development of websites.

Goal & Development

- Our goal is to create a clean, elegant, and functional website for UC Thermo Hoving, one of Rightmark's clients.
- During the development we worked with WordPress, PHP, MySQL, CSS, and Javascript.

Acknowledgements

- BIMP - Brazil Scientific Mobility Program
- CAPES - Coordenação de Aperfeiçoamento de Pessoal de Nível Superior
- IEC - Instituto de Engenharia de Coimbra
- Green Ribbon Foundation and BigMarker

(ENGR 499.44) Software Engineering

Vehicle-Interaction Modeling: Terramechanics of Granular Soils for Small Unmanned Ground Vehicles
Dionisio Jafet Soárez, Jefferson Antônio Sartori, Geralmino Gamaireo (Project Advisor), Department of Mechanical, Materials, and Aerospace Engineering, Illinois Institute of Technology, Chicago, IL 60616

Background

Terramechanics, the study of vehicle-terrain interaction, aims to understand the behavior of vehicles in terrain and the vehicle's characteristics in order to accurately model its motion. Vehicle-terrain interaction modeling is critical to predict the behavior of small ground vehicles as most Unmanned Ground Vehicles (UGV). Failing to accomplish the latter can lead to the loss of vehicle immobilization, an important factor for understanding and preventing critical experiences. This research focuses on studying the penetration-collapse effect of wheels with different diameter-to-width ratio on soils at different levels of volume compaction.

Materials

- Fluidized Testbed
- Linear Actuator and Potentiometer
- Force Sensor
- Wheel Factor Model
- 480 Watt, 8 Ohms Speaker and Amplifier

Methods

- Contact pressure collapse test: an ad-hoc fluidized testbed is used to measure contact pressure at different levels of volume compaction.
- Obtain data from these tests via Matlab and FeatFlow simulation software.
- Analyze the data acquired, comparing it to predictions generated through models developed at IIT for competitive and dissipative soils.

Results

Discussion

References

(ENGR 499.45) Vehicle-Interaction Modeling: Terramechanics of Granular Soils for Small Unmanned Ground Vehicles

Posters



Materials R&D

Phase equilibria in the Ni-Co-Al system at 800°C

Samuel Reiva, André Silva, Lucas Pires, Bruna Mafraena, Yeri Torres | ENGR498.20 Instructor: Philip G. Nash, Ph.D. Researcher: Ying Zhou

Background:
Objectives and reasons of the research in Ni Co Al alloys:

- Understand the alloy properties and behavior at different temperatures and compositions.
- Identify the different phases present in each sample and their composition.
- Create an isothermal section of the ternary phase diagram with the different alloy compositions at constant temperature.

Experimental Procedures:
The complete characterization was done in the following steps:

- Sample preparation: Alloying (100g of pure Ni + 100g of pure Co + 100g of pure Al).
- EDS analysis: Determination of the chemical composition of the samples.
- EDS of sample #12: Through the EDS analysis, the chemical composition of the sample was determined.
- EDS of sample #9: The EDS objective is to obtain the chemical characterization of a sample to create a ternary diagram of a specific alloy.
- Microscopy: Micrographs of the samples were taken at 100x magnification.
- EDS of sample #12: Through the EDS analysis, the chemical composition of the sample was determined.
- EDS of sample #9: The EDS objective is to obtain the chemical characterization of a sample to create a ternary diagram of a specific alloy.
- Microscopy: Micrographs of the samples were taken at 100x magnification.

The following diagram displays the experimentation order and tests performed:

```

graph TD
    A[Alloying] --> B[EDS]
    B --> C[EDS of sample #12]
    C --> D[EDS of sample #9]
    D --> E[Microscopy]
    E --> F[EDS]
    F --> G[Microscopy]
    
```

Acknowledgments:
Research Advisor: Philip G. Nash, Ph.D. Student: Ying Zhou
Graduate Students from Graduate School of Materials Science and Engineering (GAMES): Special thanks to John Hauser and Kathy Meyer for their assistance in the project.

Conclusions and Future Work:
As a conclusion of our work we plotted a ternary diagram for the Ni-Co-Al at 800°C.
As future work our objective is to create a ternary diagram for this alloy in different temperatures.
Phase fraction analysis via Revised refinement.

(ENGR 498.20) Phase equilibria in the Ni-Co-Al system at 800°C

Phase Equilibria in the Ni-Co-Al system - As Cast Sample

Apurva Nagarkar, Guilherme Pereira, Jean Souza, and Luiz Henrique Kóceiro | ENGR498.20 Instructor: Professor Philip Nash, Ph.D.

Background:
The Ni-Co-Al system was chosen to better understand the alloy properties and behavior at different temperatures and compositions. However, Ni base alloys can be applied in particle applications such as in turbine blades. Li's shape memory effect can also make it more accessible and practical.

Results:
The primary phase $\alpha + \gamma$ (NiCo₂) there is no eutectic reaction at boundaries between 430 and 1000°C.

Methods:
Twelve as cast samples were prepared, and divided in three different groups: 430°C, 600°C, and 1000°C. The following steps were applied throughout the study:

- Sample Preparation
- Melt Spinning
- Cutting Samples
- EDS
- Microscopy
- EDS
- EDS
- Microscopy
- EDS
- Microscopy
- EDS
- Microscopy

Conclusion:
The primary phase in B (NiCo₂) there is no eutectic reaction at boundaries between 430 and 1000°C.

Acknowledgements:
Research supported by III. Armour College of Engineering, Instituto de Inovação Educacional (IEE) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).
Co-authors: Alex Oliveira, André Silva, Lucas Pires, Jean Souza, and Luiz Henrique Kóceiro. Advisor: Philip G. Nash, Ph.D. Co-authors: Alvaro Oliveira, André Silva, Lucas Pires, Guilherme Pereira, Jean Souza, Luiz Henrique Kóceiro, and Luiz Henrique Kóceiro. Advisor: Philip G. Nash, Ph.D.

References:
[1] Vitorino, P., et al., 2014. Liquefied Propulsion by Tension: Phase Diagrams, Material Phase Data Systems (MPDS), Retrieved July 16, 2014.

(ENGR 498.20) Phase Equilibria in the Ni-Co-Al system - As Cast Sample

Phase Equilibria of Ni-Co-Al system at 1100°C

Alma Oliveira, André Silva, Guilherme Teodoro, Jessica Cornelio, Dr. Philip Nash | CHENIA

Background:
Nickel-Based polymers are a class of highly durable weight-bearing materials used in the aerospace industry. These materials have a high melting point and low density, making them suitable for use in harsh environments. The main purpose of this research is to understand the phase equilibria in the Ni-Co-Al system at 1100°C.

Results:
Optical Microscopy: Optical microscopy images showing the microstructure of the samples. **XRD:** X-ray diffraction patterns for the samples. **EDS:** Energy Dispersive X-ray Spectroscopy patterns for the samples.

Conclusion:
One phase precipitated upon the high-Al phase. The primary phase is NiCo₂. The secondary phase is Ni₃Al. The tertiary phase is Ni₃Al₂. The quaternary phase is Ni₃Al₃.

Procedure:

- Alloying
- Welding
- EDS
- EDS
- Optical Microscopy
- EDS
- EDS
- Optical Microscopy
- EDS
- EDS

Acknowledgments:
Comisión Asesora Científica Apoyo Investigación, Bruce Bremner, Instituto de Inovação Educacional, Philip G. Nash, Dr. Philip G. Nash, Dr. Philip G. Nash.

(ENGR 498.20) Phase Equilibria of Ni-Co-Al System at 1100° C

Serrated Grain Boundary via Discontinuous Precipitation in Ni-Co-Al Alloys

Marcelo Matos | Dr. Philip Nash | Co-author: Yang Zhou | Brazil Institute of Technology, São Paulo

Background:
The formation of serrated grain boundaries via discontinuous precipitation in Ni-Co-Al alloys. Serrated grain boundaries might appear during the aging or annealing process or during hot or cold rolling and prevent grain movements. It might reduce the diffusion length of solutes and increase the mechanical properties of the material.

Methods:

- Welding and wire
- Welding and wire
- EDS, SEM, TEM and optical microscopy analyses.
- Creep test

Conclusion:
The migration of the grain boundaries under discontinuous precipitation is a very slow process. For example, it took about 100 hours for the grain boundary to move 100 micrometers. The migration of the grain boundaries under discontinuous precipitation is a very slow process. For example, it took about 100 hours for the grain boundary to move 100 micrometers.

Hypotheses:
The mechanism of formation of precipitation is phase transformation of the primary phase. The primary phase is Ni₃Al. The primary phase is Ni₃Al. The primary phase is Ni₃Al. The primary phase is Ni₃Al.

Discussion and Future Work:
Given the results, indicate presence of discontinuous precipitation values for the serrated grain boundary are higher than others. This behavior is probably related to the creeps test temperature. Future work in the project includes to prepare more samples and to perform more tests.

