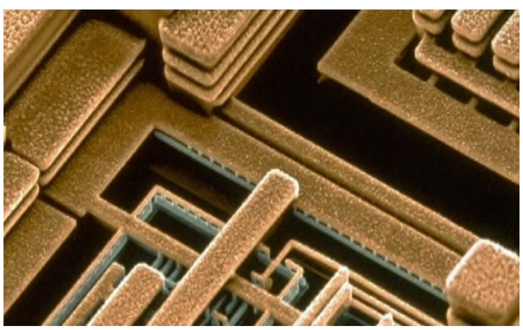
ASME DAYTON SECTION

The 6th Annual Dayton Engineering Sciences Symposium

October 25th 2010

Future of The U.S. Manufacturing Industry



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WELCOME

On behalf of the Organizing Committee, we would like to welcome you to the 6th Annual Dayton Engineering Sciences Symposium (DESS). Sponsored by the Dayton Section of the American Society of Mechanical Engineers (ASME), the symposium is designed and intended to facilitate communication between members of the regional engineering community, to provide a forum for students, engineers, and scientists, to present their work, and to sharpen their technical presentation skills.

This year's symposium features over 130 technical presentations spanning a broad range of engineering and science and a keynote speech by Mr. Michael Molnar (Director of Environmental Policy and Sustainable Development at Cummins Inc.). Mr. Molnar has 30 years of industrial experience in leadership roles across functions including Manufacturing Engineering, Systems, Quality, Capital Planning, and Technology Development. He served as a White House Fellow and he is a Fellow of both the ASME and SME (the Society of Manufacturing Engineers). His keynote talk is titled "**Manufacturing 2030: A Cummins View of Trends and Opportunities.**"

We hope that this symposium serves the Dayton Region's professional communities needs in terms of technology exchange and networking opportunities. Its success would not have been possible without the active participation of speakers, session chairs, sponsors, students, faculty, government and industry representatives, organizing committee, and the ASME Dayton Section Executive Board. We sincerely hope that you have a great time and we thank each and every one of you for your dedicated and committed contributions.

Ravi Penmetsa, Symposium Chair

Thomas Christian, Symposium Co-Chair

Sivaram Gogineni, Executive Advisor

DESS Committee

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KEYNOTE SPEAKER

Michael Molnar
Director of Environmental Policy and Sustainable Development
Cummins Inc.

Michael F. (Mike) Molnar is the Director of Environmental Policy and Sustainable Development for Cummins Inc. He has responsibilities for corporate initiatives such as energy efficiency, climate change policy, sustainability of manufacturing operations, and product materials compliance.

Mr. Molnar has 30 years of industrial experience in leadership roles across functions including Manufacturing Engineering, Systems, Quality, Capital Planning, and Technology Development. He is a licensed Professional Engineer, a Certified Manufacturing Engineer and a Certified Energy Manager. His credentials including service as a White House Fellow and election as Fellow of both the American Society of Mechanical Engineers and the Society of Manufacturing Engineers. He holds BS and MS degrees in Mechanical Engineering from the University of Wisconsin and an MBA from the University of Notre Dame.

He is an active member of professional societies, consortia, and volunteer organizations. Related to this ASME/SME event, he is currently serving as the senior leader supporting ASME Manufacturing Technical Divisions and is a member of the SME Board of Directors.

Cummins is a $14 billion international company headquartered in Columbus Indiana, composed of complementary businesses which design, develop, manufacture and distribute a wide variety of diesel and natural gas engines, subsystem components and power generation units.

Abstract:

What does the future hold for US Manufacturing? Pessimists abound with the view we have already outsourced our capabilities yet one view is correct: major changes are transforming manufacturing. The talk asserts US Manufacturing has a bright future, one where terms like Lean and Green are as important as advanced technology. More than ever, successful manufacturing requires a holistic view of sustainable operations. Key areas of products, processes and people are explored.

This macro view on sustainable operations is illustrated by a case study of what one global US firm is doing to establish “low carbon manufacturing”. With growing consensus on climate change and emerging greenhouse gas regulations Cummins sought to be a green leader by setting aggressive carbon footprint goals, which in turn required a comprehensive energy efficiency initiative. Their systematic approach is shared, from assessments and capital investments to high-impact low and no cost improvements. Making energy costs – both financial and environmental – visible empowers everyone to participate in improving operational efficiency and becoming “ENvolved”.

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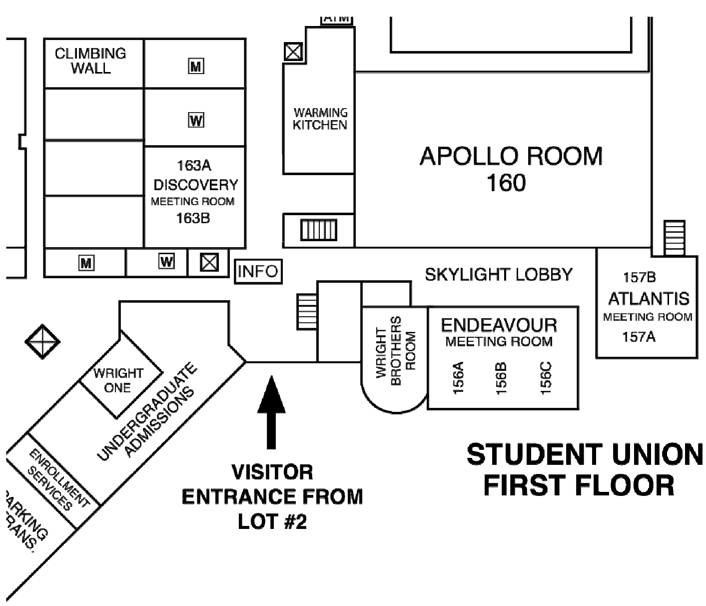
Room Locations



Chair: Nathan Klingbeil, Wright State University

8:00 AM - DESS10-0025

Reduction in LP Simulation Time Using Extended Explicit FEA and a Symmetry Cell Technique

Thomas Spradlin
Wright State University

Dr. Ramana Grandhi
Wright State University

Dr. Kristina Langer
AFRL/RBSM

Laser Peening (LP) is a residual stressing technique that uses high intensity, short duration lasers to induce compressive residual stresses on the surface of metal components. Simulation of the LP process is currently accomplished by using a two-step Finite Element Analysis that uses an explicit step and an implicit step. Though this simulation process has proven to agree well with experimental results, the simulation can take nearly a day to complete per LP shot. A typical application to a structural component can include several hundred to several thousand shots, thus making the current simulation process computationally prohibitive. This work develops an extended explicit simulation process, which takes hours instead of days per shot, and compares the results to the standard explicit/implicit process. This reduced simulation time process is then implemented in a symmetry cell technique to drastically reduce the overall simulation time of the LP processing of a large surface.

8:20 AM - DESS10-0028

Thermal-Structural Analysis and Design of Engine Exhaust-Washed Structures

Joshua Deaton
Wright State University

Ramana Grandhi
Wright State University

Structures located aft of embedded engines on low observable aircraft, known as engine exhaust-washed structures (EEWS), are exposed to a combined loading environment that includes thermal effects in addition to conventional loading. Design in this environment is often complicated by non-intuitive, configuration specific structural responses to elevated temperature and combined loading. Additionally, effective analysis of exhaust-washed structures requires a coupled analysis procedure to determine accurate structural response. In this work the history and design considerations of EEWS are briefly discussed and a coupled framework using finite element analysis has been developed and used to analyze a conceptual composite embedded engine exhaust nozzle and surrounding structure. The results of several trade studies are presented that investigate the effects of modeling parameters on thermal and structural responses. Additionally, a parametric analysis is performed on structural parameters to gain insight into the EEWS system.

8:40 AM - DESS10-0029

Predicting Stresses in Wound Metal Strip Having Parabolic Wedge Profile Using Airy Function Derivation

Jantzen Hinton
Wright State University

Dr. Arif Malik
Saint Louis University

Dr. Ramana Grandhi
Wright State University

The presented work discusses stress growth in a strip during the rolling/winding process which has a parabolic, asymmetric cross-section (wedge profile). During manufacturing, current control systems with flatness meters are unable to differentiate between "rolled-in" stresses caused by the mill and stresses caused by the winding process. Commercial finite element software is first applied to determine in-plane evolution of in-plane stresses in a strip containing 2.4% wedge for various numbers of mandrel wraps during re-winding. Coefficients of a 4th order polynomial Airy stress function are then obtained to predict the stresses according to the mandrel wrap number and planar spatial position on the strip. Having the stress field throughout the winding allows for the filtering-out of winding affects from the control system and promotes only mill adjustments to be made according to the rolled-in stress profile.

