Jan 10th, 12:00 AM

08. Engineering

University of Central Oklahoma

Abstracts from the 2013 Oklahoma Research Day

Held at the University of Central Oklahoma

05. Mathematics and Science

08. Engineering

05.08.01 Uses for Flyash in educational learning materials

Wayne Glass,

University of Tulsa

To be determines

05.08.02 Emissions Solutions through Advancements in Selective Catalytic Reduction Systems

Jeremy Massey,

University of Tulsa

In today's society, protecting the environment from dangerous pollutants is becoming ever more important. MIRATECH gave the researchers the opportunity to solve this issue by developing a selective catalytic reduction (SCR) system. This technology has existed for quite some time and is instrumental in reducing the amount of nitrous oxides that are produced from combustive systems. The main objective was to install and test new applications for a SCR system that would potentially lead to simpler design and operation, while also improving the efficiency of the system. This assignment coexisted with several other projects including the design and installation of MIRATECH's new Innovation Center, making them a world leader in emissions solutions testing. Nitrous oxides need to be removed from the environment because they are considered by the United States Environmental Protection Agency as "criteria air pollutants" and ozone precursors. Further advancements in SCR systems will lead to a healthier population, greater potential for cities to meet the air quality standards set by the EPA, and a cleaner environment for generations to come.

05.08.03 Temperature Compensation for Transmission Crystals

Stephan West,

University of Tulsa

This work reports the reasoning and process used to compensate for the temperature variation within the crystals used at Qual-Tron. Qual-Tron uses a 5MHz crystal in most of their transmitters. This crystal plays a large role in determining what frequency the product transmits on, but has a small fault in it. Due to the crystal, the transmission frequency varies with temperature. Before we had found what we though was an average curve (parts per million vs. temperature) and created an offset curve that could compensate for it. As time went on and we used this curve on more units we began to realize that the variation between crystals was too great, and one compensation curve was not going to work for every crystal. I was then tasked with a two part project. First, I needed to find a way to compensate each crystal individually without having to run a temperature test on each unit. The compensation had to get their transmission frequency to stay within five parts per million (PPM) between -40°C and 65°C. Secondly, I needed to make a program for production that could be used to compensate the crystals

05.08.04 The Design and Building of a Wind Powered Tesla Turbine

Baha Jassemnejad, Weldon Wilson,

University of Central Oklahoma

Nikola Tesla designed a bladeless turbine in order to achieve a high efficiency electric generator powered by steam. We will explain our design of this turbine and how it is operated by natural elements, the wind. We will also present a hybrid version of Tesla's turbine.

05.08.05 Redundant Communications Processor with Simple Network Management Protocol Monitoring

Baha Jassemnejad,

University of Central Oklahoma

The Federal Aviation Administration (FAA) requires redundant communication paths for any runway with the Category III listing. This redundancy is currently controlled by DataProbe's Automatic Protection Switch (APS). DataProbe has discontinued the product, and the FAA is needing a replacement. Instead of trying to find another 3rd party vendor for a system that would meet the requirements, they decided it would be a better investment to have a team of engineers design and develop such system that the FAA would own. Our task was to complete the "proof of concept" process that a previous design group had started (taking it to the next step of a full prototype), and integrate Simple Networking Management Protocol (SNMP) into the system.

05.08.06 Design and Development of a Digital Impedance Analyzer

Baha Jassemnejad,

University of Central Oklahoma

Today there are many commercially available impedance analyzers. These devices have many features and cater to a wide range of applications. They offer a wide range of test frequencies, and they can display many parameters such as phase shift. However, their major drawbacks are size and cost. Often, technicians in the field are only concerned with the real component of impedance measured at a specific frequency. The purpose of this project is to build a portable, handheld, digital impedance analyzer to be used by technicians in the field.

05.08.07 Design and Optimization of a Modular System for Biofluids Research

Baha Jassemnejad, Evan Lemley, Phd,

University of Central Oklahoma

Research over the renal artery network with (RAA) and without (RA) a deforming saccular aneurysm as well as on tissue PolyL-lactic acid (PLL) scaffolds has been previously done by the University of Oklahoma. However confirmation of their computational fluid dynamic simulation of pressure drops for the renal artery network (2D) results needs to be obtained [1] as well as their porosity and flow characteristics for tissue scaffold . It is for that reason that 3D models have been created to run 3D simulations in Gambit 2.4.6 and Fluent 6.3.26 for both RA and RAA networks. According to our simulations results the pressure difference between the two types of arteries was 7.8 mmHg, this is different form their given results of 0.9 mmHg.

05.08.08 Building of a Portable EEG Monitor

Baha Jassemnejad, Yuhao Jiang,

University of Central Oklahoma

The project is about designing and building a Portable EEG Monitor that can record electric signals from the brain and transmit them to a computer wirelessly in almost real time. This monitor is cheap and affordable to the public and can be easily carried around.

05.08.09 Design and Testing of Wireless Energy Transmission

Baha Jassemnejad, Weldon Wilson,

University of Central Oklahoma

As time progresses technology increases at an exponential rate. Consumers want for the next big thing and manufactures keep up with this demand. We are living in the wireless age. People carry phones in their pockets, and computers that need no cables. Media devices such as game consoles have gone to a point where you are no longer tethered to the system with a cord. Everyone is wireless yet they still need to plug in to charge their electronic devices. The concept of wireless energy transmission has been available for over one-hundred years but only recently has its potential been realized.

05.08.10 Design, Fabrication and Mechanical Characterization of Polyethylene Glycol Diacrylate (PEGDA) for Tissue Engineering Applications

Baha Jassemnejad, Morshed Khandaker,

University of Central Oklahoma

One of the principal challenges in tissue engineering, especially with the production of large tissue constructs, is the cell survivability within the scaffold. Several researchers developed porous 3D scaffold where oxygen and nutrients can slowly diffuse for the proper cell growth inside the scaffold. Due to limited diffusion of oxygen and nutrients, the cells placed at a certain depth (usually 3 mm) within the tissue construct do not receive adequate nutrients. For which the cells die at that depth which lead to improper tissue regeneration in the scaffold. Currently, there is a necessity to design nutrient conduit networks within the tissue construct to enable cells to survive in the matrix. In this study, tissue constructs having the nutrient conduit networks were designed and were fabricated with UV-photopolymerization process. Polyethylene glycol diacrylate (PEGDA) was used as a fabrication material. After the design and fabrication was completed, mechanical characterization was conducted to examine the mechanical properties of the tissue constructs.

05.08.11 Automated Modular Optical Tweezers

Baha Jassemnejad,

University of Central Oklahoma

Since its inception, optical trapping and manipulation by means of lasers has provided a useful way to study microscopic dielectric particles, tissue cells, and cellular organisms. An Optical Tweezers (OT) system is developed here that is both modular and automated; the OT apparatus is entirely composed of breadboard components and controlled by computer. The advantages of this approach are that the system is (1) easier to modify, (2) less expensive, (3) easily repairable, (4) user-friendly, (5) faster, and (6) less prone to random error. Due to its versatility, this type of modular, automated OT system will see applications in extreme conditions, such as deep-sea, subterranean, and extraterrestrial environments.