References:
[1] Stegeman, H., 1993. The solid solution Co_xNi_{1-x}, Berlin, Springer, 2014.
[2] Li, Z., et al., 1998. Ni₃Al precipitation in Ni-Ga-Pt alloy, London, UK, 1998.

Acknowledgments:
Marcelo Matos | Dr. Philip Nash | Co-author: Yang Zhou | Brazil Institute of Technology, São Paulo

(ENGR 498.20) Serrated Grain Boundaries via Discontinuous Precipitation in Ni-Co-Al Alloys

Investigation of shape memory effect on the Si-Co-V system

It's Amour College of Engineering
Centro de Inovação e Pesquisa - CIP

Jessica Domenis Silva, Advisor: John Haaser, Instructor: Dr. Philip Nairn

Shape memory in Heusler alloys

Abstract: This poster presents the investigation of the shape memory effect in the Si-Co-V system. The project involved the synthesis of the material via the solid-state reaction method, followed by characterization of the microstructure and mechanical properties. The results show that the material exhibits a shape memory effect, with a recovery strain of approximately 1.5% at 400°C.

Procedure

Sample preparation: Ball-milling the materials, followed by annealing at 800°C for 10 hours. Characterization: XRD, SEM, EDS, Vickers Hardness Test, TGA, and DSC.

SiCoV_x

Optical Microscopy

SEM images showing the microstructure of the SiCoV_x alloy.

SiCoCuV_x

Optical Microscopy

SEM images showing the microstructure of the SiCoCuV_x alloy.

Future Work

- Use the information of phase transformations as a function of temperature to predict the behavior of the material.
- Use DSC to understand the behavior of the material.
- Perform a mechanical test to find the stress-strain curve.

References

[1] J. Domenis-Silva, J. Haaser, P. Nairn, "Investigation of the Shape Memory Effect in the Si-Co-V System", *Journal of Materials Science: Materials in Electronics*, 2020, 31(1), 100-105.

Acknowledgments

This work was funded by the Brazilian National Council for Scientific and Technological Development (CNPq) and the São Paulo Research Foundation (FAPESP).

(ENGR 498.20) Investigation of Shape Memory Effect on the Si-Co-V System

Double Aging Effect on Corrosion Resistance and Mechanical Properties of Aluminum 7075

Bruna Marques, Lucas Sávio, Instructor: Prof. Phillip Nairn

Overview

The main objective of this project is to obtain results that will help in the design of light-weight and strength elements, which depend for a long period of time on the mechanical behavior of the material. The main idea is to evaluate the influence of aging on the mechanical properties of 7075 aluminum.

Method

Two different heat treatments were performed: T6 (solution treatment + quenching) and T6+T7 (solution treatment + quenching + aging). The samples were cut and polished, and then submitted to the aging process at 150°C for 100 hours.

Results and Comparison

Figure 1 shows the mechanical properties of the samples after the aging process. The T6+T7 treatment resulted in higher mechanical properties compared to the T6 treatment.

(ENGR 499.13) Double Aging Effect on Corrosion Resistance & Mechanical Properties of Aluminum 7075

Microstructure and Mechanical Analysis of WC-Co Cerments

Ana Flavia Capoete/Ramos dos Santos, Dr. Satya Emani and Dr. Leon Shaw, ENGR499.13

Introduction

The tungsten carbide cobalt (WC-Co) is a metal matrix composite with high hardness and wear resistance. It is a ceramic phase within the tungsten carbide. WC-Co cements have been widely used in cutting tools and mining and mining industries. The main properties of WC-Co such as hardness, fracture toughness and high temperature strength and grain size and their influence on the lifetime of the cutting tools.

Properties of WC-Co

- High hardness
- High wear resistance
- Moderate fracture toughness

Experimental Methods

- Sample preparation
- Ultrasonic cleaning
- Electrodischarge machining (EDM)
- Wire EDM
- Polishing
- Fracture toughness
- Hardness

Results

SEM images showing the grain size, measure the length of Vicker's hardness, and measure the grain length.

Future Work

The next will continue with high temperature compression test for all samples, and more grain size analysis. Other samples will be subjected to the same analysis.

References

[1] Kengalur, L. et al., Strength properties in the WC-Co system, *Journal of Materials Science*, 2014, 49(10), 3514-3521.

[2] SHETTY, D. et al., indentation fracture of WC-Co cements, *JOURNAL OF MATERIALS SCIENCE*, 2005.

[3] Alavi, A. (1981). Effect of double aging on shear deformation behavior of tungsten carbide cemented cobalt. *Journal of Materials Science Letters*, 1, 101-103.

(ENGR 499.15) Microstructure & Mechanical Analysis of WC-Co Cerments

Design and Construction of an Instrumented Urban Model for Time-Resolved Pressure and Velocity Measurements

Vitor Carvalho, Bruno Monnier, ENGR498.32

INTRODUCTION & BACKGROUND

The wind flow in an urban environment is very complex, showing great variability due to the presence of buildings, trees, roads, and other urban structures. Thus, a comprehensive description of these phenomena is lacking. One possible solution to this problem has many applications: MAVIS (Micro Aeolian Velocity) Project, wind energy conversion, dispersion, design and efficient placement of wind turbines, etc.

Method

Prof. Clark's group describes a very good model description of turbulence characteristics and large velocity fluctuations that worked appearing in an urban environment. However, this model does not consider the effect of orientation of the buildings. Thus, it is necessary to perform a series of experiments to validate this model.

Results

This work resulted in the completion of the instrumented urban area, which will be used in the next stages of our research.

ACKNOWLEDGMENT

We would like to acknowledge the support of Prof. Clark, who provided access to research and resources. The experience and knowledge obtained from this research is also greatly appreciated. Finally, we would like to thank Craig Johnson for his help in building the parts.

(ENGR 498.32) Design & Construction of an Instrumented Urban Model for Time-Resolved Pressure and Velocity Measurement

Ag plates Nanostructure produced by Discontinuous Precipitation in Ag alloys

Leandro Barreto, Researcher: Eng. Dept. Universidade F.A.T./PUC-Rio, Brazil
Coordinator: Prof. Dr. R. G. V. da Cunha, Brazil
Institution: Centro de Inovação e Pesquisa - CIP

Introduction

The project presents the development of a new technique for the discontinuous precipitation of Ag plates. The discontinuous precipitation is a solid-state transformation in the solid state involving the precipitation of a second phase in the form of discrete precipitates distributed in a matrix of the original phase. The technique can be applied to other materials, such as Cu, Al, Ti, Zn, Sn, Pb, Fe, Ni, Cr, Mn, Co, and Mg.

Materials and Methods

The one heating system was used to heat the samples to 800°C. After the heating, the samples were cooled down to 400°C. Then, they were heated again to 400°C and held for 10 minutes. Finally, the samples were cooled down to 200°C and held for 10 minutes. The samples were then cooled down to room temperature.

Future Work

In future work, the project will be developed to produce larger plates and to study the effect of the discontinuous precipitation on the mechanical properties of the material.

Results

SEM images showing the microstructure of the Ag plates.

References

[1] Ribeiro, C. M. L. C. L., Precipitation of silver nanowires by discontinuous precipitation of silver base metals, *Journal of Materials Science Letters*, 2010, 29(10), 1389-1392.

[2] Ribeiro, C. M. L. C. L., Production of silver nanowires by discontinuous precipitation of silver base metals, *Journal of Materials Science Letters*, 2010, 29(10), 1389-1392.

[3] Ribeiro, C. M. L. C. L., Preparation of silver nanowires by discontinuous precipitation of silver base metals, *Journal of Materials Science Letters*, 2010, 29(10), 1389-1392.

(ENGR 499.13) Ag Plates Nanostructure Produced by Discontinuous Precipitation in Ag Alloys

Processing and analysis of nanostructured WC-Co materials with platelet morphology

Bruna de Oliveira Coelho, Chao Zhu, Leon Shaw, ENGR499.16

Introduction

As a result of extensive thermodynamic, microstructural studies have been recognized to have remarkable and technologically attractive properties. In this work, WC-Co platelets have been achieved as nanostructured materials, such as WC-Co platelets with high density and low porosity. WC-Co is a technologically important composite material and has been used in various applications, such as punches and wear-resistant coatings.

Methodology

Transformation of the powder: Preparation for the grinding: Phosphate Powder; Quenching and polishing.

Objective

The objective of this project was to prepare a high-quality WC-Co platelet sample for analysis of its microstructure.