9:00 AM - DESS10-0031

Bimaterial Interface Plastic Dissipation During Mixed-Mode Fatigue Crack Growth in the Presence of a Graded Layer

Craig Baudendistel
Wright State University

Nathan Klingbeil
Wright State University

Layered manufacturing techniques such as welding, brazing, and laser and electron beam-based fabrication are commonly used in engineering applications. As such, resulting geometries from these practices often include the joining of two different materials. While these mismatches can produce unique material properties, fatigue cracks along the interface between the layers are a common mode of failure. Previous studies have modeled this interface between two materials as a perfect step change in elastic-plastic properties. The scope of this research is to replace this material discontinuity with a continuous linear grading of material properties between the two layers. ABAQUS finite element models are used to explore the effect that this graded layer has on the plastic dissipation in an effort to predict fatigue behavior with only monotonic fracture properties. Correlation between experimental results and analytical models would provide advances in future material development and enhance the speed at which material testing occurs.

9:20 AM - DESS10-0046

A Critical Assessment of the High Cycle Bending Fatigue Behavior of Boron-modified Ti-6Al-4V

Casey Holycross
Wright State University

Dr. Raghavan Srinivasan
Wright State University

Boron-modified titanium alloys have increased strength and stiffness compared to unmodified alloys without sacrificing ductility or an increase in density. These attractive properties are attributed to small additions of boron that refine the microstructure and form strong, stiff TiB whiskers. This study investigates the influence of TiB on fatigue strength and microstructural damage under cyclic loading of a powder-metallurgy forging with nominal composition Ti-6Al-4V-1B. Fully-reversed bending data from the testing of flat plate fatigue samples using a vibration based step test method is presented. This method simulates fatigue failure modes for high speed turbomachinery more accurately and produces high cycle fatigue results much faster than traditional tensile testing methods. Results are compared with data generated in a similar fashion for Ti-6Al-4V, as well as traditional methods. Additionally, failure mode and damage characteristics were identified using fractographic analysis.

Chair: Haibo Dong, Wright State University

8:00 AM - DESS10-0064

Designing a Micro Air Vehicle with Figure-8-Pattern Wing Flapping

Jaderic Dawson
Wright State University

P.G. Huang
Wright State University

The Center for Micro Air Vehicle Studies at Wright State University specializes in the development of Flapping Wing Micro Air Vehicles (FWMAV). Tight weight restrictions tend to limit current flapping vehicle designs to only an up-and-down vertical flapping motion. Unfortunately, the flight characteristics produced by this type of flapping motion does not produce enough lift to sustain flight. With a closer inspection of actual insect flight, we can see a more complex swimming motion along with passive pitching wings is used to produce lift. In this presentation, we shall discuss a new FWMAV design capable of producing a figure-8 wing motion using a power transmission system similar in weight and size as those used to create the original vertical flapping motion. The new design will be compared with the original design and show that using a figure-8 flapping motion can produce greater vehicle lift than vertical flapping alone.

8:20 AM - DESS10-0101

In-Flight Altitude and Roll Controller Optimization in a Flapping-Wing Micro Air Vehicle

John Gallagher
Wright State University

David Doman and Michael Oppenheimer
Air Force Research Laboratory

The Air Force Research Laboratory has made significant progress in applying cycle-averaged control methods to flapping-wing micro air vehicles similar to the Harvard RoboFly. Simple manufacturing tolerance problems or vehicle damage suffered in service could easily create behaviorally significant deviations between specific vehicles and the cycle-averaged models implicit in their controllers. These deviations can result in significant deficits in vehicle control precision. This presentation will discuss how one might overcome the above-mentioned problems via the use of a hardware-efficient adaptive oscillator component inside the rigorously derived cycle-averaged controllers. Simulation results demonstrating efficacy for both one and two-degree of freedom control problems will be presented along with preliminary analysis of how the adaptive oscillators provide improved functionality without breaking mathematical rigor of the controllers and without using excessive amounts of on-vehicle computational resources.

8:40 AM - DESS10-0112

Design and Control of an Insect-Sized Flapping Wing Micro Air Vehicle

Michael Anderson
Air Force Institute of Technology

Richard Cobb
Air Force Institute of Technology

Insect-sized flapping wing Micro Air Vehicles (FWMAVs) have been proposed for their ability to operate indoors. Numerous designs have been demonstrated for bird-sized FWMAVs, but few for insect-sized vehicles, which require different design and fabrication approaches. Here, a 7 cm wingspan design will be presented that uses bimorph piezo-electric cantilever actuators amplified through a four-bar linkage to flap the MAV wings. Novel methods for micro-fabrication that enable the repeatable assembly of such small structures will be presented along with preliminary test results of the first prototypes. Finally, a novel technique for controlling FWMAVs in hover called Biharmonic Amplitude and Bias Modulation will be described. Analysis and preliminary hardware testing has demonstrated that this control technique offers direct control over five degrees of freedom of a FWMAV.

9:00 AM - DESS10-0109

Lagrangian Coherent Structure and Wake Topology of a Wing in Hovering Flight

Hui Wan
Wright State University

Haibo Dong and Zongxian Liang
Wright State University

Wake structures of a 2D hovering plate with harmonic and non-harmonic stroke are studied using DNS (direct numerical simulation) and LCS (Lagrangian coherent structure). A plate in non-harmonic stroke experiences higher mean lift than in harmonic motion. The high lift in non-harmonic case is generated by fast reversal. In translation region, the plate in non-harmonic stroke experiences less lift. 3D LCS analysis for hovering is carried out for a wing of hummingbird. LCS is effective in finding the details of wake vortex structure. LCS and vorticity contours are complementary tools to detect vortex structure and give vortex strength respectively.

9:20 AM - DESS10-0115

Flight muscle movement to advacne bio-inspired Micro Air Vehicles (MAVs)

Travis Tubbs
Air Force Institute of Technology

Dr. Anthony Palazotto
Air Force Institute of Technology

Dr. Mark Willis
Case Western University

The Manduca Sexta (hawk moth) is the biological specimen selected for research and modeling purposes in the design and manufacturing of flapping Micro Air Vehicles (MAVs) at AFIT. The natural bioelectrical stimulus of the Dorsal Longitudinal Muscles (DLMs) and Dorsal Ventral Muscles (DVMs), the primary flight muscles, is recorded using Electromyography (EMG). The signals are recorded characterized with specific forewing movement using high speed cameras. The signals are reapplied to the muscles in an attempt to reproduce similar motion and function. The goal of this research is to demonstrate the feasibility of artificially inducing the action potential responsible for flapping which would greatly enhance further research with regard to the use of hawk moths as a viable test subject and the overall flight characteristics associated with its use as a MAV model. This research could also demonstrate possible manufacturing procedures that could enhance the understanding of flapping.

SESSION 3: Manufacturing	8:00 - 9:40 AM	Room 156C

Chair: Stanislav Kostka, Spectral Energies LLC

8:00 AM - DESS10-0067

Electrochemical Micro Machining of High Aspect Ratio Structures

Ronnie Mathew
University of Cincinnati, Micro and Nano Manufacturing Laboratory

Murali Sundaram
University of Cincinnati, Micro and Nano Manufacturing Laboratory

Deep and accurate micro holes are a requirement in several fields such as the automotive and biomedical industries. High aspect ratio micro tools are required to meet this demand, which are beyond the capabilities of most of the existing MEMS based micromachining processes. Though LIGA can produce high aspect ratio products, it has drawbacks of limited choice of work materials. Micro Electrochemical Machining (ECM) is a nontraditional manufacturing process which has the potential to achieve micro structures with high aspect ratios without residual stress. This presentation reports on the fabrication of very high aspect ratio micro tools using micro ECM process. Micro tools having diameters as small as 10 μm with aspect ratios of the order of 300 has been achieved in the present study.

8:20 AM - DESS10-0117

Manufacturing Flapping Wing Micro Air Vehicle Wings Using Chemical Etching

Bob Dawson
Air Force Institute of Technology

Flapping wing micro air vehicles in the range of sizes from a large insect to a small bird are an area of considerable research today. It has been proposed that the best form of propulsion for them is flapping wings. While prototypes have been produced in a laboratory environment that mimic natural flapping wings, their features are very small and complex, and little is known about them. In order to determine the importance of various features, we need to be able to reliably and repeatably manufacture these wings. In this presentation, a manufacturing method will be described for making wings from titanium foil at 0.005 inches thick, which has been calculated to have properties similar to a natural hawk moth wing. This method, using Microelectromechanical Systems fabrication techniques, has been shown to repeatably manufacture wings with features less than the thickness of the titanium foil.