05.08.12 Automation and Control of a Satellite Antenna Positioning and Alignment System

Baha Jassemnejad,

University of Central Oklahoma

The proposed satellite antenna control revolves around dealing with geostationary satellite communication systems. Geostationary satellites have an equatorial orbit, with each satellite corresponding to a section in the sky where a satellite dish is pointing. Stationkeeping for the satellites providers requires them to move the spacecraft within the allowed tolerance for every specific slot in the sky. As the satellites become older, the providers attempt to extend their lifetime by conserving thruster fuel. The fact that the satellite is not in a stationary position requires for a system to be in place in order to maintain signal quality by moving the dish on the ground. The system produced would use software driven motors in order to direct the antenna in the proper direction to maintain signal strength. The system would process the signal received, and use an internal stochastic algorithm in order to determine the maximum power position, which corresponds to the position of the satellite in the sky. The random velocity vectors used in a stochastic algorithm would be able to avoid local extrema and dynamically adjust to find the actual satellite position regardless of any other interference. The device would be able to be deployed in remote and harsh locations that makes travel both a costly endeavor and one full of technician risk.

05.08.13 Power Oscillator for a Transcutaneous Energy Transfer – TET System

Baha Jassemnejad,

University of Central Oklahoma

Transcutaneous Energy Transfer (TET) systems are used to supply wireless power to implanted biomedical devices by electromagnetic induction. Performance power oscillators are required for creating dynamic inductive links between transcutaneous coils in order to allow efficient power transfer. This research includes the study, analysis, and design of power oscillators that utilize low-power piezoelectric crystals to provide high frequency stability to maintain maximum power transfer. Several electronic oscillator configurations are considered and multiple experiments are being conducted to test their efficiency, evaluate their performance, and determine their main differences for usability in TET systems.

05.08.14 Automation and Remote Control of an Astronomical Observatory

Baha Jassemnejad,

University of Central Oklahoma

The Selman Living Lab, located in northwest Oklahoma, is an astronomical observatory and biological research station which is owned and operated by the University of Central Oklahoma. As an astronomical observatory, it consists of two manually controlled domes, one of which is currently housing a 12” reflector telescope. In order to improve the utility of this remote station, an automation and control system is needed to enable both remote and automated observing. The purpose of this project is to devise a modular system that can easily enable the automation of a typical ash dome/observatory setup. This system makes use of various sensors to track the movement of any telescope stationed in the dome, and moves the dome to match the orientation of the scope. The telescope is then driven by commercially available software designed for the telescope model currently in use at the observatory. Safeguards will prevent the dome from being opened and operated in poor weather conditions, and an automated dust cover and solar filter will protect the optics from the sun during solar observing.

05.08.15 Virtual Test Impairment Measurement Set

Jeff Fallon, Anh Ho, Jonathan Adams, Juan Orozco,

University of Central Oklahoma

Transmission Impairment Measurement Sets (TIMS) are equipment widely used in the communications field to test the performance and reliability of analog lines. TIMS provide the communications industry with a useful tool to analyze impairments a line might be experiencing and the information needed to isolate and correct problems, such as low voice and data quality. Current TIMS are stand-alone devices that lack automation to perform the necessary tests. Transitioning from standard stand-alone devices to user-defined devices allows for automation of the testing processes and helps with improving efficiency, accuracy, flexibility, durability, and functionality. Virtual instrumentation provides us with the technology to accomplish this, and, at the same time, it facilitates future improvements and modifications. The main objective of this project is to develop a user-defined virtual instrument that will advance functionality and improve the quality of the transmission impairment measurements. This is being accomplished by developing a software application that utilizes a graphical interface environment, NI LabVIEW©, and data acquisition hardware. Using this instrument, testing can be monitored remotely, completed in a timely manner, and supervision is only required for very short periods of time. Implementation of this virtual instrument in the communications field would expedite the maintenance process of analog lines and would expand the versatility of measurement sets.

05.08.16 Stent Contrast Enhancement Filter in Interventional X-Ray Fluoroscopy

Yuhao Jiang, Eranda Ekanayake, Niralee Raichura,

University of Central Oklahoma

Stent, a tiny interventional device which is made of thin steel wires, is difficult to detect because of both contrast dilutions of flat panel detector pixels and quantum and clinical background noise. In this study, a multistage stent contrast enhancement filter is proposed to selectively boost the contrast of stent contour without significantly accentuating the image noise. Specifically, convolution-based directional filter banks are applied to unsharp mask enhanced images to detect stent orientations and edges. The next stage of filter process is to extract the symmetrical parts in the stent. local symmetry measure is implemented. Combining the information obtained from last two steps we are able to generate a stent contour map, partially or completely, for partially or fully deployed stent, respectively. The contour map is then scaled by a value determined by a ROC study and added back to the original image to get a contrast enhanced stent image. To conduct the experiments, we use computer generated synthetic images. It is shown that the stent enhancement filter is an effective filter for the improvement of stent visibility in the interventional fluoroscopy. We also found this new filter is advantageous to the unsharp mask filtering from the comparison studies.

05.08.17 Speech Intelligibility of the Temporal and Spectral Speech Coding Strategies

Mohamed Bingabr, Blas Espinoza-Varas, Cedric Tinang, Lingpo Huang,

University of Central Oklahoma

Cochlear implants (CI) stimulate the auditory nerve fibers in the cochlea to restore the hearing sensation in people with severe or profound hearing loss. Continuous Interleaved Stimulation (CIS) is the contemporary CI speech-coding strategy (SCS) and the zero-crossing SCS was recently developed by the first two authors. CIS is based on tonotopic coding the spectral bands of the speech, where low frequency spectral bands activate electrodes at the apex, and high frequency spectral bands activate electrodes at the base. The zero-crossing SCS is based on the zero crossings pattern of the speech time waveform and the waveform amplitude maxima between zero crossings. The time intervals between adjacent zero crossings (speech segment durations) convey information about the instantaneous spectral information in the waveform, longer segments corresponding to low and shorter segments corresponding to high frequencies. The segment duration determines the longitudinal extent of electrical stimulation along the basilar membrane, measured from the base. The maximum amplitude of the waveform within the segment determines the current amplitude delivered to the electrodes. In normal-hearing participants, this paper compares the speech intelligibility of HINT sentences and CNC words processed by each of the two strategies. For HINT sentences, the average speech intelligibility was 99% and 98% for the zero-crossing and CIS strategies, respectively. For CNC words, the averages were 85% and 81%

05.08.18 Development of Productivity-based Estimating Tool for Energy and Environmental Impact of Heavy Duty Diesel Construction Equipment

Apif Hajji, Phil Lewis,

Oklahoma State University

Although there are already methods and models for estimating productivity rate and emissions for heavy duty diesel (HDD) construction equipment, there currently is not a means for doing all of these at once. This research presents the framework for a tool that can be used to estimate the production rate, activity duration, total fuel use, and total pollutant emissions from earthwork activities. A case study and sensitivity analysis for an excavator are presented. The tool is developed by combining a multiple linear regression (MLR) approach for modeling equipment productivity with the emissions calculation algorithm from EPA's NONROAD model; pollutants estimated include NOx, PM, HC, CO, and CO2. Furthermore, the equipment fuel use rate is also estimated. Results indicate that the excavator productivity model had high precision and accuracy, low bias and R2 = 92%. The estimating tool proposed in this research will be an effective means for assessing the fuel consumption and air pollutant emissions of earthwork activities and will allow equipment owners, fleet managers, policy makers, and project stakeholders to evaluate the energy and environmental impact of their construction projects.