Conclusion

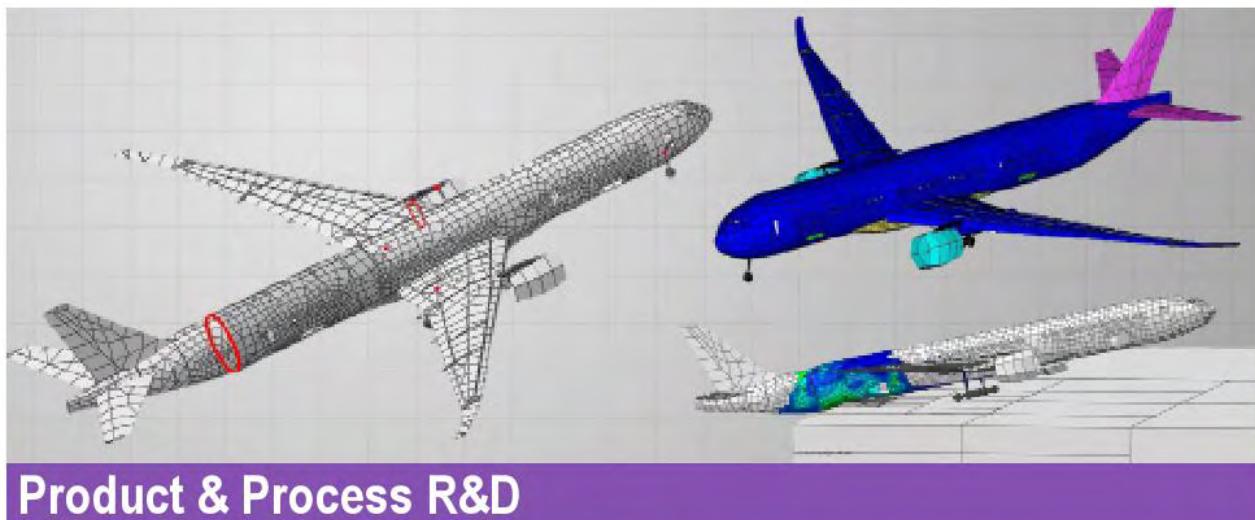
Email: bruna.coelho@uol.com
Phone: (21) 998-6899

Results and Conclusion

The industrial WC-Co doesn't show good density ($\approx 70\%$). The material presents a lot of voids.

(ENGR 499.16) Processing & Analysis of Nanostructured WC-Co Materials with Platelet Morphology

Posters



Product & Process R&D

Airport Runway Landing Analysis
Vincius Alves, Bruna Moita, Dárcio Koga, Juliano de Oliveira, Nathane Andrade, André Baccelar, Thiago Reck, Dr. Roberto Cammino
ILLINOIS INSTITUTE OF TECHNOLOGY | Armour R&D | ENGR 498

Background
A runway is defined as "a rectangular area on land or water prepared for the landing and takeoff of aircraft". By definition, the International Civil Aviation Organization (ICAO) and it's composed by three main layers which are concrete or asphalt and the subgrade that corresponds to the soil.

The Federal Aviation Administration (FAA) has developed an airtight software capable to design pavements of runways using finite elements. This model and its extension to the airport.

This project has the purpose to analyze the stress effects caused on the runway by an aircraft landing, seeking to optimize the cost of construction.

Methods

Design with FEA Software + Additional Materials + Information About Airplane and Runway = Results

Discussion

This research was capable of analyzing the impacts of the loads on the runway. According to the runway design, the runway designed to hold all the other pieces fastened. And also to support the impact caused by the aircraft landing, absorbing the energy and distributing it evenly among the different layers. If the soil has a high resistance, the runway can be less resistant.

Our project based on a simplification of the runway construction and reducing of costs.

Based on this research, other projects can be developed related with airplane design, and new techniques can be found in order to improve the cost of construction.

References

- Armour College of Engineering for offering the course ENGR 498
- Mr. Roberto Cammino for the orientation.
- Dr. Michael Neuman from UNO-Nebraska for airport design background.
- Dr. Michael Giroz and Dr. Aman Shah for finite element knowledge.

Results

(ENGR 498.02) Airport Runway Landing Analysis Using Finite Elements

Computational Analysis of a Fuselage Structure
Igor Mönnes Guesser, Luiz Felipe Saboia, Mariana Luisa Cardoso, Renato Sartori | Instructor: Dr. Roberto Cammino - ENGR498.02 | Armour R&D | ENGR 498

Background
Airplanes are designed as mass, stiffness, weight and size. The fuselage is the part of the airplane that holds all the other pieces fastened. And also to support the impact caused by the aircraft landing, absorbing the energy and distributing it evenly among the different layers.

To make sure that it is a reliable and safe structure, numerical simulation is a method to test our model in several load cases.

In this project the software of the Abaqus FEA is used to perform the dynamic analysis of landing impact. The impact is simulated with a payload force applied with no support of the Abaqus software.

Methods

Results

(ENGR 498.02) Computational Analysis of a Fuselage Structure

Evaluation of alternative materials for aircraft bodies during belly landing
Felipe Alves, Guilherme Gradim, Vanessa Cândido and Dr. Roberto Cammino, ENGR498.02 | Armour R&D | ENGR 498

Background
A belly landing is a landing that occurs in an incorrect nose-down position, causing the aircraft to touch down with the front wheel first and the rear wheels later. It is a common cause of aircraft damage and one of the most frequent types of aircraft accidents. These types of landings can cause significant damage to the aircraft, especially when the aircraft is carrying passengers. The goal of this research is to evaluate the impact of the aircraft body when it touches the ground.

Methods

Results

Future Work

In future simulations the group will work on different types between the airplane and perform impact tests to see how well it works in an emergency landing situation.

Acknowledgments

- Special thanks to Dr. Roberto Cammino for helping me.
- Thanks to Dr. Roberto Cammino for giving me the opportunity of working abroad.

References

- 1. http://www.flightmechanics.com/CHPT01/01_AircraftLandingTheory.html
- 2. <http://www.intechopen.com/books/aircraft-impact-analysis/>
- 3. <http://www.aiaa.org/2009-0482/>
- 4. <http://www.aiaa.org/2009-0483/>
- 5. <http://www.aiaa.org/2009-0484/>
- 6. <http://www.aiaa.org/2009-0485/>
- 7. <http://www.aiaa.org/2009-0486/>
- 8. <http://www.aiaa.org/2009-0487/>

(ENGR 498.02) Evaluation of Alternative Materials for Aircraft Structures During Emergency Landings

Structural Aspects in Design Using Finite Element Methods
Oliviano Góis, Júlio Santoro, Rodrigo Poxa | Armour R&D | ENGR 497 | ENGR 497

Background
In baseball games, the main purpose is to obtain the ball's position to swing speed velocity. Then, a better ball exit velocity is going to be reached, increasing the ball exit velocity and trajectory, by finding a lower spot contact rate than the average object of study through the past several years.

The sweet spot is known as the location on the baseball bat where the maximum contact with the ball occurs, defining the most effective ball exit velocity on a bat swing.

Professional experienced players have said that the best spot is located at the top of the bat, between 5 to 7 inches from the tip of the barrel.

Initially, a wood bat was used due to the prehistoric baseball requirements.

The center of percussion (COP) is the point on the bat where the impact will produce the minimal reaction to the batter's hand, which is the sweet spot is often misunderstood as the COP.

The main goal of this research is to study the sweet spot on the bat, consequently finding the optimum ball exit velocity (BEV) and understand the stresses on the bat due to the ball impact.

Methods

Results

Discussion

- Ball exit ball velocity during impact

Step by Step

- Develop a CAD model based in a professional baseball league bat using SolidWorks
- Develop a CAD model based in a professional baseball league bat using SolidWorks
- Develop a grid to simulate the batter's hand holding the bat using SolidWorks
- Define the material properties of the baseball and the bat
- Produce a proper mesh for the bat and the ball using HyperMesh
- Analyze of energy, strain and displacement of the bat and the ball on a ball using Abaqus
- Analyze the results obtained on Abaqus to determine the sweet spot of the bat

References

- 1. CHALI, L. (1997) ICMR Research Program: softball and baseball.
- 2. KOTHAM, A.M. (2003) Determining the performance characteristics of a baseball bat.
- 3. KOTHAM, A.M. Baseball and Bat Performance Standard. 1st ed. NIST Research Council, meeting. (2003)
- 4. BROOK, H. (2005) The Sweet Spot of a Baseball Bat, American Journal of Physics, 73(1), 18-23.
- 5. H. Solid Models of Baseball Bats, American Journal of Physics, 73(1), 18-23.

(ENGR 498.02) Evaluation of Baseball Bats During Impact With a Baseball

Evaluation of Helmet Protection
Amaldo Jacob, Caroline Faria, Gustavo Ferreira, Kleison Reis, Mariana Motta, Thiago Meneghetti
Dr. Roberto Cammino ENGR498.02

BACKGROUND

Most accidents in the construction site can be avoided by simply using personal protective equipment.

In this project, we focus on the safety of helmets, trying to evaluate the maximum capacity of helmet protection and the impact in the skull at the same time, using two different composite Aromatic Isotactic Styrene (AIS) and High Density Polyethylene (HDPE) helmets.

RESULTS

Figure 1: Stress analysis of the helmet during impact.

Figure 2: Stress analysis of the helmet during impact.