8:40 AM - DESS10-0063

Emerging Nontraditional Manufacturing Processes for Micro and Nanomachining of Engineering Materials

Murali Sundaram
University of Cincinnati

Miniaturized components and products offer unique advantages. They occupy less space, and consume less energy and material. They can be cheaper. Hence, there is a strong demand for miniaturized components from diverse industries such as electronics, optics, medical, biotechnology, automotive, communications, and avionics industries. But, product miniaturization poses multiple challenges and demands innovations and continuous improvements in manufacturing technologies to ensure the processing of wide range of materials. In this presentation, several research issues associated with downscaling of few nontraditional processes, namely, micro electro discharge machining, micro electrochemical machining, and micro ultrasonic machining will be addressed. These nontraditional manufacturing processes provide an alternative (or sometime the only feasible) method for manufacturing complex shapes on wide variety of materials. Details of the system design, process monitoring, simulation, and experimental results will be presented and discussed.

9:00 AM - DESS10-0120

Evaluation of Manufacturing Techniques of Flapping MAV Wings

Nathanial DeLeon
Air Force Institute of Technology

Maj. Ryan O'Hara and Dr. Anthony Palazotto
Air Force Institute of Technology

There is no doubt that the goal of flight through flapping has been an aberrant and unattainable topic since the time that mankind has dreamed of taking to the skies. We have a history of investigation into this arena, and from birds to bugs thus far we have yet to duplicate the complex and effective methodologies that these naturally occurring creatures have emulated for thousands of years. Using the Manduca Sexta (North American Hawkmoth) as the model flapping-flier, manufactured wings, along with the naturally occurring wings were flap tested for the purpose of investigating there dynamic material characteristics. In an attempt to mimic the characteristics of the wing, several prototypes have already been manufactured for the flappable wing. Investigation and testing of these biologically inspired flapping wings will be discussed and shown in this presentation.

9:20 AM - DESS10-0009

Fabrication and Characterization of Zinc Oxide Thin Films for Solar Cells

Theresa Hill
Wright State University

Hong Huang
Wright State University

Photovoltaic cells generate electricity by receiving solar energy into the cell, generating electrons, and simultaneously transporting electrical charge out of the cell. Therefore an exterior layer that is both optically transparent and electrically conductive is desirable. Transparent conductive oxides (TCO's) are the ideal exterior layer for the photovoltaic cell as they are capable of both functions. Zinc oxide is a non-toxic and inexpensive TCO material in comparison with the state-of-the-art tin doped indium oxide (ITO). Therefore, optimizing the fabrication of high-quality zinc oxide thin films at low cost plays a significant role in the advancement of solar technology commercialization. The sol-gel process has advantages over other techniques in terms of low-cost, feasible mass production. In this work, key variables affecting zinc oxide sol-gel processing were investigated. Resulting films were characterized for transparency by UV-VIS spectrophotometry. Chemical reaction mechanisms within the sol-gel process were analyzed using Raman spectroscopy.

SESSION 4: Sensors	8:00 - 9:40 AM	Room 157A

Chair: Lang Hong, Wright State University

8:00 AM - DESS10-0111

The Development of Sensors for the Detection of Net Forces and Torques Caused by ExoplanetSat's Reaction Wheels

Michael Fu
Beavercreek High School

The ExoplanetSat project at the Massachusetts Institute of Technology aims to launch into orbit a satellite capable of observing extrasolar planets. Reaction wheels are an integral part of ExoplanetSat, as they provide the reaction torque for the satellite to rotate in space. However, the physical imperfections associated with the reaction wheels result in the generation of excess forces and torques that could have serious consequences for the satellite as a whole. This project aimed to improve a sensor capable of detecting and measuring these forces and torques by increasing the stability and natural frequency of the sensor. Analysis of the newly-developed model shows a 200% increase in the natural frequency of the sensing device, indicating that stability was greatly improved. Future studies will aim to increase the natural frequency further by incorporating different materials and/or altering the dimensions of the device.

8:20 AM - DESS10-0072

Characterization of Piezoelectric Transducers

John Little II
Wright State University, AFRL/RBSVA

Thierry Pamphile and Richard Burns
Air Force Research Laboratory

Structural health monitoring systems utilize piezoelectric patches which are bonded to a structure and operated in a variety of modes, including sensing acoustic emission events, generating and sensing elastic waves, and measuring electromechanical impedance signatures. In addition, although piezoelectric patches are not typically used to measure load information, they can provide strain information which can be used to derive load history, improving an SHM system's performance. This work describes an experiment designed to determine what factors affect the response signal generated by a piezoelectric patch bonded to an aluminum coupon during tensile fatigue cycling where the response signal is modeled as a sinusoidal term. Using analysis of variance techniques, factors such as cycle frequency, strain level, temperature, stress ratio and fatigue cycles are analyzed to identify their significance, and provide a regression model describing the piezoelectric response in terms of these controlled variables.

8:40 AM - DESS10-0104

Unmanned Aircraft System (UAS) Weather Radar & Detection Algorithms

Vincent Raska
AFRL/RBCC

Dr. Rockee Zhang
University of Oklahoma, Atmospheric Radar Research Center

Paul Gehred and Mary Bedrick
16th Weather Squadron, WPAFB OH

Art Feinberg
Intelligent Automation Inc.

Forecasters and observers worldwide help pilots avoid/mitigate the detrimental effects of weather on aircraft operations. Hazards include turbulence, up/downdrafts, lightning, hail, precipitation, and icing. Reducing these effects with an onboard means for weather avoidance is a concern for UAS operations. Despite meteorological support and weather radar, human judgment/experience are ultimately credited for preventing many weather-related aviation accidents/incidents in piloted aircraft. Without corresponding weather detection and evaluation capability a UAS can experience degraded mission readiness and damage during flight in hazardous conditions. AFRL is researching technologies enabling UAS to avoid hazardous weather. Intelligent Automation, Inc., and University of Oklahoma are developing a X-band airborne weather phased array radar to detect a broad range of hazards. Incorporating monopulse beamforming techniques, the system under development detects weather hazards while avoiding complicated antenna array architecture. Leveraging dual-polarized antenna and transceivers, the system identifies and classifies atmospheric hazard types.

9:00 AM - DESS10-0116

Sensory RTLS for Healthcare Applications

Akshay Jain
Wright State University, Engineering Innovation and Entrepreneurship Program

Bob Myers, Urvish Soni, Vikram Sethi, and Mary Fendley
Wright State University

Real time locating systems (RTLS) is a technology which tracks the current location of devices or individuals. Initially, RTLS applications were limited to inventory and asset tracking, navigation and network security. Now it is believed that RTLS can be enhanced to meet the growing need for monitoring individuals in assisted living environments. This can be accomplished by introducing “Sensory RTLS” systems which integrate pattern detection software and body parameter measurement sensors into RTLS. The resulting intelligence derived from sensor data, pattern detection algorithms, and RTLS location information would allow early signaling of healthcare providers of the individual’s healthcare needs. Due to the social and economic benefits of sensory RTLS system, this research seeks to find the potential markets for such technology, and the paths that can lead to its successful commercialization.

9:20 AM - DESS10-0048

Large scale signal and information processing by simultaneous characterization of randomness and structures

Jianbo Gao
Wright State University

Wen-wen Tung
Purdue University

Qian Han
Wright State University

Complex systems with many interacting or correlated subsystems often are both random and structured. Conventionally, information processing of data from such systems only focuses on either the random feature or the structured feature of the data. Such approaches only offer limited understanding. To more effectively discover knowledge from complex data, we propose a multifractal based technique for complex system analysis. We illustrate the usefulness of the approach by applying it to target detect in sea clutter radar returns and gene identification from genomic DNA sequences

SESSION 5: Systems Design	8:00 - 9:40 AM	Room 157B

Chair: Partik Parikh, Wright State University

8:00 AM - DESS10-0041

Implications of WSARA 2009 for the Automated Aerial Refueling (AAR) Project

Robert McCarty
SynGenics Corporation

Jacob Hinchman, Daniel Schreiter, Ba Nguyen, and Karen Irvin
Air Force Research Laboratory

The Weapon System Acquisition Reform Act (WSARA) of 2009 aims to eliminate inefficiencies in US Defense projects. WSARA is directed toward major defense acquisition programs, but will also impact the conduct of Air Force Science and Technology (S&T) projects such as the Automated Aerial Refueling Phase II (AAR II) project. The basis for WSARA impact on S&T projects stems from its increased emphasis on the use of systems engineering (SE) during the defense acquisition technology development phase . The AAR project is intended to recommend requirements for future development of the capability for Remotely Piloted Aircraft (RPA) to refuel from manned tankers. This presentation will illustrate the extent to which AAR II project execution will be shaped by, and will be in compliance with the intent of WSARA.