05.08.19 Modeling the Structural Mechanics of Cilia and Flagella

Gang Xu, Miciah Guy,

University of Central Oklahoma

The goal of this study is to use computational engineering methods to characterize the structural mechanics of cilia and flagella. The ultimate objective is to contribute to providing novel methods for diagnosis and treatment of a number of cilia-related disorders (ciliopathies). Cilia and flagella are nanoscale hair-like structures that bend actively to propel cells or move fluid and materials in airways and other passages. The cytoskeletons of cilia and flagella are composed of nine outer microtubule doublets encircling a central pair of singlet microtubules. Cilia and flagella undergo large bending deformations that are driven by molecular dynein motors fueled by ATP reactions. In this study, we built computational finite element models to simulate our micromechanical testing experiments on the flagella of unicellular algae Chlamydomonas reinhardtii, including bending a single flagellum at its tip or middle length. We found that the apparent flexural rigidity of flagella depends not only on the bending stiffness of microtubules, but also on the mechanical properties of interconnecting components. With proper combinations of mechanical properties of different structural components, the model can reproduce the behavior of actual flagella. Our structural mechanics models combined with experimental techniques provide a powerful approach for improving the understanding of the structural basis for the motile function of flagella and cilia.

05.08.20 Investigation of Artificial Gravity Habitat Dynamics

Geoffrey Kibble, Alyssa Avery, Brian Delano, Calvin Brown, Carolina Vega, Chase Colvin, Jake Hathaway, Jamey Jacob, Ph.D., Jaymie Jordan, Kale Woosley, Reyhan Eusufzai, Shane Spear, Shea Fehrenbach, Steven Asplin, Thomas Verschelden, Zach Barbeau,

Oklahoma State University

Future envisioned missions to deep space elicit problems and challenges not fully investigated by the world's spaceflight organizations. One of the most prominent issues is prolonged exposure to weightlessness. The human body functions day-to-day with the resistance and force of gravity; in the absence of this phenomenon, bones/muscles swiftly atrophy. Another alarming effect, which has been acknowledged in recent years, is loss of vision due to prolonged spaceflight. Researchers hypothesize that lack of gravity increases pressure on the optic nerve, thus causing vision loss. An effective way to generate a force similar to gravity is to rotate a body to produce centrifugal force. For a small scale investigation of this concept, the Oklahoma State University Space Cowboys team has designed an inflatable beam-rotating experiment. The effects of various internal pressures on the beam's stiffness and rotational stability will be examined. Inflatable structures are lightweight, have a high ratio of deployed to packed volume, and could provide sufficient support for a rotating spacecraft that produces an artificial gravity force. The experiment is designed to allow the deployment pressure to be altered between test runs (parabolas). As spaceflight becomes more ambitious and missions of longer duration become both desirable and possible, spacecraft designs must provide crew members with an Earth-like gravity environment.

05.08.21 Cellular Anti-Tumor Immunological Responses Induced by Laser Immunotherapy with Immunologically Modified Carbon Nanotubes

Joseph Aquaviva, Ellen Boarman, Wei Chen,

University of Central Oklahoma

An enhanced immune response is vital for a successful cancer therapy. Glycated chitosan (GC) has shown promising results in producing an anti-tumor immune response when combined with phototherapy. GC is also an excellent surfactant. Recently, carbon nanotubes have been used extensively in biomedical applications. Specifically, single-walled carbon nanotubes (SWNTs) have shown enhanced light absorption in the near-infrared (NIR) range. Also, through transmembrane movement, SWNTs act as drug carries and allow therapeutic agents to enter cells. Using GC and SWNTs, we constructed immunologically modified carbon nanotubes (SWNT-GC). SWNT-GC and GC were incubated with tumor cells to assess the capability of SWNTs transporting GC into the cells, and to determine the toxicity of SWNTs. We also incubated tumor cells, treated with laser-SWNT-GC, with dendritic cells (DCs) and T cells to ascertain the effects the newly constructed immunologically modified carbon nanotubes have on immune cells. The immunologically modified carbon nanotubes increased T cell proliferation and DCs activity, while proving to be nontoxic and capable of entering the cells. Laser immunotherapy with immunologically modified carbon nanotubes is a novel modality for producing an anti-tumor response.

05.08.22 Temperature Compensation for Transmission Crystals

Stephan West,

University of Tulsa

05.08.23 Mercury Robot

Blair Baldridge,

Oklahoma State University

Oklahoma State University has annually hosted the Mercury Robotics competition since 2010. “The challenge is to design, build and remotely operate a robot. The robot must be capable of navigating a maze while being controlled from a great distance. The robot must be able to detect communications problems and provide position information to the operator." The stated ultimate goal of the mercury robot is to increase the students’ interested in engineering science and technology. Each team has to drive the robot over the internet from a location of 100 miles away. They are given 15 minutes to navigate the maze as many times as they need; whichever team achieves the fastest lap wins the competition. Time penalties are given for whatever team strikes obstacles found in the maze. In case of losing the WiFi signal during navigation of the track, the robot needs to clearly indicate a loss of signal condition. Also, the robot has to be able to park in an allocated parking spot that measures 12 inches in width, and climb up and down a 30 degree angle ramp.

05.08.24 3-Dimensional Profiling of Canine Prostate by Using Sparse 2-Dimensional Axial and Sagittal Trans-rectal Ultrasound Images for Guiding Trans-rectal Optical Tomography Reconstruction

Dhanashree Palande, Daqing Piao,

Oklahoma State University

School of Electrical and Computer Engineering, Oklahoma State University, Stillwater, Oklahoma 74078 Purpose: To provide a 3-dimensional spatial prior to the image reconstruction of trans-rectal optical tomography for prostate cancer detection. Approach: 2-dimensional segmentation of the axial TRUS images are performed extensively, however, 2-dimensional segmentation of the sagittal TRUS images are challenging, due to more complexities in contrast, morphological features and image artifacts, as well as significant inter-subject variations of the prostate shape and size. We develop a routine of segmenting 2-dimensional TRUS images obtained from canine prostate, based on the combination of a Snakes algorithm and selected manual segmentation. Result: The segmentations obtained from a sparse set of axial and sagittal images are aligned to form the 3-dimensional contour of a prostate. The resulted prostate profile is implemented as the spatial prior to constrain image reconstruction of trans-rectal optical tomography. The trans-rectal optical tomography images reconstructed with the prostate profile prior are compared with those reconstructed without any spatial prior.