DISCUSSION

- The behavior of AIS helmets is better than HDPE helmets under impact.
- On the other hand, HDPE is cheaper and has a lower density than AIS.
- The helmet is effective for impact protection of objects falling up to 15 meters height, as shown in the figures.
- This project shows the relevance of the helmet in the construction site.
- To obtain better values:
 - the refinement of the mesh would be increased.
 - Run more tests with other materials and heights.

ACKNOWLEDGEMENTS

Special thanks to the Brazilian Government and CAPES for this opportunity. Special thanks to the Institute of Mathematics and Computer Science - Araruna College of Engineering, Dr. Cammino and Tully Miatoczyk for making this project possible.

REFERENCES

1.-D. Study Works (Eds.) (2001). Advances in Applied Mechanics Modeling and Simulation. (pp. 1-100). McGraw-Hill Online Materials Information Resource. Retrieved from <http://www.mhhe.com/studyworks/>

(ENGR 498.02) Evaluation of Helmet Protection During Impact of Head to Ground & Impact of an Object to Head

Evaluation of optimization tools for strong mechanical designs and comparison to new software
ILLINOIS INSTITUTE OF TECHNOLOGY

Background

HyperMesh and Abaqus are engineering softwares, which fusion how people work in the industry and how manufacturing processes will operate in real-world environments. In addition, their main goal is to improve an existing design. This is important in order to this the software developers create the best technology and then integrate it into existing and usually complex systems. This project allows engineers to efficiently evaluate complex performances related to the interaction between a system and its environment, to provide system services, to manage simulation processes and data.

METHODS

CAD Model, Meshing, Analysis, Optimization.

Discussion

- We compared five different uses for HyperMesh and Abaqus. We used HyperMesh using OptStruct in HyperMesh, and Virtual.PX35 in Abaqus.
- We compare methodologies used to establish the best one to identify which one has advantages and disadvantages if several relevant aspects during the process.
- We analyzed what could be done to improve Virtual.PX35 methods.

Author profile of our members

- Araruna College of Engineering for funding of Engineering Themes course ENGR 498
- Virtual.PX35
- Brazilian government and CAPES
- Roberto A. Cammino, PhD.
- Michael R. Gray, PhD
- Vanderlei Góes, Business Manager at Virtual.PX35

REFERENCES

- Finite element method applications in solids structures and heat transfer. (pp. 1-100). (Eds.), Taylor & Francis, 1990.
- Polymer Processing: Fundamentals

(ENGR 498.02) Evaluation of Optimization Tools for Strong Mechanical Designs & Comparison to New Software

Finite Element Analysis of Wing
Filipe Loureiro, Henrique Naves, Murilo Galmarini, Koenig Montero;
Instructor: Dr. Roberto Cammino - ENGR498.02

Background

With the development of Material Science, new solutions related to structural strength and stability have been developed, allowing a better comprehension of the behavior of wing components due to cyclic loads.

Today, aircraft manufacturers use safer than other major modes of transportation; however, failure can occur. It is then necessary to understand all the components of the aircraft to prevent them from failing.

Trying to go further than being just user of this technology, the goal of this work is to test a specific component of the aircraft, the force due to certain flight conditions at the same time, and to measure the material stresses.

Methods

Numerical simulation using Finite Element Analysis, HyperMesh and Abaqus software.

- Find a model that satisfy needs.
- Import the file to HyperMesh file.
- Apply boundary conditions to the model.
- Run a finite fluid dynamics analysis grid.

Discussion

- We found out that the wing is affected the most. The wing suffers bending and twisting when the aircraft turns. The highest stress is over the heel edge of the wing, meaning over the leading edge.
- From our work we can see under which velocity patterns begin to occur.
- When the angle of attack over the airflow around the wing changes, tends to become more turbulent.

Acknowledgements

- Dates (Coord. de Aplicações Pesquisa, Brazil)
- Universidade de São Paulo (Brazil)
- II Araruna College of Engineering

REFERENCES

1. Koenig, Juan, Montero, Koenig, and R. C. (2013). "Analysis of the Wings of an Aircraft using Finite Element Analysis (FEA) and Optimization of the Reference Cell." *Journal of Aerospace Engineering*, Vol. 2, No. 1, April 2013 (10)-10.

2. Koenig, Juan, Montero, Cesar, Mark, Montero, Juan, and R. C. (2013). "Optimization of the Airplane Cell." *Journal of Aerospace Engineering*, Vol. 2, No. 1, April 2013 (10)-10.

3. Koenig, Juan, Montero, Cesar, Mark, Montero, Juan, and R. C. (2013). "Optimization of the Airplane Cell." *Journal of Aerospace Engineering*, Vol. 2, No. 1, April 2013 (10)-10.

(ENGR 498.02) Finite Element Analysis of an Aircraft Wing

Evaluation of Hockey Sticks During Impact with Hockey Puck
Felipe Burque, Conrado de Melo, Rafael Ferrara de Freitas, Vitor da Gama Gadot, Dr. Roberto Cammino, ENGR498.02

Introduction

Ice hockey is a sport played on ice (ice), and is very popular in the United States, Canada and Europe. The players use a stick to move the puck, which is a vulcanized rubber disk used to score goals.

The three main common materials that soccer sticks are made of are wood, aluminum and carbon fiber composites. The first hockey sticks were made of wood, but nowadays the sticks are made of wood and aluminum or carbon fiber composites.

Methods

CAE Models, Mesh Generation, Simulation, Analysis.

Conclusions

According to the analysis, it is possible to conclude that:

- Aluminum sticks provide the puck with higher initial velocity.
- For both materials the shot at the edge of the stick provides a greater impact on the puck with higher initial velocity.
- The highest stress levels happen when the stick is shot at the center of the stick.
- The stress levels in the wood and aluminum sticks are very similar.

Results

Figure 1: Hockey player controlling the puck.

Scope

For this research, two materials wood and aluminum, were tested in order to analyze which one provides the puck with the highest initial velocity and the greatest impact on the stick. Moreover, the other goal was to find the "sweet spot" of the stick, in other words, the optimal point where the stick provides the highest initial velocity to the puck.

Figure 2: Hockey stick.

Figure 3: Wood stick and aluminum stick shot at the edge of the stick.

Figure 4: Wood stick and aluminum stick shot at the edge of the stick.

Figure 5: Wood stick and aluminum stick shot at the center of the stick.

(ENGR 498.02) Evaluation of Hockey Sticks During Impact with Hockey Puck

Thermal-stress solar panel analysis using Finite Elements Method
Andrea Camargo, Raul Silve, Dr. Roberto Cammino, Dr. Almon Shabli
Illinois Institute of Technology, Chicago, Illinois 60616

Introduction

Solar panels, also known as photovoltaic cells, are very promising and popular approach to collect solar energy. Some panels are photovoltaic cells, while others are thermal solar panels.

For the thermal solar panels single junction silicon technology, the conversion efficiency reaches about 15% ($\pm 2\%$), therefore, to increase the conversion efficiency, the life-time must be reduced.

The efficiency of the photovoltaic cells is mainly determined by the temperature. As the temperature increases, the performance is reduced. Therefore, the panel needs to dissipate under standard operating conditions.

The main purpose of this research is to use FEA to do a thermal stress analysis and see the effects of the node nodes on the module.

Simulation

STEP / IGES Model → Analysis (heat effect) → Assessment (thermal, mesh).

Conclusions

- The type of material of each layer will change the simulation results.
- The thickness of each layer will change the temperature that the sun provides varies during the day, the thicker the layer, the higher the temperature.
- In general, during the summer the module temperature will be higher than during the fall, winter or spring.

Acknowledgements

- Araruna College of Engineering for funding of Engineering Themes course ENGR 498

References

1. Rangel, Rangel, R. L., Rangel, J. A. Mechanical Characteristics of Recycled Hockey Sticks Under Impact. *Journal of Polymer Science Part A: Polymer Chemistry*, Vol. 37, No. 12, December 1999, pp. 3513-3517.

2. Flores, R. M., Wherry, J. E., Etchegaray, D. L., and Hwang, S. J. Thermal Properties of Recycled Plastic. *Journal of Polymer Science Part A: Polymer Chemistry*, Vol. 37, No. 12, December 1999, pp. 3513-3517.

3. Jin, M., Miller, E., Thomas, K. In: *Finite Analysis of Composite Materials*. (pp. 1-100). Springer US, Boston, MA, 2003. doi:10.1007/978-1-4615-0240-3_1.