8:20 AM - DESS10-0088

Towards Speed Agility for the Air Force

Cale Zeune
AFRL/RB

The Air Force Research Laboratory has been making focused investments in technologies for future airlifters. Tomorrow's aircraft will be able to takeoff and land on short airfields as well as cruise faster than today's military mobility fleet, giving it unparalleled efficiency, access, and flexibility. Numerous technology areas need to be matured to enable this capability. Work in these areas has been ongoing under the guidance of the Air Force Research Laboratory for a number of years. Early studies examined vehicle characteristics, performed sensitivity studies, and developed technology roadmaps. Next steps included high lift component maturation activities with studies and small scale experiments. Later, wind tunnel tests were run to understand aerodynamic performance and the individual contributions of components. Recent programs have focused on validation activities to increase the TRL of the integrated suite of technologies; including high Reynolds number tests and large sub-scale validation efforts on hybrid powered lift systems.

8:40 AM - DESS10-0118

Space Simulator Control System Development

Christopher McChesney
Air Force Institute of Technology, United States Air Force

Attitude control requirements of spacecraft are determined based on mission requirements. These requirements include aligning solar arrays, thermal radiators, and vehicle instrumentation. High performance attitude control systems (ACSs) must combine accurate pointing and moderately fast maneuverability. Reaction wheels and control moment gyroscopes (CMGs) are the preferred control actuators for this as they provide continuous, smooth control with minimal disturbances. The objectives of this research are to design, build, test, and evaluate the performance of a CMG cluster on the Air Force Institute of Technology's (AFIT) attitude dynamics simulator, SimSat II. The CMG cluster design chosen for this research is a 4-unit pyramid design with a spherical momentum envelope. This system will be evaluated against performance measures specied by the AFIT faculty. This work includes addressing known hardware-software interface issues encountered in previous work that limited overall performance.

9:00 AM - DESS10-0122

Design and Development of a Dynamic Two Way Time Transfer Experiment utilizing a 3U CubeSat

Mark Lesar
Air Force Institute of Technology

Dr. Richard Cobb
Air Force Institute of Technology

Recent research at the Air Force Institute of Technology (AFIT) has indicated potential improvements in determining position accuracy by augmenting GPS or differential GPS systems with Two-Way Time Transfer methods. Modeling indicates a 44% 3-D relative positioning accuracy improvement for a network of vehicles and a 60-70% improvement in positioning accuracy for geostationary satellites using GPS. However, no actual ground-to-space experiments have been conducted in order to validate the technology. AFIT has joined with Symmetricom, a world-leader in precise timing solutions, in order to design and develop a low size, weight and power version of Symmetricom’s ATS-6502 timing modem as the payload of a low earth orbit 3U CubeSat. AFIT is currently in the preliminary design stage, and plans to lead the integration and space qualification effort and conduct mission operations from its ground station once the satellite has achieved orbit, which is expected sometime in early 2013.

9:20 AM - DESS10-0134

Surveillance for Intelligent Emergency Response Robotic Aircraft (The SIERRA Project)

Robert Charvat
University of Cincinnati

Andrew Nels, Nick Buhr, and Dr. Kelly Cohen
University of Cincinnati

The Surveillance for Intelligent Emergency Response Robotic Aircraft (SIERRA) Project is focused on providing a tactical Unmanned Aerial System (UAS) for the benefit of wildland firefighting. In the past decade, wildland fires, either natural or man-made, have caused a growing amount of devastation. The project works with the application of UAS technology to reduce the level of damage associated with wildland fires. The University of Cincinnati in collaboration with the State of West Virginia Forestry is developing a system for wildland fire use. The project calls for a live demonstration of a UAS system during a controlled wild fire burn. The demonstration will provide important data for the continued development of a tactical UAS system for this application. The event is scheduled for March 2011 in the Morgantown West Virginia area.

Chair: Ann Heyward, OAI

8:00 AM - DESS10-0002

Electric Ultra-light Aircraft Phase II

James Van Kuren
Advisor to Miami University students

Chad Carter, Evan Hipp, Tim DiMarino, Zach Gibson, Patrick Jones
Miami University

The objective of Team Silent Strike is to finish the preliminary work of the previous team. Team High-Flight proposed in 2009 to convert an ultra-light aircraft's gas engine to an electric motor. Using High-Flight's research on the electric motor, the battery system, and the motor control system, team Silent Strike has been working to mount the electric motor to a dynamometer and gain and analyze more data on the torque, and rotational power of the Electric engine. If the values obtained from the dynamometer data are sufficient for our flight, the next phase will be to create a mount, keeping the plane's center of gravity centered at the same point for the new electric system; followed by a successful test flight. With the addition of a few small parts, team Silent Strike has the motor mounted to the dynamometer and the electric system complete and ready for preliminary lab testing.

8:20 AM - DESS10-0003

Design of a Small Scale River Turbine

James Van Kuren
Miami University

James W.J. Cooling, Andrew M. Fagan, Kevin P. Gniazdowski, Matthew J.
Miami University

This report documents the design and construction of a portable river turbine as part of a Miami University senior design team project. The device has the ability to turn the kinetic energy of the flow of a river into electricity. The objective was to provide an efficient, clean energy source that was environmentally friendly and easy to use. The team was able to design and build a working prototype of a portable river turbine. Testing was conducted in two local rivers and spinning of both the impeller and alternator was achieved. Data was collected on the RPM output of the turbine versus the river velocity. However, no power data was actually measured due to complications with electrical wiring schematics and the time constraints of the project. The concept of the portable turbine was proven, but further iterations of the prototype would be necessary to achieve all of the desired results.

8:40 AM - DESS10-0061

Postural Balance: Predicting the Onset of Fall

Zhuo Chen
Miami University, Department of Mechanical and Manufacturing Engineering

Carson Willey and Dr. Amit Shukla
Miami University, Department of Mechanical and Manufacturing Engineering

Human bodies experience sway-like motion while standing due to continuous interplay between gravitational forces and control mechanisms. The postural control process uses continuously integrated information from visual, vestibular and somato-sensory receptors. The central nervous system is then able to determine body position, sites of instability and movement. The corrective responses are then regulated through complex feedback and feed-forward mechanisms expressed through the musculoskeletal system. These responses usually keep the body within a small zone of movement when standing. In this work, standing position is modeled as an inverted pendulum where the feet are fixed and the head is free to move. There're many medical conditions that can affect the postural control system leading to reduced postural competence and an increased risk of falling. This research is to understand the effect of parameters on the stability boundary to detect and predict the onset of fall using computational models and associated simulations.

9:00 AM - DESS10-0098

Using MOVES to Estimate On-Road Motor Vehicle Emission in the Miami Valley, Ohio

Tinina Hale
Central State University

Ramanitharan Kandiah
Central State University

Motor vehicles contribute a considerable amount of air pollutants to the atmosphere. Emission of Individual pollutant depends on many factors such as type, model, year and speed of the vehicle, and the geographical and the meteorological variables relevant to the location. With such number of variables estimating the emission becomes complicated. Mathematical models calibrated with the actual data can be used to simulate such pollutant emissions for the regulatory and technical purposes. MOtor Vehicle Emission Simulator (MOVES) is a recent state of art model developed by US Environmental Protection Agency. This presentation demonstrates a case study of estimating three important air pollutants from a passenger car and a heavy duty truck in the Miami Valley, Ohio for the daily parameters averaged from the annual values.

9:20 AM - DESS10-0085

Comparison of the Traffic Counts in Three Counties in Miami Valley, Ohio

Andre Morton
Central State University

John Davenport and Ramanitharan Kandiah
Central State University

Various air pollutants emitted by the vehicles can harm the human health and the environment. It is also noted that the quantities of these pollutants released by a vehicle can vary with the type of the vehicle, meteorological conditions and traffic conditions. Hence as a part of this process, it is necessary to estimate the number of different types vehicles travel in different types of roads, and also to classify the pollution levels in the transportation network using the traffic count as the surrogate estimates. This presentation uses a self organizing map based data mining technique to compare the traffic counts of three counties in Miami Valley for 2000 & 20006.