05.08.25 Mechanical Effectiveness of Polyvinyl Alcohol/Polyvinyl Pyrrolidone (PVA/PVP) as an Intervertebral Disc Polymer

Khiet Tran, Ashton Williams, Kooroush Azartash-Namin, Morshed Khandaker, Zheila Azartash-Namin,

University of Central Oklahoma

The intervertebral disc(IVD) provides support and enables six degree of freedom motions(6DOF): flexion, extension, right/left lateral bending, compression, and axial rotation. When individuals suffer from degenerative disc, the nucleus pulposus(NP) deteriorates, causing loss of articulation in the IVD. However, replacements for the NP can be used. The objective of this study was to evaluate the mechanical performances of a potential NP replacement consisting of polyvinyl alcohol/polyvinyl pyrrolidone(PVA/PVP) polymer. The hydrogel was synthesized by physically cross-linking with 95%-weight PVA and 5%-weight PVP. Using a dynamic rheometer, elastic(G') and viscous(G'') moduli of the hydrogel can be determined by calculating the complex shear modulus(G*) under low-frequency oscillating shear deformation. A slider-crank mechanism was assembled with a Universal Mechanical Testing System to evaluate the mechanical effectiveness of the hydrogel in a bovine spine (BS) under physiological 6DOF motions. The experimental setup consists of displacement sensor, plate force sensor, and a 6-axis force/moment sensor. The G' of the hydrogel was tested at parameters 5%, 10%, and 15%(228.6 Pa, 988.8 Pa, and 1793 Pa). The G' for the natural bovine specimen at 5%, 10%, and 15%(712.9 Pa, 522.1 Pa, and 363.3 Pa). Position, velocity, acceleration, and force of the experimental model at 6DOF motions were verified using a dynamic simulation model.

05.08.26 Application of a geometric-sensitivity-difference based reconstruction method to improve object depth-localization for fluorescence diffuse optical tomography in a circular outward imaging geometry

Krishna Teja Tokala, Daqing Piao,

Oklahoma State University

Purpose: To improve object depth-localization for fluorescence diffuse optical tomography (FDOT) in a circular-array outward-imaging geometry that is subjected to strong sensitivity variation with respect to imaging depth. Approach: We demonstrate FDOT image reconstruction based on geometric-sensitivity-difference (GSD) method that optimizes the data-model fit based on the paired measurements corresponding to two pairs of source-detector that share either the source or the detector, in comparison to the conventional method that optimizes the data-model fit based on the unpaired measurements corresponding to individual pairs of source-detector. The FDOT image reconstruction based on GSD-scheme applied to same-source source-detector pairs is demonstrated using simulated continuous-wave measurements in a circular-array outward-imaging geometry, of which the native sensitivity varies strongly with respect to the depth. The outcomes of GSD-based image reconstruction are compared to those of the conventional baseline method that utilizes the native sensitivity and does not involve depth-compensating scheme. Result: This alternative approach effectively reduces the variation of the reconstruction sensitivity, comparing to the reconstruction based on the native sensitivity of measurement. Conclusion: The GSD method improves the depth localization taking advantage of the source-detector pairing for the fluorescence reconstruction of the anomalies.

05.08.27 Design of an Optical Tweezers Force Calibration Procedure

Niralee Raichura, Baha Jassemnejad, Erdoo Segher, Gang Xu, Jophine Abraham,

University of Central Oklahoma

Optical Tweezers (OT) —which use tightly focused laser beams to trap and manipulate microscopic dielectric particles, tissue cells, and cellular organisms—have proven valuable in areas such as cell biology, biophysics, and materials science. A microsphere trapped in the OT can function as a soft mechanical spring to apply forces on the order of pico-Newtons (10^-12 N). The goal of this study is to design and develop the force calibration procedure for the OT in our department. First, we developed a numerical model to simulate the calibration of our OT system. For the simulation, the trapped microsphere is modeled as a sphere attached to a spring. The thermal fluctuations of a microsphere are mimicked by applying small random forces on the microsphere. We have developed MATLAB codes for this simulation to estimate the spring constant based on the similar fluctuations, and to confirm the tracking program that will be used for tracing the microsphere's positions in real experiment which are needed for the calibration of our OT system. The calibration of our OT system would be useful in the future cellular and molecular bio-mechanical studies.

05.08.28 Physical Properties of an Electro Active Polymer

Zheila Azartash-Namin, Morshed Khandaker,

University of Central Oklahoma

Electro active polymers (EAP) are a grouping of materials which undergo deformation when stimulated by electrical energy. Soft dielectric EAP consists of a deformable dielectric between two electrodes behaving as a compliant capacitor. The working principle of soft dielectric EAPs states that when activated, the electrodes of the capacitor will charge to opposite polarities generating a stress induced by coulombic forces in which the electrodes attract and move closer together. Using this principle, a linear actuator can replicate skeletal muscle behavior for use in prosthetic applications. The objective of this project is to (1) prepare a soft dielectric EAP made with poly(vinyl) alcohol (PVA) and polyvinyl pyrrolidone (PVP) and (2) to examine the physical properties of the specimen using an experimental setup. The hydrogel was synthesized by physically cross-linking PVA and PVP in a 95%:5% ratio, respectively. Malvern CVO rheometer was used to perform viscoelastic tests obtaining values of 0.9818Pas, 2.793Pas, and 3.02Pas for initial, second and sixth freeze/thaw cycles. This data showed a trend of increasing viscosities after each freeze/thaw cycle. The elastic (G') and viscous (G'') moduli of the PVA/PVP hydrogel were determined by calculating the complex shear modulus (G*) under low-frequency oscillating shear deformation. The G' of the hydrogel was tested at parameters 5%, 10%, and 15% strain with results of 228.6Pa, 988.8Pa, and 1793Pa, respecti

05.08.29 Characterizing Fuel Use Rates of Heavy-Duty Diesel Equipment: A Case Study for Wheel Loaders

Heni Fitriani, Phil Lewis,

Oklahoma State University

Heavy duty diesel construction equipment consumes large quantities of fuel and subsequently emits significant quantities of air pollutants. This poster presents a methodology for characterizing fuel use rates of construction equipment in order to better estimate air pollution emission rates and is based on real-world data collected from the equipment as it performed construction activities in the field. This study examined five wheel loaders by estimating the weighted-average fuel use rate via an engine load modal analysis. For each wheel loader, the engine load data was classified into 10 modes, ranging from the minimum to the maximum engine load, and an average fuel use rate was determined for each mode. The overall weighted-average fuel use rate was determined by multiplying the modal average fuel use rate by the percentage of time spent in that particular engine mode and then summing the results for each of the 10 modes. Monte Carlo simulation was used to model the distributions of the weighted-average fuel use rate for each wheel loader by randomly selecting values (within specified ranges) for the percentage of time spent in each engine mode and the modal average fuel use rate. Preliminary results indicate that there is inter-vehicle variability in the weighted-average fuel use rates of the five wheel loaders. A sensitivity analysis was also performed in order to determine which variables have the greatest impact on the weighted-average fuel use rate.