4. Matlack, W. *Wood Science*. Elsevier, 1981. matlack.com.

5. Rodriguez, J. *Rubber Technology Institute of Puerto Rico*. Composite Rating Using Abaqus. Clemson University, 2002.

(ENGR 498.02) FEA of a Thermal-Stress Solar Panel with Hypermesh & Abaqus

Rigid Body Crash of an Aircraft
Ivan Portela, Jonatas Gólio, Lorrane Nunes, Lucas Filgueira, Ocavio Revaldo, Paulete Victor Cordeiro, Renan Magalhães, Dr. Roberto Cammino

Introduction

On July 6th, 2013 an Asiana Airlines Boeing 777-200 with 296 people on board crashed on final approach to runway 29L at San Francisco International Airport. The aircraft was traveling northwardly to hit the seawall 115 meters (375 feet) before the beginning of the runway. The cause of the accident was attributed by human error, after an abnormal low altitude approach at low speed. The main objective of this work is to use the finite element method to simulate the impact of the aircraft on the ground, to determine the best way to reproduce the real situation.

Results

Figure 1: Airplane highlighted.

Discussion

- The normal impact speed is extremely common to occur at very low speeds.
- A model with deformable elements is first run to determine where the weak spots are located.
- The aircraft is then modeled as a rigid body using relative movements only at joints (parts).
- A combination of rigid and deformable bodies on critical or desired spots could be used.
- We investigated scaling the model to determine its usefulness to reproduce the real situation.

Methods

1. Generate the CAD model of a Boeing 777-200ER to represent the exact one involved in the impact.

2. Convert and import the model into the software HyperMesh to create a surface mesh.

3. Reproduce the impact with the aircraft and the motion of the aircraft during the accident.

Figure 2: Airplane.

Figure 3: Deformation highlighted.

Acknowledgements

- The Aviation Herald
- Aircraft Performance and Design, John D. Anderson, 1997
- Aerospace Specification Metals Inc.

References

1. Aviointerface. (2013). *Boeing 777-200ER Crash at San Francisco International Airport*. Retrieved from <http://aviointerface.com/2013/07/06/boeing-777-200er-crash-at-san-francisco-international-airport/>

(ENGR 498.02) Finite Element Analysis of the Asiana Airlines Flight 214 Crash

Posters

Bike Frame Analysis Under Different Loads Using Finite Element Method

Marcelo Vidal, Nicols Arredondo, Rafael Almeida, Thais Araujo
Dr. Alexes Sartori
Illinois Institute of Technology, Chicago, Illinois 60616

ENGR 498.03

Background

The most commonly materials used for built a bicycle are the AISI 4130 Steel and Aluminum 7005-T6. Steel has been used by ordinary cyclists, while aluminum has been chosen most by athletes for competitions and triathlons because of the lightness.

Material	AISI 4130	Al. 7005-T6
Density	7.856 g/cm ³	2.76 g/cm ³
Young's Modulus	215.87	29.16
Yield stress (MPa)	315.87	29.16

Methods

Dimension

- A dimension has a safety factor of 5.39 and it is lighter.
- The concerns of using aluminum are the low durability and the difficulty to repair.
- Aluminum is more durable and easy to repair, but it is heavy and expensive.
- Increasing the number of nodes, using more and smaller elements, improves the results and interactions among the elements.

Acknowledgements

- Armour College of Engineering for funding of course ENGR 498.03
- Capes for Sciences and Frontiers Program
- Brazilian Scientific Mobility Program

Results

After running the analysis in Abaqus, we obtained the following results:

- The highest stress occurred in the flat frame.
- The performance of Aluminum 7005-T6 is comparable to AISI 4130 Steel.
- Despite Steel has high yield stress, it is heavy and more expensive compared to aluminum.

References

1. "Material Type," MarcaWeb, Web. 17 Jan. 2013.
2. "Abaqus 6.10 Model," Gridcad.com, Web. 11 Jan. 2013.
3. "Abaqus 6.10 Manual," MarcaWeb, Web. 11 Jan. 2013.
4. "Study of Materials," MarcaWeb, Web. 21 Feb. 2013.

Creation of a Simple Human Model to Evaluate Crash Performance

Andre Luiz Tavares, Shenen Silva de Souza and Dr. Roberto Cammino, ENGR498.03

ILLINOIS COLLEGE OF ENGINEERING
UNIVERSITY OF ILLINOIS AT CHICAGO

Background

In a product design process, often a model with great importance, especially in the vehicle development industry, this relates to determine the validation of a design since a modified error may result in countless casualties.

For that reason, several tests are required to verify the project feasibility. The main problem is the cost of these tests and the time consumption. On that aspect, diverse companies make use of software to perform simulations instead of physical tests in production. However, many of these softwares do not provide anthropomorphic models to evaluate the car test and they must be purchased separately, which can be expensive.

Methodology

Discussion

- Dummy reported moving energy shift as expected
- Forces concentrated on the neck and waist.

For the future:

- Validate our model by comparing with existing software to verify the accuracy
- Create a more realistic model for appropriate results
- Utilize diverse students projects (Brazilian Academic, CAR) to verify the responses

Acknowledgements

- CAPES
- Instituto de Pesquisas Energéticas e Nucleares
- Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)
- Brazilian Scientific Mobility Program
- Dr. Roberto Cammino

Results

References

1. Grubbe, Mr. Dummy by Bier Hollander
2. Humanistic Approach, Volterra, Hybrid in 3D, Bilev Duman Catalog
3. Maritime Model of Plasticity, Durability and Model

(ENGR 498.03) Bike Frame Analysis under Different Loads using Finite Element Method

(ENGR 498.03) Creation of a Simple Human Model to Evaluate Crash Performance

Scissor Car-Jack: A Finite Elements Analysis

Carina Villala Manzi, Filipe Costa Martins, Gabriel Francisco de Oliveira, Dr. Almos Shihhi, ENGR498.03

Background

• Car-jack, widely applied tool to lift and support vehicles. • Inner rear boltsight turns 0 to large sets + 220° (E).

Objectives

- Find the best lifting point.
- Observe how stresses vary with different angles
- Propose an angle that will not cause fatigue.

Method

From a proposed geometry, the screw was removed (prior to assembly) and the model was remeshed using HyperMesh.

Results

Conclusion & Future Steps

- The best location is the bottom part of the jackjack since it shows the lowest stress during lifting.
- The problematic stage occurred when the angle was 180°, however, a high stress also happened when the angle was 240°. The maximum stress at the end of the lifting process are critical for the tool.
- More lifting stages need to be tested to better understand how the peak stress varies with the opening angle.

References

1. Almos, Dr. Shihhi, L. 2013, E. & Silveira, M., 2013. First Project Finite Element Analysis (FEA) of a car jack. URL: <http://hypermesh.cefetnmg.br/cefe/2013/03/03/first-project-finite-element-analysis-fea-of-a-car-jack/>
2. Material Properties, MarcaWeb, Web. 10 Jan. 2013.

Acknowledgements

- Thanks to Carina, Filipe, Gabriel, Dr. Almos Shihhi, for their support.
- Thanks to Dr. Almos Shihhi (Institute of International Education) and Special thanks to Dr. Silveira, Dr. Camillo and Dr. Gomes.

(ENGR 498.03) Scissor Car-Jack: A Finite Element Analysis

(ENGR 498.03) Static Structural Analysis of Automotive Damper

(ENGR 498.03) Static Analysis of Differential Behavior under Torque

Influence of different element size in an automotive damper static structural analysis

Hamilton Lúcio da Cunha, IIT Armour College of Engineering, Illinois Institute of Technology, Chicago, IL 60616

Background

The damper is an important component that has the function of reducing the effects of traveling on an asphalt surface.

Objectives

- Weight 854 Kg.
- Objective: Comparing a static analysis between different sizes to evaluate the damper structural performance under loading.

Introduction

• The damper is an important component that has the function of reducing the effects of traveling on an asphalt surface.

Results

Conclusion

PIECH

- Results converge at about 4600Pa.
- The temperature will stay constant.
- Element size of 1.0-mm is recommended.

STRUCTURE

- The structure will stay under the load.
- At 1.0 mm causes the pressuring time will increase by one minute.
- At 0.5 mm the element size was decreased the results tend to stabilize in a value near 100 MPa.
- The results with element size 0.2 to 2 mm is more representative for this damper.
- Using the smallest size of 0.1 mm the maximum load that the structure can support is approximately 15.0 Kt. It supports the car loaded with 5 people of 140 Kg.

References

Bassani, D. & Howell, G. 2004. Crashworthiness of a racing car chassis. In: SAE International. Proceedings of the International Congress and Exposition. 2004-01-0204. Available online in <http://www.sae.org/abstracts/2004-01-0204.html>.

(ENGR 498.03) Static Structural Analysis of Automotive Damper

(ENGR 498.03) Structural Analysis of a Racecar Chassis Using Finite Element Method

(ENGR 498.03) Structural Analysis of a Racecar Chassis Using Finite Element Method

106 Armour College of Engineering
ILLINOIS INSTITUTE OF TECHNOLOGY

Product & Process R&D

Computational Analysis of the Structure of a Gameboy
Augusto Miller, Larissa Costa, Júlio Siqueira, Wagner Rodrigues
Dr. Alain Shiffi
Illinois Institute of Technology, Chicago, Illinois 60616
ENGR 498

Background

The Gameboy is a portable gaming device created by the Nintendo. It was first released in Japan in 1989. It was a huge success and is still \$13.490 millions units worldwide.