SESSION 7: Renewable/Clean Energy-I	8:00 - 9:40 AM	Room 163B

Chair: Bellur Shiva Prasad, Wright State University

8:00 AM - DESS10-0007

Ground Source Heat Pump Sizing Codes

Kyle Hughes
Wright State University

J. Menart
Wright State University

Ground source heat pump systems have become progressively more popular due to the increase in energy cost and the demand for sustainable development. Studies show that ground loop heat exchangers being used in North America are being oversized by 10% to 30% - causing the payback period to increase. A more accurate ground source heat pump modeling system will reduce the initial cost in the ground loop. There are a number of commercial programs available to size geothermal loops. This paper will provide a review of present modeling techniques including the heat transfer analysis and other options available in the codes.

8:20 AM - DESS10-0012

Utilization of the DOE Computer Code Energy Plus to Perform Heat Load Calculations for a New Ground Source Geothermal Heating and Cooling Design Tool

Paul Gross
Wright State University

Dr. J. Menart
Wright State University

At Wright State a project to develop a detailed computer tool for ground source geothermal heat pump systems is underway. As part of this project it is required that the heating and cooling loads of a particular home or building be known. The building energy simulation tool EnergyPlus, developed by the Department of Energy, is being utilized. Using a graphical user interface in the Wright State geothermal energy code, a user can select between two different heating and cooling analysis options, novice or expert. Both of these options will utilize EnergyPlus; however, the Wright State geothermal code will allow for a novice connection to EnergyPlus and an expert connection to EnergyPlus. This is being done so engineers and nonengineers can make use of the Wright State geothermal design code. This talk will cover the development of a MatLab code that connects to EnergyPlus from the Wright State geothermal computer code.

8:40 AM - DESS10-0086

Preparing the Workforce for Energy/Green Jobs

Robert Gilbert
Sinclair Community College

Sinclair Community College's Energy Technician Certificate and courses for the Energy Management degree are presented. Courses in building energy efficiency range from weatherization to commercial and industrial assessment. The renewable energy program includes solar photovoltaic and solar thermal. Sinclair's energy efficiency/renewable energy program is built upon classroom learning, laboratory experiences, and field experiences with community partners. Sinclair students gained field experience in renewable energy when they worked on DP&L's 1.1 megawatt solar photovoltaic installation on Yankee and the PV installation at the Miamisburg Technical Center. Sinclair students also participated in the solar PV installation at the Dull Green Energy Museum. Students gain field experience in building energy efficiency by performing energy audits for non-profits.

9:00 AM - DESS10-0042

Toward Optimization of Systems with Combined Geothermal Heat Pumps and Solar Hot Water Heating in Residential Buildings

Dustin Langille
University of Dayton

Dr. Andrew Chiasson and Jarret Kelley
University of Dayton

The focus of this research is the development of a design tool that optimizes the ground heat exchanger length and solar collector area in hybrid geothermal-solar thermal systems. Current progress including heat pump model development with the program TRNSYS will be presented.

9:20 AM - DESS10-0062

New Commercial Ground Source Geothermal Design Computer Code

Jim Menart
Wright State University

Shiva Prasad, Paul Gross, and Kyle Hughes
Wright State University

This presentation will discuss the current status of the ground source geothermal heat transfer computer code being developed by the authors as part of a Department of Energy grant. This code is meant to be an improvement on the commercial codes currently available. Currently most commercial codes utilize g-factors to model the unsteady heat transfer between the fluid loop and the ground. The code being developed at Wright State will utilize a two-dimensional, unsteady finite volume method. This computer code will provide complete temperature information in the ground and the fluid as a function of time, axial position, and radial position. Great efforts are being made to keep the computational times of the computer code reasonable and to make the computer code easy to use.

Chair: Rebecca Hoffman, SIMULIA

10:00 AM - DESS10-0019

Simulation of Multi-Shot Laser Peening Effects on a Curved Geometry

Anoop Vasu
Wright State University

Dr. Ramana Grandhi
Wright State University

Laser Peening(LP) is a surface enhancement technique used to induce desirable compressive residual stresses to improve the fatigue resistance of metallic components. Finite Element Analysis is implemented for this research to predict and investigate the effects of key LP process parameters on the mechanically induced LP residual stresses. A critical region on the curved portion of an aircraft lug, which is prone to fatigue failure, is analyzed. A curved geometry is modeled to replicate this critical region. The parameters to be considered include the temporal pressure profile, LP peak pressure, laser spot size, percentage overlap between shots, and model radius of curvature. Parametric investigations using Design Of Experiments approach is utilized to find an ideal combination of design variables for a stable residual stress field. Two objectives are used to represent this ideal: minimizing the presence of tensile residual stresses and maximizing the compressive residual stresses along the critical region.

10:20 AM - DESS10-0020

Laser Peening Simulation In Pre-Existing Residual Stress Fields

Dan Gorsky
Wright State University

Dr. Ramana Grandhi
Wright State University

Laser Peening (LP) is a Surface Enhancement Technique (SET) that uses high intensity, short duration laser pulses to plastically deform surface layers in metallic components, inducing desirable residual stresses. Other SET's, such as low plasticity burnishing or glass bead peening, can be applied to a material before LP. The goal of these techniques is to create a compressive residual stress field at the surface of a part. Many LP simulations have been developed in recent years to determine the optimum parameters for LP application but a simulation of a compounded SET such as glass bead peening with subsequent LP has yet to be investigated. A 2-D model will be implemented to understand the result of the aforementioned SET combination. LP parameters will be varied to explore how LP simulation affects the residual stress field when applied on top of a glass bead peened surface.

10:40 AM - DESS10-0060

Statistical Analysis of Fatigue Failure in Laser Peened Test Coupons

Kristina Langer
AFRL/RBSM

When applied judiciously, laser peening can be an effective surface treatment method for mitigating fatigue damage and prolonging fatigue life in metallic structures. Recently, several series of aluminum test coupons were laser peened and then tested to failure under uniaxial fatigue at the Air Force Research Laboratory's FIRST lab. The failure data was then analyzed using computer intensive statistical resampling techniques (bootstrapping) to better understand observed trends regarding fatigue scatter, confidence intervals, and life enhancement. The statistical results suggest that probabilistic nature of the failure response must be considered in order to accurately assess the life benefits of laser peened components.

11:00 AM - DESS10-0114

Design of the Flexible and Fatigue Strength Enhanced Spinal Implant Rods

Sagar Bhamare
University of Cincinnati

Dr. Dong Qian, Dr. S.R. Mannava, and Dr. Vijay Vasudevan
University of Cincinnati

Titanium alloy pedicle screw system is the mainstay of spinal fixation procedures in the thoracic and lumbar spine areas. Typically, a 5.5 mm diameter rigid rod is used in lumbar spine area. In implanted rigid devices, fatigue failure occurs in patients where an abnormally high load is placed due to patient obesity, failure of the fusion to heal properly, or high levels of patient activity during the post-operative period. In this work, the 5.5 mm diameter rod is re-designed with special features to increase flexibility, and simultaneously enhance the fatigue strength by applying the laser shock peening (LSP) process to the re-designed rod. Finite Element simulations are performed on various designs to achieve the design goals. Simulation results are validated by performing 3 and 4 point bending tests on the rods following the ASTM procedures. Effect of LSP on the fatigue behavior of the re-designed rod is presented.

Chair: Hui Wan, Wright State University

10:00 AM - DESS10-0074

Using Computational Fluid Dynamics to Assess the Energy Losses in Palliative Strategies of Hypoplasitc Left Heart Syndrome

Justin Niehaus
University of Cincinnati

Dr. Shaaban Abdallah
University of Cincinnati

Dr. Jeffrey Shuhaiber
Cincinnati Children's Hospital

Computational Fluid Dynamics (CFD) is used to numerically solve highly nonlinear equations that cannot be solved by any current analytical means. Fluid flow, such as blood flow in the heart is governed by such equations. Hypoplastic Left Heart Syndrome (HLHS) is a congenital heart condition which leaves the infant with an under developed left ventricle. The three palliative strategies for managing HLHS are the Norwood procedure with a Blalock-Taussig Shunt, the Norwood procedure with a Right Ventricle to Pulmonary Artery Shunt, and the Hybrid procedure. Little is known about the energy loss differences in the procedures. CFD will be used to construct models of the three palliative strategies to compare the energy losses in each system, as well as the heart wall shear stress and blood flow to the pulmonary and systemic circulatory systems.