05.08.30 Effects of Glycated Chitosan on Interstitial Laser Immunotherapy for the Treatment of Metastatic Cancer

Cody Bahavar, Allie Sikes, Ellen Boarman, Jessica Goddard, Robert Nordquist, Wei Chen,

University of Central Oklahoma

Metastatic cancer is the number one cause of cancer death. Interstitial laser immunotherapy (ILIT) is an innovative treatment used to treat metastatic cancer. ILIT combines both immunotherapy and phototherapy to create a long-term tumor suppression in the host's immune system. An infrared laser with cylindrical diffusion is used to irradiate tumors and cause the release of tumor antigens. ILIT can induce a tumor-specific immunity in the body. Although ILIT is still being developed, its results in clinical trials have shown to be very beneficial for late-stage breast cancer and melanoma patients. Glycated chitosan (GC) is the immunological stimulant used for ILIT. Having an optimal dosage of GC is critical for maximizing the effects of our treatment. We have performed animal studies to test which dosage of GC is optimal. The results suggested that the optimal dose of glycated chitosan is in the range of 0.1 to 0.3 ml per rat tumor.

05.08.31 Automated Speaker Recognition System Based on Spectral and Temporal Analyses of the Speech

Cedric Tinang, Aaron Langston, Mohamed Bingabr, Tommy Le, Trison Graham,

University of Central Oklahoma

Automated Speaker Recognition (ASR) is the ability of a machine to accurately recognize a speaker by comparing his/her voice to a voice stored in its memory. Human voice is unique and can be classified by a voice biometric (VB) that is based on the anatomy of the speaker's glottis, nasal cavity, oral cavity, teeth, tongue, and throat constriction. The objective of this research and project is to develop ASR system that extracts the VB from a preset password, uttered by a speaker, and compares it to a VB stored in the system, only granting access if the two voice biometrics match. The voice password was chosen to insure the use of all anatomical parts of the human speech production system, so the extracted VB will be reliable for speaker recognition. The proposed ASR system consists of several subsystems that use different signal processing techniques to extract different parameters of the VB. The subsystems filter out any noise in the speech signal, segment the uttered sentence into words, run a cross correlation in the time and frequency domains to compare articulation and speaking style of the words, extract vowels to compare formants of the vowels, extract the pitch of the speaker, extract the consonant "m" to compare the anatomy of the nasal cavity, and finally perform statistical analysis to determine a match or mismatch between the voice biometrics, based on weighted factors of each test. Seventy percent of the subsystems have been developed and tested successfully.

05.08.32 Design, Construction, and Launch of Near Space Balloon

Blice Nuchka Okome M'bika, Ahmed Alshbaan, Jerry Haubrick, Pankaj Karna,

University of Central Oklahoma

The senior engineering project is to design and construct a research platform capable of conducting scientific measurements at very high altitudes. A 1500 g meteorological balloon will lift a 10 lbs payload until the balloon burst, and then a 9 ft recovery chute deploys and delivers the package to the surface. The minimum intended ceiling for the experiment will be approximately 60,000 ft. The capsule will contain a video camera, to record the balloon's journey for the duration of the flight. The research platform will measure cosmic ray levels, barometric pressure, relative humidity, temperature, and magnetic field intensity as functions of altitude during the flight. To conduct and data log the experiments, we have designed an on board flight computer utilizing the BASIC Stamp microcontroller. The flight computer will also transmit telemetry data to the research team live, via long range radio modems, so that the payload can be tracked to its landing site. The data obtained for magnetic field will be compared to simulated data. The findings will help understanding of 3 dimensional aspects of magnetic field intensity from the ground to the upper atmosphere. We used Solidworks to design the capsule and decided to use an insulated polyurethane case to keep the electronics at a safe temperature inside the capsule.

05.08.33 Anti-Tumor Immunity Induced by Combination of Glycated Chitosan and High Intensity Focused Ultrasound

Wei Chen,

University of Central Oklahoma

High intensity focused ultrasound (HIFU) has been used for cancer treatment using its selective photothermal destruction of target tumor. In this study, a HIFU system was used to treat animal tumors with an immunological stimulation through application of a novel immunoadjuvant, glycated chitosan (GC). We stably transduced multimodality molecular imaging probes, including mRFP, firefly luciferase and herpes simplex virus 1 thymidine kinase (HSV1-tk) into murine 4T1 breast cancer cell line. The growth and metastatic tumor cells were detected using the IVIS system and microSPECT/CT system for fluorescence imaging and radionuclide-based imaging. We found that GC has a potential to reduce cell migration in vitro by decreasing the Twist1 expression. We also treated the 4T1-bearing mice using GC, HIFU and HIFU-GC. The results showed that tumor metastasis was apparently suppressed by a combined treatment using HIFU and GC, but not in HIFU or GC alone. Histology two weeks after treatment showed accumulation of macrophages in treated tumors. We also found that plasma collected from mice treated with HIFU-GC could significantly suppress the viability of cultured cells compared to untreated or single treated group. In summary, these results suggest that the HIFU therapy combined with GC can enhance the tumor immunogenicity and tumor control.

05.08.34 Nitric Oxide Production in Macrophages Induced by Tumor Cells After High-Fluence Low Power Laser Irradiation

Wei Chen,

University of Central Oklahoma

High-fluence low-power laser irradiation (HF-LPLI) provides simulation to cell death. It is well known that dead cells or dying cells provide antigens to trigger recognition of the specific cells by the immune system. In order to determine the effect of HF-LPLI on antigen-presenting cells, we investigated the effect of HF-LPLI treated tumor cells on macrophages phagocytosis and nitric oxide (NO) production. Our results showed that HF-LPLI induced EMT6 tumor cell death. We also observed that HF-LPLI treated EMT6 tumor cells could be phagocyted by macrophage cells and could induce NO production in macrophages. Our study shows that HF-LPLI-treated tumor cells can effectively regulate immune system and HF-LPLI can be used for tumor treatment.