After the success of the Gameboy, other models of portable gaming devices were created and released, some examples are the Gameboy Advance, DS, 3DS, etc.

The finite element method is a technique that applies numerical methods to obtain approximate solutions of engineering problems.

In this research, we utilized Finite Element Method (FEM) with the software HyperWorks to perform a static and dynamic analysis of a Nintendo gameboy. The structural performance of the device has been evaluated under different scenarios such as different drop velocities and different drop sceneries.

Methods

CAD Model → FEM → Post-processing → Results

Discussion

For the static analysis, the stresses were found in the caps. For the dynamic analysis, the higher stresses were found on the covers, mostly on the top of its small concave section area.

Plastic deformation occurs in all the drop analysis, the bottom part does not break and did not crack, being stiff material is suggested to mitigate the amount of denting.

Acknowledgements

• Alain College of Engineering for funding of Engineering Themes course ENGR-498.
• CAPES/CNPq for sponsoring the program.
• Dr. Alain Shiffi for providing the necessary support.

Results

Figure 1: Nintendo Gameboy CAD model.

Figure 2: FEM Mesh.

Figure 3: Calculations.

Figure 4: Final Surface.

References

1 - ABI Plastic Material Data: www.mateus.com.
2 - Gameboy: www.wikipedia.org; 11-12-2010.
3 - Gameboy Encyclopedia: www.gameboycyclopedia.com.

(ENGR 498.03) Structural Analysis of Nintendo Gameboy

Technical and Sustainable Evaluation of a Short Span Bridge
Jairo Pedro C. Pires, Leocio Nasidromo, Rafael Lima de Sa, Rafael Wildson C. Góes, Dr. Alain Shiffi, ENGR498.03
R&D

Overview

This project is an attempt to demonstrate how the use of Finite Element Analysis (FEA) can help reduce financial resources to build bridges. In this research, we considered FEA technology with a sustainability assessment approach to evaluate a short span bridge, being it made of reinforced concrete, steel or wood.

Methods

• Reinforced Concrete:
▪ Difference of a reinforced concrete beam, a wood beam and a steel beam.
▪ Analysis of the bending test based on four joint bending test of beam.

• Sustainability Assessment:
▪ Social
▪ Economic
▪ Environmental

Sustainability

Results

CAD model > shell mesh → CAD model > 2D mesh and line draft.

Steel Reinforced Concrete Testing Data

Wood (Douglas Fir) Testing Data

Environmental Assessment

Economic Assessment

The Economic Analysis was done using a basic study that compares the cost of the bridge construction of using the material that can be bought at a different supplier.

References

1 - Gameboy: www.wikipedia.org; 11-12-2010.
2 - Plastic Material Data: www.mateus.com.
3 - Gameboy Encyclopedia: www.gameboycyclopedia.com.

(ENGR 498.03) Technical and Sustainable Evaluation of Short Span Bridge

Steady State and Dynamic Operation of a Catalytic Reaction in Two Coupled Reactors
Carolina Machado, Gustavo Vitoria Gomes, Ecilia Regina Silva Danias and Dr. Satish Parulekar, ENGR498.29

Background

- Chemical & biological processes – major role of chemical reactions, bioprocessing.
- Catalysis – important for steady state operation, reactors with recycle streams – recycle steady states, reactor stability.
- Multi-scale modeling – operational flexibility, validity, lifetime in industry.
- Mathematical reactors – operating databases over multiple scales.
- Large reactors – variation in extent of mixing, examining bypass, dead zones – equivalent to recycle streams.
- Multiple steady states – performance variation and effect of simulation runtimes.

Problem works/ System dynamics

A catalytic reaction with inhibitor by reactor in two parallel reactors. adsorbent particle rates, effects of surface-to-particle interaction between reactors.

Results

Notation:

- Notation: $\dot{V}_1 = \text{Recycle rate}, \dot{V}_2 = \text{Inlet flow rate}$
- Labels: \bullet Stable Node, \bullet Unstable Node
- Initial conditions: $x_1 = 0.01, x_2 = 0, x_3 = 0, x_4 = 1$
- Overmix interaction ($\dot{V}_1 = 65, \dot{V}_2 = 16, \dot{V}_3 = 0$):
- Two-way coupling interaction ($\dot{V}_1 = 65$):
- Two-way coupling interaction ($\dot{V}_1 = 10$):
- Dynamics:
- Two-way interaction – no feedlimit for one reactor – steady state (0.01, 0.01, 0.01, 0.98).

Methods

A mathematical contribution written in MATLAB. MATLAB was used to sketch steady states of the two reactors and to find the steady states of the system. The steady state of the system allows for determination of steady states of steady states and provides simulation results in both numeric and graphical formats.

References

1 - Iglesias, U.S.: Chemical Reaction Engineering, 4th ed., Upper Saddle River, NJ: Prentice-Hall, 2007.
2 - Kwei, T.K.: Polymer Processing, 2nd Edn., Marcel Dekker, New York, 1997.
3 - Parulekar, S.W.: Catalytic Reaction in Two Coupled Reactors with Adsorbents: Feed Conditions. "Ind Eng Chem Res Under review".

Acknowledgments

This project was supported by the Brazilian Scientific Mobility Program (BRAZILIAN). We thank the CNPq and FAPESP for the opportunity to work on the project and the institutions provided by the Illinois College of Engineering.

(ENGR 498.29) Steady State & Dynamic Operation of a Catalytic Reaction in Two Coupled Reactors

Analysis of Hyperelastic Material Models
Gabriel Macêdo, Isao Topolski, Paulo Henrique, Felipe Pedrosa, Ederon Láz, Dr. James Grudzinski, Illinois Institute of Technology, Chicago, Illinois 60616
ENGR 498.34

Background

The Asian test is a method used to assess the mechanical behavior of rubber, elastomers, adhesives and soft tissue. This test uses a constant strain rate dependent on the restraint points, which can test the specimen's behavior under different types of mixed strains. The Asian test can also prove the behavior of the material using a butterfly specimen, the substrate must act as the outer part of the specimen, and the inner part of the material to be tested. The fixture in this case is made of metal and the specimen of Rubber.

Results

1. Comparing results of the Analysis with and without the fixture

2. Comparing strain distribution of regular specimen and adhesive specimen

3. Comparing simulation and real data

4. Comparing different material models

Conclusion

1. The results simulated the fixture with and without fixture, decreasing the width of the fixture.

2. Both shear and tensile strains are larger and tensile extrusion.

3. The hydrostatic model is closer to the real behavior, but the difference between the curves is caused because there was no validation data was not available.

4. Neo-Hooke and Arruda-Boyce models have the same behavior, but the Arruda-Boyce has a different Strain-Stress curve.

Acknowledgments

Ilinois Institute of Technology, Arthur College of Engineering, FAPESP - Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CNPQ - Conselho Nacional de Desenvolvimento Científico e Tecnológico, BIRD - Brazilian Industry Science Program, International Institute of Education.

Methods

Geometry Analysis (CAD) → Run analysis and compare the results → Import the results to the material models or Abaqus

(ENGR 498.34) Analysis of Hyperelastic Material Models

Biomechanics: Finite Element Studies of Monkey Mandibles
Allan Magalhães, Matheus Passos, Igor Paiva, Dr. James Grudzinski, Dr. Calum Ross ENGR498.34

Background

It is hypothesized that the current shape of a monkey's mandible is determined through evolutionary process through its eating habits. Finite element analysis can be used to analyze the strength differences between mandibles that use teeth, incisors and molars.

2. The hypothesis model is closer to the real behavior, but the difference between the curves is caused because there was no validation data was not available.

3. The hydrostatic model is closer to the real behavior, but the difference between the curves is caused because there was no validation data was not available.

4. Neo-Hooke and Arruda-Boyce models have the same behavior, but the Arruda-Boyce has a different Strain-Stress curve.

Methods

Gathering understanding of the biomechanical model ↓ Developing a set of constraints ↓ Analysis of the strain in the model using Abaqus ↓ Compare the resulting different constraint conditions

Discussion

The strain data from different load cases of the monkey mandible were analyzed and compared. The strain was examined at location on both the right side and the right side. In this way, it was possible to see a similarity in the behavior of the sets of teeth sides of the mandible independent of loading side.

Results

Fig 1: Strain Cope position

Fig 2: X-Ray of the jaw

Fig 3: Incisors strain analysis (right side)

Fig 4: Molar strain analysis (right side)

Fig 5: Premaxillary struts analysis (right side)

(ENGR 498.34) Biomechanics: Finite Element Studies of Monkey Mandibles

Posters

Structural Analysis of a Gravity Dam Using Finite Elements

Aline Almeida, Arthur Roaverdant, Cais Tavares, Claudio Gonçalves, John Almeida and Dr. James Grudzinski, ENGR498.34

Introduction

A dam is a hydraulic structure built across a river or stream to block the water flow and creates a reservoir on the upstream side for irrigation, hydroelectric power generation, water supply, flood control, navigation, recreation, etc. The elevation of dams is increasing since reservoirs are directly connected.