10:20 AM - DESS10-0075

CFD Investigation of Powdered Vaccine and Gas Dynamics in Gene Gun

Salah Soliman
University of Cincinnati

Dr. S. Abdallah
University of Cincinnati

CFD is used to analyze the micro solid particles and the gas flow fields in the supersonic nozzle that is part of the Gene gun. The particles are accelerated to high speeds sufficient to penetrate the epidermis/dermis layer to achieve the pharmaceutical effect. The effect of driver pressure, particle mass and gas swirl are studied. The effect of increasing driver pressure increased the particle velocity and did not affect the particles distribution. The gas accelerates the particles until they reach the gas velocity for light particles; however for gold small particles they achieve only 50% of the gas speed. The computed results show that the particles of all sizes are concentrated at the core of the nozzle. The swirling of the gas field enhances the distribution of light particles across the device exit, but has no effect on heavy particles.

10:40 AM - DESS10-0053

Numerical Study of Sheath and Aerosol Flows in the Annular, Combination Region of a Baron Fiber Classifier

Prahit Dubey
University of Cincinnati

Dr Urmila Ghia
University of Cincinnati

Dr Leonid Turkevich
The National Institute for Occupational Safety and Health

Experimental evaluation of the role of fiber length in Cytotoxicity requires length-separated fibers in quantities sufficient for in-vivo and in-vitro toxicological studies. Baron fiber-Classifier is an instrument which works on the principle of dielectrophoretic separation and is used for separating fibers according to their length. An aerosol of uncharged fibers, along with upper and lower annular sheath flows, is introduced into the annular gap between the two concentric cylinders of the classifier. With the combined action of electrical body force and aerodynamic Stokes drag on the particles, fibers are separated by length. The goal of the present investigation is to numerically study the aerodynamic flows and their interactions on the classifier's upstream, annular, entry region where the aerosol in introduced. A CFD analysis will help to better understand and, subsequently resolve the aerodynamic issues encountered during attempting to implement design improvements i.e. increasing throughput, on the Baron fiber-classifier.

11:00 AM - DESS10-0092

Computational Modeling of Functionally Graded Electrodes in Solid Oxide Fuel Cells

Chao Wang
Wright State University

George P. G. Huang
Wright State University

Ryan Miller
Air Force Research Laboratory

The functionally graded electrodes (FGE) have been recently proposed to show a significantly potential to improve the performance of solid oxide fuel cell (SOFC) as compared to the conventional electrodes using a uniform composite layer. The results have been found to increase the molar concentration of fuel gases at triple-phase boundary (TPB) and hence reduce the overpotentials. A mathematical model is used to mimic the FGE at the micro-scale level. This model is based on a comprehensive approach including the dusty-gas model (DGM) for porous-media transport in electrodes, the modified Butler-Volmer equations for the electrochemical reactions at the TPB layers and polarization losses of electrolyte. The current model makes use a formulation for the active surface area such that three different kinds of graded electrodes, namely, composition graded, particle size graded and porosity graded, can be properly described. The results are then compared with available experimental data with encouraging outcomes.

Chair: Sharmila Mukhopadhyay, Wright State University

10:00 AM - DESS10-0001

Supercritical Fluid Deposition, Characterization, and Photoluminescence Study of PbS Quantum Dots

Joanna Wang
AirForce Research Lab, Materials and Manufacturing Directorate, Dept. Chemistry, University of Idaho, Moscow, ID 83844

Bruno Ullrich and Gail Brown
Air Force Research Lab, Materials and Manufacturing Directorate

Chien M. Wai
Department of Chemistry, University of Idaho

Lead sulfide (PbS) nanoparticles have been deposited on Cu grid and glass using supercritical fluid CO2 (Sc-CO2) as a solvent. Transmission electron microscope (TEM) images show that Sc-CO2 deposition form uniformly distributed 2D quantum dot (QD) arrays, whereas solution deposition displays non-uniform PbS nanostructures. Scanning electron microscope (SEM) images show that the PbS nanoparticles can be deposited in nanoscale pores by Sc-CO2 that cannot be achieved by solvent deposition method. An apparatus for depositing PbS QDs employing Sc-CO2 solution deposition method using glass substrates was designed. The PbS QDs deposited in this way have shown improved uniformity and areal coverage in comparison to solution deposition. The optical properties of the PbS nanoparticles were measured by photoluminescence (PL) and UV-Vis-NIR spectroscopies. The samples fabricated by the Sc-CO2 deposition process showed room temperature emission at 0.84 eV, which is blue-shifted from the bulk value at 0.41 eV due to quantum confinement.

10:20 AM - DESS10-0038

Functionalization of Carbon Nanostructures with Silver Nanoparticles for Biomedical Devices

Adam Maleszewski
Wright State University

Sharmila M. Mukhopadhyay
Wright State University

Saber Hussain
Air Force Research Laboratory

The purpose of this project is to demonstrate the feasibility of silver nanoparticles (Ag-NP) attached to hierarchical substrates for biological applications. The effectiveness of Ag-NP-based anti-microbial structures and biosensors may be dramatically enhanced by the use of these hierarchical structures, such as carbon nanotubes (CNT) attached to larger surfaces. These can offer a high surface area, bio-mimetic surface suitable for cell-device interactions. Ag-NP would be a suitable component in many such devices due to its plasmonic surface properties (e.g. in sensor and directed energy applications) and its anti-microbial properties (desirable for fluid filtration due to its lightweight, and, depending on the particle size and dose, low toxicity). Meaningful control over the Ag-NP sizes and degree of adherence has been achieved. The interaction between silver and human epidermal cells (keratinocytes) has also been investigated in vitro and will be discussed.

10:40 AM - DESS10-0040

Fabrication of Highly Active Porous Catalysts by Attachment of Metal Nanoparticles on Hierarchical Carbon Structures

Hema Vijwani
Wright State University

Dr. Sharmila M. Mukhopadhyay
Wright State University

The effectiveness of catalysts and electrochemical devices can be significantly enhanced if the available surface area in a given volume is increased by the creation of hierarchical nanostructures. The goal of this project is to demonstrate this concept in a Palladium-graphite system. Palladium nanoparticles have been deposited on porous carbon-foam substrates whose surface area has been further increased by several orders of magnitude through the attachment of carbon-nanotubes. These catalytic structures can lead to unprecedented-miniaturization since a very small amount of precious metal can be used to increase the surface activity. Potential devices include sensors, water-purification systems, fuel-cell electrodes, and hydrogen-storage devices. In this project, fabrication issues of these structures will be presented along with microstructure and spectroscopic analyses. Possible ways of controlling nanocatalyst dimensions and distribution will be discussed. Electrochemical behavior and water-purification capabilities of these structures are being investigated and some of those results will also be presented.

11:00 AM - DESS10-0073

Carbon nanotube-based composites for electrochemical devices

Lingchuan Li
University of Dayton Research Institute

Khalid Lafdi
University of Dayton Research Institute

In addition to outstanding mechanical, electrical and thermal properties of carbon nanotubes (CNTs), their large surface area, fibrous structure, high electrochemical activities, and chemical stability in electrolytes make it promising to find their applications in electrochemical devices. An investigation was given on exploiting nanoparticle-modified and metallized CNTs for composites that may sense chemicals and biochemicals. It was demonstrated that the modified CNTs had exceptional catalytic activities towards certain chemicals. Moreover, preparation of metal oxide/CNT and conducting polymer/CNT composite films were carried out, and performance of the films was studied for their potential applications in supercapacitors and fuel cells.

Chair: Jonthan Black, AFRL

10:00 AM - DESS10-0135

Development of a portable laser ranging sensor for integration into the existing AFIT TeleTrack system

Greg Moran
Air Force Institute of Technology

AFIT is investigating the feasibility of integrating a newly designed laser ranging sensor into its existing optical satellite tracking system. A modified system engineering process is being used to design, analyze, build, and test the rapidly developed prototype of the portable satellite laser rangefinder (PSLR). Emphasis is being placed on the concepts of “Fast, Inexpensive, Simple & Tiny” and “Test Early, Test Often” to accommodate the constraints of an academic curriculum. Both the system and the associated test plans are being developed in parallel while assessment of the utility of each is continuous throughout. Incremental testing has already been conducted and there are plans to continue this approach. This briefing will focus on the results to date from preliminary laboratory tests and the lessons learned which will be applied to the remainder of this research. Aspects from both the technical prototype development and the systems engineering process will be addressed

10:20 AM - DESS10-0125

Space-Based Chromotomographic Experiment (CTEx)

Jason Niederhauser
Air Force Institute of Technology

Dr. Jon Black, Dr. Richard Cobb, Lt. Col. Eric Swenson, and Lt. Col. Michael Hawks
Air Force Institute of Technology

The purpose of this program is to develop and fly a novel multifunctional imaging chromotomographic (CT) spectrometer payload in space to demonstrate the ability to perform multiple remote sensing missions while on orbit. The instrument is very simple relative to other spectrometers, consisting of a standard optical telescope, a rotating direct vision prism and a camera. During the measurement of successive video frames, the dispersion axis is rotated, causing the image of the spectral features to trace out circles with wavelength dependent radii. This rotation has the effect of multiplexing the color information of the image over the array, which, otherwise, is operating as a broadband polychromatic sensor. Tomographic computational methods similar to the limited-angle tomography used in medicine are used to reconstruct the scene. The experiment has been briefed and ranked by recent AF and DoD Space Experiments Review Board, with a request for future integration and launch services.