05.08.35 Laser Immunotherapy in the Treatment of Late-Stage, Metastatic Melanoma Patients

Wei Chen,

University of Central Oklahoma

Melanoma is a deadly skin cancer. While it only accounts for about 4% of all skin cancer occurrences, it causes more than 70% skin cancer related deaths. Melanoma is closely related to the host immune system. Therefore, immunotherapy is arguably the most effective way of treating advanced melanoma. The ideal immunotherapy methods should not only effectively eradicate the local tumors, but also control and eliminate the metastatic tumors at distant sites. A special immunotherapy was developed for treating advanced (stage III/IV) melanoma and other solid tumors, using a combination of laser irradiation and application of immunoadjuvant, glycated chitosan, both locally. This new method, called laser immunotherapy, involves in situ treatments of tumor deposits to enhance local immunity and concomitantly, system-wide anti-tumor responses. This treatment paradigm is likely the basis for the abscopal effect observed following laser immunotherapy. One specific approach in laser immunotherapy is percutaneous insertion of laser fibers that can be used to reach any location in the body. Recent case reports demonstrate the step-wise development of this technology for the purpose of demonstrating for the first time, its practical application. Other immunotherapeutic agents such as anti-CTLA4 antibodies can also be used to multiply and enhance these local immune responses induced by laser immunotherapy, to provide more potent system-wide immunological anti-tumor effects that translat

05.08.36 Developing Autonomous Solutions for Hazardous Environments

Allen Goekler,

University of Tulsa

The purpose of this project was to develop a solution to visual inspection and monitoring in remote environments. Some areas of the world are too remote or treacherous to access with conventional methods, in other cases, it is too hazardous. Using standard hobby planes and off-the-shelf electronics, we aimed to provide a small easy to use, long range unmanned aerial vehicle (UAV). This vehicle would be simple enough that anyone could learn the system in an hour, some faster. This system would also have to be self-reliant, in that if something were to happen with a radio signal, it would default to a failsafe and find its way home. Rather than use the tried and true approach for hobbyist UAVs, which utilized three radios of different frequencies for control, telemetry, and video; we aimed to develop a system that relied on only one Ethernet radio to stream both video and flight data back to the user. With this in mind, we were able to develop a vehicle that once in the air; we were able to stream video, read flight data, and control the device on a single radio frequency.

05.08.37 Energy Losses in Microjunction Chains

Ane Muvadgah, Evan Lemley, Phd,

University of Central Oklahoma

The purpose of this project is to measure the energy losses (EL) in microjunction chains (MJCs). Three dimensional MJCs will be using computer-aid drafting (CAD) software, and several simulation runs will be carried out with computational fluid dynamic (CFD) software to allow for the investigation of energy losses as a function of interconnection length, angle between exit branches for each duct, and number of branches.

05.08.38 Photothermal Effects of Glycated Chitosan Bound to Single-Walled Carbon Nanotubes

Brock Henderson, Jessica Goddard, Joseph Aquaviva, Ryan Griswold, Wei Chen,

University of Central Oklahoma

Phototherapy has been used in many biomedical applications to combat tumor cells. Recently, carbon nanotubes have been used extensively in biomedical research. Specifically, single-walled carbon nanotubes (SWNTs) possess an enhanced light absorption at 980nm. Gylcated chitosan (GC) is a potent immunoadjuvant as well as an effective surfactant. The combination of SWNT and GC is a novel approach to increase selective photothermal response in tumor cells. We combined GC and SWNT to construct a SWNT-GC suspension. The SWNT-GC retains the enhanced absorbency properties of SWNT while allowing selective thermal destruction. This experiment was conducted to observe the advantages of two different immunoadjuvants, GC and polyethylene glycol (PEG), compared to water. Tumor cells showed the largest increase in heat shock proteins secretion when combined with SWNT-GC. Keywords: Single-walled carbon nanotubes, immunomodifier, selective light absorption, treatment of cancer, near-infrared light

05.08.39 Design and Implementation of a Partical Image Velocimetry System for Fluid Dynamics.

Sultan Almaglooth, Andrew Henderson, Ane Muvadgah, Evan Lemley, Phd, Yunhao Lin,

University of Central Oklahoma

This project is supported by the Department of Engineering and Physics at University of Central Oklahoma. The main goal of this project is to produce and design a functional Particle Image Velocimetry (PIV) experimental apparatus with a lower cost compared to commercial apparatus and sufficient performance. This apparatus will be able to determine the fluid velocity profile which is flowing in a test section that consists of milli-sized junction to measure the pressure drop across the test section, and to find loss coefficient as a function of Reynolds number using entropy generation concepts. The apparatus consists of six main components which are a camera, laser, cylindrical lens, laser lifting system, test section, PIV Lab software, and fluid driving system. The results of this project will yield four deliverables. First, PIV system for less than $1000. Second, two T-junctions with round and sharp edges to be used in experiments. Third, a system that will drive fluid through the test section at variable Reynold's numbers with steady flow. Finally, a report detailing experimental data and entropy generation calculations, that compares the experimental results with simulated results.

05.08.40 Effects of Micro Fibers on the Fracture Strength of Implant-Cement Interfaces

Aayush Khadka, Morshed Khandaker, Sandip Banstola, Utsaha KC,

University of Central Oklahoma

The interfacial mechanics at the implant-cement interfaces is a critical issue for implants fixation and the filling of tissue defects created by disease. Electrospinning is a process by which fibers with micron or nano diameters can be obtained from an electrostatically driven jet of polymer solution. The present study is based on the hypothesis that the differences of the surface properties at aluminum (Al)/cement interface due to incorporation of micron fiber may have significant influence on the quality of Al/cement union. The objectives of this study are to design and construct electrospinning unit for the fabrication of Polycaprolactone (PCL) fiber and to measure the interface fracture strengths of sandwiched Al/cement samples with unidirectional, bidirectional and random micron fibers at the interface under tension, mixed and shear forces. PCL beads were dissolved in acetone with concentrations varying from 5-15 wt.% using sonicator. The random distributed fibers were collected on carbon tape in the stationary XY. Scanning electron microscope (SEM) was used for viewing the fibers. Tension tests were conducted on Al/cement sandwiched specimen. The interface fracture strength of sandwiched samples was measured. Our preliminary study found that the values of KIC of Al/PMMA with fiber were higher when compared to the values of KIC of Al/PMMA without fiber under tension force. Results indicated that the addition of the fiber to Al improved the quality of Al/cement union.