Methods

Figure 1: CAD Model
Figure 2: Geometry
Figure 3: Meshed Model
Figure 4: Displacement Analysis (PLA/3D)
Figure 5: Stress Analysis (PLA/3D)

Discussion

- Create a CAD Model. Use Hypermath JAH (Ansys) to mesh a model of the structure.
- Import the CAD Model into Hypermath JAH (Ansys) to analyze the stress and displacement of the structure.
- Verification of the Decrease of pressure as different water pressure loadings.
- Analysis of stress and displacement of the structure.

Future work

For the next objective of this research, we are going to increase the height of the dam. We will also add more nodes to the structure to reduce the forces exerted upon it. In this work, the dam is subject to three principal types of loads: dead load, water load, and earth load. The dam has a width ratio, whereas the height is constant. The main purpose of this simulation is to evaluate the stresses and displacements in the structure of a gravity dam under different loading conditions, which will hold the dam.

Acknowledgements

This work was supported by the Department of Chemical and Biological Engineering, Coordination for Improvement of Higher Education Personnel - CAPES/Brazil

References

1. "Mechanistic models in earth dams," Nature 432(7004):212 (2004).
2. "Aerobic Oxidation of Biomass," Springer-Verlag (2011). e-jog design (2011). "Aerobic Oxidation of Biomass," Springer-Verlag (2011).
3. "System of Earth Oxidation and Classification," Civil Engineering Blog, n.º 27 Sept. 2011 Web. 30 Sept. 2011.

(ENGR 498.34) Structural Analysis of a Gravity Dam Using Finite Elements

Design and simulation for bioenergy and food

Felipe da Nascimento Freire, João Carlos Silva Lira, Kenji Urakai Junior
Dr. Fouad Teymour
(ENGR 499.01)

Introduction

The main objective of this research was to use 3D simulation software to study the behavior of bioethanol on the area of interest. The simulation was conducted using ANSYS Hypermath JAH (Ansys) to predict the behavior of bioethanol in a reactor. The simulation was conducted using ANSYS Hypermath JAH (Ansys) to predict the behavior of bioethanol in a reactor. The simulation was conducted using ANSYS Hypermath JAH (Ansys) to predict the behavior of bioethanol in a reactor. The simulation was conducted using ANSYS Hypermath JAH (Ansys) to predict the behavior of bioethanol in a reactor.

Methodology

The simulation was conducted using ANSYS Hypermath JAH (Ansys) to predict the behavior of bioethanol in a reactor. The simulation was conducted using ANSYS Hypermath JAH (Ansys) to predict the behavior of bioethanol in a reactor. The simulation was conducted using ANSYS Hypermath JAH (Ansys) to predict the behavior of bioethanol in a reactor.

Results

The simulation was conducted using ANSYS Hypermath JAH (Ansys) to predict the behavior of bioethanol in a reactor. The simulation was conducted using ANSYS Hypermath JAH (Ansys) to predict the behavior of bioethanol in a reactor. The simulation was conducted using ANSYS Hypermath JAH (Ansys) to predict the behavior of bioethanol in a reactor.

Discussion / Future Work

The simulation was conducted using ANSYS Hypermath JAH (Ansys) to predict the behavior of bioethanol in a reactor. The simulation was conducted using ANSYS Hypermath JAH (Ansys) to predict the behavior of bioethanol in a reactor. The simulation was conducted using ANSYS Hypermath JAH (Ansys) to predict the behavior of bioethanol in a reactor.

Acknowledgements

This work was supported by the Department of Chemical and Biological Engineering, Coordination for Improvement of Higher Education Personnel - CAPES/Brazil

References

1. "Mechanistic models in earth dams," Nature 432(7004):212 (2004).
2. "Aerobic Oxidation of Biomass," Springer-Verlag (2011). e-jog design (2011). "Aerobic Oxidation of Biomass," Springer-Verlag (2011).
3. "System of Earth Oxidation and Classification," Civil Engineering Blog, n.º 27 Sept. 2011 Web. 30 Sept. 2011.

(ENGR 499.01) Design & Simulation for Bioenergy & Food

Biochemical Engineering for Food and Energy

Liane Mihale, Lucia R. Lima (Undergraduate), Dr. Paula Teymour (Advisor), ENGR499.01

Department of Chemical and Biological Engineering, Illinois Institute of Technology, Chicago IL 60616, USA

Introduction

The synthesis of seeds as fuel for human consumption has been a common practice in many countries. Seeds contain energy in the form of lipids, proteins, vitamins, minerals and carbohydrates. Seeds are a valuable source for the production of biofuels, especially for biodiesel fuel for bacterial growth (US Food and Drug Administration, 1987).

The research aims to evaluate the production and safety assessment of great seeds in a minor analysis.

Methods

Agro production. Reactions were runway broccolli and infant seeds, fertilizer (nitrate 10%), and distilled water. The effect of ozone and probiotics on the synthesis growth and safety was assessed.

Results

Figure 1: CFU counts of sprouting medium of broccoli seeds for various probiotics.

Figure 2: CFU counts of sprouting medium of arachis seeds for various probiotics.

Discussion / Future Work

According to the results, the ozone was effective to increase the growth of seeds. The seeds containing probiotics presented a differential formation (Figure 2), showing that the probiotics used in the seeds did not affect the growth of the other organisms.

References

1. Gómez, J., et al. "Influence of probiotics on seed germination and seedling growth." *Journal of Applied Microbiology* 100(4): 745-753 (2006).

2. US Food and Drug Administration. "Food for Human Consumption." (1987).

(ENGR 499.01) Engineering Solutions for Food & Nutrition

Study of Carbon Monoxide Oxidation in an Autothermal Catalytic Reactor

Student: Ana Carla F. Viana; Fabio da S. Faria; Professor: Nader Adardeg
Department of Chemical and Biological Engineering - ENGR499.33

Introduction

This work is based on the study of an oxidation reactor, where platinum coated alumina is used to accelerate the conversion of CO to CO₂. The reaction is exothermic. The stoichiometric reaction takes place in a autothermal reactor, where the energy from the reaction is used as a source of heat for the reactor's jacket.

Methodology

• Analyze the process. An iterative method using Euler's algorithm, as well as Matlab related is adopted to study the parameter effects of feed flow rate, jacket inlet temperature, CO concentration and initial temperature used to start the reaction.

Results

• Control of process: Labview program is used to control the raw flow rate of the gases which are included in the reaction and to get the data acquisition.

Discussion / Future Work

• Jacket inlet gases are heated to different temperatures (as 125 and 175°C) to observe the start of reaction. During the process, the system temperature is monitored and it is noticed that at the ignition temperature, the temperature inside the reactor suddenly rises until the jacket temperature is decreasing.

• It is observed that the higher the temperature of the jacket, the faster the reaction is converted. In the graph is noticed that the maximum temperature for this reaction, which is very high, makes possible to reach the maximum conversion, in opposition to the results gotten by data acquisition.

References

• Celaya, Richard William. "Design and Control of Tubular Autothermal Reactors." Ann Arbor: UMI, 1987. 564 p.

• Hahn, R. Scott. "Elements of Chemical Reaction Engineering." 4th Edition, 2013.

Acknowledgements

This research had an important help of Brian Mitchell, who worked with us and gave us support and attention in all the steps and Professor Nader Adardeg, who gave us this important opportunity.

(ENGR 499.33) Study of Carbon Monoxide Oxidation in an Autothermal Catalytic Reactor

2 Ways Storage

Student: Rafael Diniz; Instructor: Mike Stacey and Abhirup Chatterapathy, ATR498.06

Problem

Necessarily, there are a bunch of products that are stored inside plastic packaging. These products are usually stored in houses as a result of their nature. However, they are usually stored in the kitchen, bathroom, and bedroom. However, these products have a limited shelf life. Therefore, to reuse and then throw them away, it is often possible to only bring one small bag of trash to the trash can. This leads to a lot of waste. As a result of this limitation and lack of space in bags, I have been working on a new way of packaging for personal products.

Solution

My goal consists in reformulating how containers are packaged. A new way of storage that people can use to store their products. To do this, better result, I will use a High Density Polyethylene (HDPE) because it is a material that is good for containers for cosmetics and household cleaners. Failure before the product would be reused.

Market

There are a huge market for plastic packaging. However, the ideal addressable market for my product would be cosmetics and household cleaners that could be reused.