10:40 AM - DESS10-0133

Satellite Detection and Real-time Orbit Estimation with Commercial Telescopes

Gregory Briggs
Air Force Institute of Technology, Riverside Research Institute

Initial orbit estimation with commercial telescopes has been demonstrated by previous AFIT research; however, measurements used were obtained via prior knowledge of the satellite's orbit, and results showed limitations due to lack of range information from optical measurements. In order to mitigate these obstacles, a method for satellite detection and tracking using modified CCD cameras is being developed together with real-time orbit estimation. With these capabilities, once a satellite is detected, the telescope could track the satellite across the sky, recording and analyzing imagery data to estimate the orbit in real-time. This orbital estimate would then allow a second telescope (separated by a suitable baseline) to begin tracking the satellite as well. With both telescopes tracking, triangulation would provide the desired range estimation. In this way, one could generate higher fidelity orbit estimates. This presentation will show the techniques for satellite detection and real-time orbital estimation used in this research.

11:00 AM - DESS10-0119

Design of i-Cricket motes

Yogendra Patil
Wright State University

Dr. Kuldip Rattan
Wright State University

Global Positioning System (GPS), satellite-based navigation system, is playing an important role in localization-oriented applications. They require line-of-sight (LOS) with the satellites to work. However, receiving satellite signals in indoor locations is a major problem. This problem can be overcome by using Cricket motes as indoor localization systems. They are inexpensive, accurate, easy to configure and deploy. However, to configure the Cricket motes for localization applications requires manual procedure. The objective of this project is to develop self-configuring Cricket motes system to automatically create local coordinate system. Ongoing experimental tests have shown that an optimum placement of Cricket motes is required in order to achieve a robust and accurate coordinate system. These self-configuring Cricket motes can then be used to find the unknown position of a robot in indoor locations. Furthermore, the algorithm can be extended to accurately track, monitor and navigate an autonomous robotic system.

Chair: Sivaram Gogineni, Spectral Energies LLC

10:00 AM - DESS10-0084

Improving the accuracy of time-resolved H2 picosecond coherent anti-Stokes Raman scattering (ps-CARS) thermometry by incorporating in situ measurements of H2 Q-branch Raman coherence lifetimes

Waruna Kulatilaka
Spectral Energies, LLC

Paul S. Hsu, Hans U. Stauffer, and Sukesh Roy
Spectral Energies, LLC

James R Gord
Air Force Research Laboratory

We report direct measurement of H2 Q-branch Raman coherence lifetimes using time-resolved picosecond coherent anti-Stokes Raman scattering (ps-CARS). A custom-built, high-peak-power, nearly transform-limited ps laser system offers an ideal combination of frequency and temporal resolution for such measurements. The coherence lifetimes measured for pure H2 at room temperature are in good agreement with the decay rates that were derived from the previous high-resolution studies. Measurements were also performed in binary mixtures of H2-X (X=Ar, N2, CH4, and C2H4). A simple theoretical model was developed to extract temperature from the time-delayed ps-CARS spectra which is free of nonresonant interferences. This approach addresses the effects of rotational-level-dependent decay lifetimes on time-delayed ps-CARS. By obtaining the ps-CARS spectra at a select handful of probe pulse delays, we outline a simple procedure for accurate temperature determination based on a Boltzmann distribution using time-delayed ps-CARS spectra of H2, independent of the sample composition.

10:20 AM - DESS10-0103

Gas-phase Thermometry in Reacting Flows using Fiber-coupled Picosecond Coherent Anti-Stokes Raman Scattering (CARS) Spectroscopy

Paul Hsu
Spectral Energies, LLC

Waruna D. Kulatilaka and Sukesh Roy
Spectral Energies, LLC

Anil K. Patnaik and James R. Gord
Air Force Research Laboratory, Propulsion Directorate

We have developed a picosecond (ps) laser-based, fiber-coupled coherent anti-Stokes Raman scattering (CARS) spectroscopy system for gas-phase thermometry in harsh combustion environments. The unique feature of ps-CARS is that the required energy per laser pulse is approximately 100 times lower than that of conventional nanosecond (ns) CARS, making it ideal for fiber-delivery and enabling transmission of the required amount of laser energy without causing damage to the fibers. Furthermore, ps-CARS spectroscopy would allow the suppression of non-resonant background for improving the sensitivity and accuracy of CARS thermometry in high-pressure hydrocarbon-fueled combustors. A ps fiber-coupled CARS system using all-silica, multimode, step-index fibers has been developed. Temperature measurements using this system were demonstrated in an atmospheric-pressure, near-adiabatic laboratory flame. Proof-of-concept measurements showed significant promise for fiber-based CARS spectroscopy in harsh combustion environments.

10:40 AM - DESS10-0105

Laser-Induced Fluorescence (LIF) Detection of OH Using High-Repetition-Rate Femtosecond Pulses

Hans Stauffer
Spectral Energies, LLC

Waruna D. Kulatilaka and Sukesh Roy
Spectral Energies, LLC

James R. Gord
Air Force Research Laboratory, Propulsion Directorate

The commercial availability of femtosecond laser systems with kHz and greater repetition rates holds great promise for high-bandwidth observation of transient events in combustion environments via the monitoring of number density and temperature time series. We describe here the development of laser-induced-fluorescence (LIF) detection schemes to probe combustion-relevant species using a high-repetition-rate ultrafast laser. In these initial experiments, a femtosecond laser system with a 1-kHz repetition rate is used to induce fluorescence, following two-photon excitation, from hydroxyl (OH) radicals present in a premixed, laminar flame. A range of experiments will be described, including studies of the dependence of observed signal on OH number density and on optical pulse duration.

11:00 AM - DESS10-0123

Novel Polymer Derived Ceramic Sensor for Gas Turbine Bleed Flow Measurements

Sivaram Gogineni
Spectral Energies, LLC

Prof. Jay Kapat and Dr. Mark Ricklick
University of Central Florida

As current gas turbine engines operate with hot gas temperatures well beyond the melting temperatures of the materials used within the machine, cooling of these components is a crucial aspect of engine performance. In-flight knowledge of the levels of coolant air bled from the compressor serve multiple purposes; including aiding in situational awareness & assessing maximum engine capabilities, as well as improved maintenance planning. In order to address these issues, Spectral Energies, LLC in collaboration with University of Central Florida (UCF) is developing a novel polymer derived ceramic (PDC) thermal anemometer sensor, similar in operation to a conventional hot wire anemometer. This sensor which is robust, fast response, and light weight can serve as an optimal solution for the bleed flow measurement for in-flight conditions. Several benefits can be immediately realized from this PDC sensor; including resistance to thermal, structural, and abrasive failures, as well as ease of implementation.

Chair: Julie Skipper, Wright State University

10:00 AM - DESS10-0070

Novel Carbon Foam/Polycaprolactone Scaffolds for Tissue Engineering Applications

Jerry Czarnecki
University of Dayton

Khalid Lafdi and Panagiotis Tsonis
University of Dayton

Current tissue scaffolds lack a balance of mechanical strength and healing potential. Porous carbon foam has numerous properties that can balance strength and healing and aid in bone regeneration. Polycaprolactone (PCL), a biodegradable polymer, has properties that make it an attractive support material. Carbon foam and polymer composites were fabricated keeping carbon foam porosity constant and varying pore size. The composites were introduced to simulated body fluid at 37ºC and degraded for 1 year. The compressive modulus, failure load and maximum stress of the scaffolds were determined and compared to experimental values of cancellous bone. Results indicate that carbon foam composite scaffolds have properties similar to cancellous bone and could be an attractive candidate for use as a bone regeneration scaffold or implant.