05.08.41 Discovering Amplitude Quantization as an Elementary Property of Macroscopic Vibrating Systems through Doubochinski's Pendulum

Jason Yeisley, Andrew McFarlin, Chris Conley, Chris Stewart,

University of Central Oklahoma

A new class of vibratory processes known as "argumental oscillations" was established in the late 1960s. This was originally discovered by Danil Doubochinski, who noticed the occurrence of amplitude quantization in certain macroscopic oscillating systems. He was able to use these findings as a kind of "bridge" between classical and quantum physics. In our project, we are recreating one of Doubochinski's experiments to further extend the knowledge of these quantized amplitudes and to gather new data. This pendulum uses the standard pendulum's frame with a fixed arm and oscillates in a fixed plane. In contrast with a standard pendulum, Doubochinski's pendulum has a permanent magnet as the pendulum bob and will interact with a magnetic field. The magnetic field in which the pendulum bob passes through is created by a solenoid placed directly under the pendulum bob. The solenoid is constructed by wrapping copper wire around an iron core and then connecting this device to an AC voltage source to produce an electromagnetic field. There are two main experiments that will be done when observing this pendulum; first, we will observe any effect the pendulum will experience if the length of the pendulum arm is changed. Next, we will adjust the frequency from our power source at these different arm lengths from a range of 10 Hz to 200 Hz. By performing these experiments, we can examine the effects these changes have on the quantized amplitudes

05.08.42 Exothermic Temperature Measurements of Novel PMMA Bone Cements

Morshed Khandaker, Zhaotong Meng,

University of Central Oklahoma

Poly Methyl Methacrylate (PMMA) bone cement produce exothermic reaction during its polymerization process, which damage the surrounding bone tissue. Nanoparticles additives can be incorporated with the PMMA cement to reduce the exothermic reaction. The objectives of this project are to determine change of temperature during curing process of PMMA with different types and concentrations of nanoparticles. PMMA beads were added with 2wt%, 6wt%, and10wt% of nanoparticles (MgO, $BaSO_4$, hydroxyapatite (HAp), SiO_2, chitosan, chitin). The mixer was dissolved in benzoyl peroxide monomer using 2:1 solid: liquid ratio. PMMA cements were poured on ½ in. diameter and ¾ in height mold in an acrylic plate. A custom made temperature measurement system was used to determine the temperature changes of the different PMMA cements in the mold. The system consists of 4-channel thermocouple (InstruNet Inc.), data acquisition device, data acquisition software and laptop. This study found the curing time increased and the exothermic temperature slightly decreased, while the concentration of the nanoparticles increased. As concentration of the nanoparticle increased to 10wt%, some sample with certain nanoparticles needed more time to solidify. SiO_2 took about 30mins to cure with 10wt%. MgO and chitosan have lower temperature changes. More data of samples with different concentration are currently being collected to get a better comparison of exothermic temperature created by different nanopar

05.08.43 Loss Coefficient Calculation Using Entropy Generation with an Inexpensive Particle Image Velocimetry System

Brock Ring, Andrew Henderson, Daniel Atkinson, Evan Lemley, Phd,

University of Central Oklahoma

An essential concept in fluid dynamics is the energy losses of a fluid as it flows through junctions or bends. These losses can be generalized for junction geometries and used to drastically simplify calculations. The objective of this research was to determine if an inexpensive Particle Image Velocimetry (PIV) system could be used to calculate the loss coefficient in a test section using the entropy generation of a fluid. This was done by performing PIV analysis on a steady state, laminar, fully developed flow through a straight tube. This type of flow allows the calculations to easily be checked by pressure measurements up and down the stream. A computer code was then written to analyze the flow profile and perform the necessary calculations. Our findings showed that the loss coefficient from the entropy generation code could be calculated to within 3%-10% difference of the calculations made by taking pressure measurements.

05.08.44 Loss Coefficient Determination of an Acrylic Bifurcation.

Andrew Henderson, Aric Gillispie, Brock Ring,

University of Central Oklahoma

This proposed research is a part of a cooperative project in coordination with Dr. Herwig and Dr. Schmandt of the Hamburg University of Technology. Our research group consisting of myself and Dr. Evan Lemley of the University of Central Oklahoma are tasked with designing, setting-up, and performing experiments on the proposed bifurcation or y-junction. A bifurcation/junction is a division of flow. Dr. Herwig and Dr. Schmandt have conducted Computational Fluid Dynamic (CFD) simulations of the proposed bifurcation. The proposed Y-junction has been designed using 3D Computer Aided Design (CAD) software SolidWorks. The inlet and outlet diameters are 3.175mm and the angle between the outlets will be ⟦45⟧^0. The Y-junction will be fabricated out of acrylic using the university's in-house Roland milling machine. Pressure drop and volume flow rate data will be collected and used to determine the loss coeffiencent as a function of Reynolds number for the proposed Y-junction. Finally, the experimental results will be Validated and Verified (V&V) to that of the planned simulated results.

05.08.45 Design, Simulation, Fabrication, and Experimental Analysis of a Double Pipe Heat Exchanger

Lince Rumainum, Abdellah Ait Moussa, Jan Ronard Pinpin, Mohammed Almomen,

University of Central Oklahoma

The design of heat-transfer equipment involves a trade-off between the two conflicting goals of low capital cost (high overall heat-transfer coefficient, small heat-transfer area) and low operating cost (small stream pressure drops). Optimal designs thus involve the constraints of capital and energy costs, which are constantly changing. In this project, we develop a computer interface similar to commercial computer software packages used for heat exchanger design, the underlying computer program calculates and optimize the size of heat exchangers within the constraints of capital and energy costs; particular emphasis is on the design of a double pipe heat exchanger. Heat transfer simulation using ANSYS Fluent, in addition to engineering experimentation were also conducted to confirm the efficiency and reliability of the proposed designs.

05.08.46 Mechanism of Laser Immunotherapy in Treatment of Late-Stage, Metastatic Breast Cancer Patients

Wei Chen,

University of Central Oklahoma

Laser immunotherapy (LIT) is a local intervention for late-stage, metastatic cancers. It combines tumor irradiation by a near-infrared laser light and immunological stimulation by a novel immunomodifier. In the past 18 years, LIT has been developed from a simple concept to clinical trials with promising pre-clinical and preliminary clinical results. The hypothesized mechanism of LIT is the activation of dendritic cells (DCs), enhancement of uptake and the presentation of antigens, and activation of a tumor-specific T-cell response. Specifically, two overseas (Peru and the Bahamas) clinical studies using LIT were conducted. We have followed the treated patients during the past several years. Here we report the survival data of the treated patients. We also report the development of tumors after LIT treatment using different imaging modalities, such as CT, PET-CT, and MRI. A number of no-option patients have had complete responses after LIT. In a number of patients, the distant metastases, such as in the lungs, have been reported shrinking or disappearing. Overall, the preliminary results of LIT in our clinical trials are promising. We also report the results of our studies in support of the hypothesized mechanism of LIT.

05.08.47 Optimization of Diesel Oxidation Catalyst and Diesel Particulate Filter System

Matt Coffman,

University of Tulsa

Combustion engine exhaust gases are one of the largest sources of pollutants in the United States. Emissions standards are aimed at limiting the quantity of harmful pollutants contained in exhaust gas from stationary, mobile, and area sources. Criteria levels for exhaust are consistently made more stringent every several years at both the state and federal level, meaning emissions solutions companies need to adapt quickly to meet the ever changing demand. Diesel oxidation catalysts (DOC) and diesel particulate filters (DPF) were tested on a 150 kW engine to improve the exhaust chemistry of compounds emitted to the atmosphere. It was hypothesized that a more economical DOC-DPF system could be optimized to yield less than a 20% increase in oxides of nitrogen and maintain the ability to actively burn off particulate matter below 250 °C. Various DOC-DPF combinations were tested, sequentially varying several parameters like precious metal ratios, wash coat loading, cell density, DPF coating, and space velocity. This batch of testing did not yield a more cost-efficient DOC-DPF system than those currently used in the commercial industry; however, it did produce results helpful for understanding the interplay in these dynamic process reactors.