Competition

Product	Disposable	Reusable	Cost	Space	2 Units
Disposable	✓	✗	✗	✗	✗
Reusable	✗	✓	✗	✗	✗
Disposable	✓	✗	✗	✗	✗
Reusable	✗	✓	✗	✗	✗
Total	✓	✓	✗	✗	✗
Value	✗	✗	✗	✗	✗
Budget	✗	✗	✗	✗	✗

Acknowledgments

- Co-authors: Dr. Armando Soares de Paula da Silva Superior (CAESE)
- Armour College of Engineering, IT Research Institute (IRI) (University of Illinois at Chicago)
- John Wiley lab manager, Idea Share

References

1. Braga, C. Simple Methods of Identification of Polymers, 5th Edition, Butterworth Books.
2. Idea Share Inc.

(ATR 498.06) Idea to Product - The Prototyping Process for Entrepreneurial Engineers - 2 Ways Storage Report

Blackout Nap – Sleep Eye Patch

Student: Regis Dasmalos Sales Filho Research Advisors: Mr. Abhirup Chatterapathy and Mr. Michael Stacey
ATR498.06: Idea to Product – The Prototyping Process

Introduction

The research project has the objective to start an ideal airplane. It is very easy to come up with ideas, but to make it real is hard. First, we did the market research and then we did the research. From the first hand how an entrepreneurial company runs its projects. The research company was started and we used it as a case study. Abstract challenges were given and turned into practical solutions. Practical approaches were designed and developed in front of these.

Solution

• A disposable eye mask without elastic cords that is able to sleep in flight.

Business Plan

1. Value Propositions
Airline passenger to sleep in flight (airplane).
2. Customers Segments
• Every passenger
• Every airline
3. Channels
• Online distribution
• Airline distribution
4. Revenue Streams
• Sales
5. Key Resources
• Financial resources
• Intellectual Capital
6. Key Partnerships
• Company and its materials suppliers.
7. Key Stakeholders
• Geographical location of the company and airline.
Engineering to improve the product technology.
8. Opportunities Cost
• Assumption cost
• Startup cost
• Startup revenue estimates
• Travel expenses

Problem

- Sleep in flight places
- Sleep when someone is reading by your side

Adhesive Market

Domestic and International Flights	3.12 Bi
Blackout Nap	3.3 Bi
Third Staff Workers	3.3 Bi

References

1. IATA - International Air Transport Association
2. DOD - United States Department of Defense
3. Blinds Nap
4. HT Max Corp

Acknowledgments

CAPES

(ATR 498.06) Idea to Product - The Prototyping Process for Entrepreneurial Engineers - Blackout Nap

IT Alfonso College of Engineering
INSTITUTE OF TECHNOLOGY

EXTENDABLE CUBE OUTLET
Thiago Mendes. Instructors: Mike Stacey and Abhishek Chatterjee
ATR 498-06: Idea to Product - The Prototyping Process

OBJECTIVES
To provide solutions to common problems by developing new ideas and to learn the step-by-step of how to map an idea come results. How to prototype, notions of marketing and business.

PROBLEM


- Low number of outlets and, sometimes, it's possible to have a no regulation or standardization about the minimum quantity of power outlets. Common sense says that as there is every super-busy wall should have one.
- You will always have more devices than power outlets to plug them on.
- In bedrooms, you might need less, but it varies when it comes to other rooms like kitchen, garage, and so.

SOLUTION


A Retractable Wall Outlet that can be used to extend the reach of an outlet to provide power to devices. Once used, the protocol would return to its original position, preventing associated wires are lost.

Market
The main focus of this product is to reach the households and users in the U.S. The number of Family Households are approximately 100 million. Considering 30 million households ten possible addressable market on this product, an income of \$ 380,000,000.

Acknowledgement
SSBC

References
www.census.gov

(ATR 498.06) Idea to Product - The Prototyping Process for Entrepreneurial Engineers - Extendable Cube Outlet

IT Alfonso College of Engineering
INSTITUTE OF TECHNOLOGY

Surgical Dental Articulator Edelthur
Arthur de Araújo Antunes, Instructors: Mike Stacey and Abhishek Chatterjee
ATR 498-06: Idea to Product - The Prototyping Process for Entrepreneurial Engineers

Abstract
The objective of the surgical dental articulator Edelthur is to develop the traditional dental articulator used in the campo of orthodontics and oral surgery in order to speed up and simplify the process.

The Edelthur is a surgical dental articulator which is used by the surgeon in orthognathic surgery to position the segments of maxilla and mandible in the desired position.

Solution

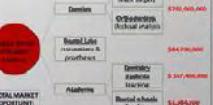

It was developed from the conventional dental articulator, in order to speed up and simplify the mock surgery.

Competition

Virtual surgical	✓
Traditional Method	✓
Surgeon and Adolescent doctor	✓ ✓ ✓

Acknowledgment

- Comunidade de Apoio à Inovação de Produtos de Novo Mercado (ANAP)
- Arthur College of Engineering, ITA
- Dr. Silviano dos Santos Andrade

Market


Reference
 - MAGE, STEPHEN. Orthognathic surgery. Chapter 27. In: *Principles and practice of orthognathic surgery*. New York: Thieme, 2006.
 - Arthur de Araújo Antunes. *Virtual Surgical Dental Articulator*. 2015. <http://www.ita.edu.br/centros/ceip/ceip2006.html>

(ATR 498.06) The Prototyping Process for Entrepreneurial Engineers - Surgical Dental Articulator Edelthur

ILLINOIS INSTITUTE OF TECHNOLOGY
Rodrigo dos Santos Francisco
Alumnus College of Engineering, Illinois Institute of Technology

SCIENCE

Core Problem
Umbrella theft affects thousands of people daily and can cause fits, affect paper delivery and elections when the cover is willing to share between weeks with others.

Method
After research about different behavioral techniques, I found that the best way to avoid that umbrella continues after different people every day and part of the problem continues because the umbrella is not a quick way through a sharing system.

Results



Through the competitive analysis and market research, we can identify the market that will be interested about the technology.

Conclusion


We all have different uses everyday, but not all can be easily implemented.

Through tools such as prototyping, market research and business plan, we can identify potential users and the best way to implement and sell these ideas.

Using competitive analysis and financial data, the addressed market, we can analyze and validate the market and see if the product will be able to succeed in our new product or service.

References
 [1] Home Trends in Long Distance Run Hill. Ed. Brookline.
 [2] Permanent. Rutgers & Newark - New Jersey. 2002.
 [3] It's time for 2011 snow storm season. <http://usatoday.com/weather/2011-snow-storms.html>
Author Acknowledgments
 I would like to thank the professor, Abhishek Chatterjee and Mike Stacey, for believing in the project and for their support. I would also thank the unspoken concepts of the team members, who were involved. My gratitude to take many, many hours of my free time doing the design and prototyping stage.

Product **Promote Using** **Helping People** **Helping People** **Helping Business**
 Existing Products X X X
 New Idea X X X X

Business Model
 Social Enterprise
 Social Enterprise
 Social Enterprise

Figure 1 - Application Model

(ATR 498.06) Idea to Product - The Prototyping Process for Entrepreneurial Engineers - Umbrella Sharing

Social Media Comments

Sage Corps @sage_corps · 18h
Really impressive R&D projects showcased by Brazilian college students at @IITEngineering Armour R&D Expo



Olliver Moura @OlliverMoura · 15 hrs · feeling inspired with Jaime Garcia Diaz Alejo and 2 others at Illinois Institute of Technology

Engineering Expo w/ AllCell Technologies



Lulz da Silva Jr. with Tales Parrini Dantas and 7 others · 18 hrs · Clã do GPS hahaha. Valeu a parceria! Summer Research Project #CsF #IIT #Chicago



IIT Campus Life · 18 hrs · IIT Campus Life

The MTCC is the place to be today! Armour College of Engineering held a poster session for their BSMP students today. There were almost 200 posters that were presented. Great job everyone!

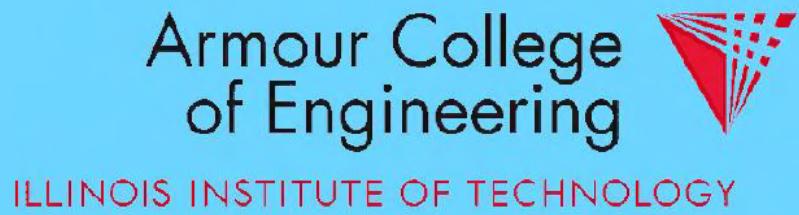


AmberAutumn @MsAmberAutumn · 15h · @IITEngineering @IITCommunity Wondful students, amazing expo, incredible innovations! I ❤️ IIT



**Armour College of Engineering
would like to thank the following:**

AllCell Technologies
Big Marker
Brazilian Science Mobility Program (BSMP)
Consulate General of Brazil in Chicago
Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)
Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)
Institute of International Education (IIE)
Motorola Solutions
The Green Ribbon Foundation
Tremco Roofing
Virtual.PYXIS



Armour College of Engineering
10 West 33 Street, Suite 224
Chicago, IL 60616
engineering.iit.edu

Natacha DePaola, Ph.D. Carol and Ed Kaplan Armour Dean of Engineering