05.08.48 Photoacoustic Imaging in Determination of Tissue Temperature During Laser Irradiation

Wei Chen,

University of Central Oklahoma

Temperature increase can be used for tumor treatment since acidic condition of tumor tissue is more sensitive to heat. Determination of tissue temperature is crucial in destroying target tumor cells and in sparing normal surrounding tissue. Photoacoustic imaging has become a non-invasive tool for clinical diagnosis. In this study, we develop a system using the photoacoustic system to monitor the temperature increase during photothermal therapy, which was carried out by utilizing a continuous wave laser and photoabsorber-enhanced black ink with a absorption peak in the near-infrared optical range. A focusing photoacoustic imaging is interfaced with a nanosecond pulsed laser to image tissue-mimicking phantoms before and after irradiation by a near-infrared laser light. The results demonstrated that changes in the photoacoustic signals could reflect temperature changes in tissue. More importantly, photoacoustic signal could be used to determine the temperature at the boundary of photoabsorber-enhance tissue during photothermal irradiation. Photoacoustic imaging method can be potentially used to guide photoabsorber-enhanced photothermal therapy.

05.08.49 A Method for Obtaining a Particle Image Velocimetry

Aric Gillispie, Evan Lemley, Phd,

University of Central Oklahoma

To better understand what happens to fluids in microchannels, it would be very useful to be able to visualize the fluids direction and its speed, or its velocity vector. Through simulations and calculations, pressure loss and flow rate can be determined, but to actually see what is happening would give clarification to what is happening throughout a field of view. The method we used to do this was particle image velocimetry or PIV. This allows vectors to be obtained based on the speed and direction of a fluid at a particular point. This was done through the use of neutrally buoyant particles in the fluid of a channel, and a high-powered laser with a diffraction grating lens that reflects off the particles allowing them to be tracked with a high frame rate camera. The laser itself was mounted to a platform that can be adjusted in very small increments to insure the laser sheet is passing through the precise location containing the neutrally buoyant particles. Once captured, the images were put into software called PIVlab where the particles were tracked from frame to frame, and the velocity vectors developed and displayed throughout a chosen field of view. The vectors could be measured to determine the rate the fluid was moving in different places, and whether or not vortices were forming, causing pressure loss. We obtained results showing precisely how the fluid was moving in a given location with the use of a particle image velocimetry system for fluid dynamics research.

05.08.50 Synthesis and Optical Properties of pH-Responsive Novel Conjugated Polyampholytes

Wei Chen, Okhil Nag,

University of Central Oklahoma

A novel conjugated polyampholyte, PQA-BT, was designed and synthesized by incorporating blue (fluorene-phenylene) and green (benzothiazole, BT) emission moieties on the main backbone, and cationic as well as anionic charge groups on the side chains. PQA-BTs are soluble in water and showed pH dependent optical properties. BT emission of the polymers increased with increasing the pH of the solution, which is due to intra/inter-chain aggregation via deprotonation and electrostatic complexation between cationic quaternary ammonium ion and anionic carboxylate ion. With increasing pH aggregation induced fluorescence (PL) emission efficiency of BT increases. FRET ratio between green and blue emission shows linear relationship with the pH.

05.08.51 Exothermic Temperature Measurements of Novel PMMA Bone Cements

Zhaotong Meng,

University of Central Oklahoma

Poly Methyl Methacrylate (PMMA) bone cement produce exothermic reaction during its polymerization process, which damage the surrounding bone tissue. Nanoparticles additives can be incorporated with the PMMA cement to reduce the exothermic reaction. The objectives of this project are to determine change of temperature during curing process of PMMA with different types and concentrations of nanoparticles. PMMA beads were added with 2wt%, 6wt%, and10wt% of nanoparticles (MgO, BaSO4, hydroxyapatite (HAp), SiO2, chitosan, chitin). The mixer was dissolved in benzoyl peroxide monomer using 2:1 solid: liquid ratio. PMMA cements were poured on ½ in. diameter and ¾ in height mold in an acrylic plate. A custom made temperature measurement system was used to determine the temperature changes of the different PMMA cements in the mold. The system consists of 4-channel thermocouple (InstruNet Inc.), data acquisition device, data acquisition software and laptop. This study found the curing time increased and the exothermic temperature slightly decreased, while the concentration of the nanoparticles increased. As concentration of the nanoparticle increased to 10wt%, some sample with certain nanoparticles needed more time to solidify. SiO2 took about 30mins to cure with 10wt%. MgO and chitosan have lower temperature changes. More data of samples with different concentration are currently being collected to get a better comparison of exothermic temperature created by different nanopar

05.08.52 Data Acquisition for Laminar Fluid Systems

Daniel Atkinson,

University of Central Oklahoma

The goal of this research is to more efficiently take in data pertaining to laminar fluid flow in a junction and/or channel by upgrading the currently used hardware as well as modifying the current software and creating new software. Current research in the lab uses pressure losses and fluid flow rates to calculate loss coefficients for the junction. This system uses a number of analog sensors interfaced with a microcontroller which is then interfaced with a computer for data acquisition. My research will upgrade the microcontroller to more efficiently pass data to the computer. On the software side of my research, I will be implementing a new acquisition program that will be more robust than the current supporting features such as taking in information about the fluid running through the junction to be used by the program for calculations. This will make running a broader spectrum of fluids through our experimental systems more efficient and more accurate. To complete these tasks I will be implementing a modular approach first implementing new hardware which is still compatible with the old software then adapting current programs for implementation in the redesigned data acquisition program.

05.08.53 Design of a Temperature Measurement and Acquisition Device to be Used in Conjunction with Laser Photothermal Therapy

Lance Straughn, Amanda Walker, Shayla Pearson, Wei Chen,

University of Central Oklahoma

Thermal therapy, with appropriate elevation of temperature in target tissue, can be a potential method for cancer treatment. Elevating and maintaining tissue temperature at a desired level during laser irradiation is crucial for the effectiveness of thermal therapy. Dr. Wei Chen, the leader of a research group who has developed laser immunotherapy for the treatment of cancer, has expressed a need for a temperature measurement device that is less costly and more mobile than his current equipment. Our project is aimed at designing a cost effective, portable, and highly precise temperature measurement device to be used in conjunction with laser photothermal therapy. The device currently provides a digital display of temperature readings from multiple sensor inputs and records these values into memory. The device will provide a notification to the user, indicating that the target tissue has reached a critical temperature that has been specified by the user. In future applications of our device, an automatic control of the laser to maintain a specified temperature of the target tissue will be developed based on the trigger of the notification. Our design provides an accurate temperature measurement device that is easily transported and at a fraction of the cost of current equipment.