10:20 AM - DESS10-0113

Quantitative Computed-Tomography-Based Strength Assessment Helps Identify Low Bone-Strength Individuals in a Clinical Environment

Bino Varghese
Wright State University

Thomas Hangartner
Wright State University

Dual-energy x-ray absorptiometry (DXA)-based bone mineral density (BMD) / bone mineral content (BMC), which is the current clinical standard for identifying low bone strength individuals, underestimates bone geometry, and the strength analysis is limited to only a representative region of the bone. Here, a combined numerical–experimental study is performed comparing FE-predicted surface strains with strain gauge measurements. 36 major, cadaveric, long bones (humerus, radius, femur and tibia), which cover a wide range of bone sizes, were tested under three-point bending and torsion. The FE models were constructed from trans-axial volumetric CT scans, and the segmented bone images were corrected for partial-volume effects. The material properties were calibrated by minimizing the error between experiments and simulations among all bones. Novel image-based bone-strength indicators (BSI) that take into consideration the volumetric-nature of bone and correlate with the performance of the 3-D FE models in capturing bone strength were developed and tested.

10:40 AM - DESS10-0030

Developing a Virtual Patient for Communication Training

April Barnes-Renfro
Wright State University

Jennie Gallimore, Ph.D. , Phani Kidambi, and Rosalyn Scott, M.D.
Wright State University

Communication is a core clinical skill for healthcare professionals but the amount of time focused on training, the quality and quantity of feedback and the diversity of actual patient interactions can be inconsistent. Computer-based virtual patients (VPs) supplement conventional training methods by providing practice in a safe environment, greater accessibility, standard performance and objective feedback. The objective of this research is to develop an interactive, high-fidelity VP for training communication skills. A prototype has been developed that utilizes speech recognition and a script-mapping mechanism to converse with the user in a natural manner. The integration of 3D imaging and emotion detection is currently in progress. Eventually, the VP response will vary based on speech and emotion input from the user. Objective measures of communication will also be incorporated. It is expected that the realism of the VP interaction will improve the effectiveness of communication training for healthcare providers.

SESSION 14: Renewable/Clean Energy II	10:00 - 11:20 AM	Room 163B

Chair: James Menart, Wright State University

10:00 AM - DESS10-0056

Hybrid Geothermal Heat Pump Systems Using Nocturnal and Seasonal Heat Rejection with Radiators

Jarret Kelley
University of Dayton

Dr. Andrew Chiasson and Dustin Langille
University of Dayton

Hybrid Solar-Geothermal systems allow for more balanced ground loads in heating dominated climates by using the solar thermal energy to "recharge" the ground. The purpose of this research is to determine if unglazed solar panels can be used to radiate heat out of the system to provide more balanced ground loads in cooling dominated climates. TRNSYS is used to determine the feasibility of this setup, and TRNOPT is used to determine the optimum number of panels and boreholes.

10:20 AM - DESS10-0099

Imbalanced Heat Load in Ground Source Heat Pump (GSHP) Systems – Is this a Problem?

B. G. Shiva Prasad
Wright State University

James Menart, Kyle Hughes, and Paul Gross
Wright State University

Geothermal energy is not only clean but also omnipresent, plentiful and eternal. However, GSHP is still not popular and also has not yet become cost effective compared to fossil fuels in most places due to the low heat content of the easily reachable energy source available at shallow depths. Design and cost estimation tools for GSHP systems are available. However, there are serious questions regarding the thermal inertia and the nature and extent of response of the ground to an imbalance in heat extracted or dumped into the ground over a long time. The methods applied in the above tools for accounting for such imbalance appear arbitrary and need further refinement. This aspect has a significant impact on system design & cost as well as the future of geothermal energy as a practicable source. This presentation will discuss the analytical (including CFD) investigation in progress to answer the above questions.

10:40 AM - DESS10-0141

Silicon-Coated Carbon Nanofibers for Lithium-Ion Battery Anodes

Gerard Simon
Wright State University, Air Force Research Laboratory

Benji Maruyama
Air Force Research Laboratory

David Burton
Applied Science, Inc.

Tarun Goswami
Wright State University

Of all the materials that can be used in lithium-ion battery anodes, silicon has the highest theoretical capacity (4,200 mAh/g). However, its tendency to expand 400% when alloying with lithium makes it unusable in bulk or thin film forms for an anode material. Despite this, a silicon-coated carbon nanofiber (CNF) may be a viable method of exploiting silicon's capacity in a battery anode. Silicon-coated CNFs were fabricated through chemical vapor deposition by Applied Sciences, Incorporated (ASI) and formed into buckypaper-type anodes for electrochemical testing. Silicon-coated "veil" samples, also fabricated by ASI, were tested concurrently. The silicon-coated CNF paper demonstrated a maximum capacity of 570 mAh/g in the first cycle, but suffered from high fade. The silicon-coated veil demonstrated a capacity of 954 mA/g in the first cycle, but faded to 766 mA/g after 20 cycles.

11:00 AM - DESS10-0027

TRNSYS Simulation to Harness Thermal Energy from Abandoned Oil and Gas Wells - A Case Study in Ohio

Charles Ampong
University of Dayton

Dr. Andrew Chiasson
University of Dayton

Interest in harnessing useful thermal energy from abandoned oil and gas wells has been growing in the United States because of its supposed benefits to both the oil and geothermal industries. This project investigates a single-well potential of a closed-loop borehole heat exchanger (oil well) for direct heating applications. The TRNSYS software package is used for transient system modeling and simulation of a single closed-loop concentric-tube heat exchanger over a multi-year period. The well depth and the variations in temperature (thermal gradient) along the well bore are incorporated to investigate the thermal performance of the well. A time varying thermal load estimated for a Greenhouse is added to the model to investigate the direct heating potential of the well system. Preliminary findings of this study will be presented, including the technical and economic analysis of operating such a system as compared to a traditional fossil-fuel heating system of a Greenhouse.

Chair: Benjamin Smarslok, AFRL

1:20 PM - DESS10-0022

SORCER enabled Collaborative Reliability Based Design Optimization

Nagesh Aithal
Wright State University

Dr.Ramana V Grandhi
Wright State University

Today's product design often involves multiple project partners due to competitive constraints and distributed expertise. Tighter and better collaborations are needed to reduce the design life cycle and expedite product delivery to market. During this process, hundreds of computational tools belonging to geographically distributed partners are utilized to estimate precise product performance. Hence, there is a need for a sophisticated platform to share the expertise, tools, and methods among partners and enable seamless and secure data sharing. In this work, Service Oriented Computing Environment (SORCER), a Federated Method Invocation technology is used to develop a common computational framework in which several computational tools to perform FEA, Optimization, Reliability analysis, and Aeroelasticity analysis will be wrapped as services. The developed framework is implemented on Reliability-Based Design Optimization (RBDO) problems.

1:40 PM - DESS10-0069

Swarm Optimization for Real-Time Adaptation for Variable Operating Points

Alan Jennings
University of Dayton

Raul Ordonez
University of Dayton

This work presents a swarm optimization to create functions approximating an optimal point as a one dimension operating point changes. The objective and cost functions are modeled by neural networks. The network gradients are used to optimize a population of agents by minimizing the cost for the agent's current operating point. When an agent reaches an optimal point for the current operating point, additional agents are generated to step in the operating point gradient directions while settling to local optimum. These optimal points forms a inverse function via spline interpolation. In this manner, a locally optimal function is created for each settled agent. These functions are naturally clustered in input and output spaces. The best cluster over the anticipated range of operating conditions can be chosen and the process optimized in real-time to respond to different set-points. Results are shown for a diverse set of functions.

2:00 PM - DESS10-0014

Transonic Aeroelastic Analysis of Supersonic Tailless Air Vehicles

Kenneth Gannon
Wright State University

Dr. Ramana V. Grandhi
Wright State University

The transonic flight regime introduces a critical aeroelastic condition due to the aerodynamic nonlinearities prevalent in transonic flow, which in turn results in a dip in the flutter boundary. Transonic aeroelastic analysis is an important facet in regards to supersonic aircraft design, as such designs will undoubtedly pass through the transonic regime. Limited knowledge and research exists in the upper transonic regime for aircraft designs of Mach 2 or higher. The goal of this research is to explore and predict the transonic aeroelastic behavior of such designs in order to determine the occurrence of flutter "chimneys" or other transonic aeroelastic phenomena such as limit cycle oscillations and body freedom flutter. Being able to predict the transonic aeroelastic behavior of such aircraft will aid in obtaining a better understanding with which to optimize a supersonic design in such a way as to delay the occurrence of flutter under specified flight conditions.

2:20 PM - DESS10-0023

Quantification of Modeling Uncertainty in Aeroelastic Analyses

Matthew Riley
Wright State University

Ramana V. Grandhi
Wright State University

Traditional uncertainty quantification techniques in engineering design concentrate upon the quantification of parametric uncertainties--uncertainties of the input design variables. In problems with a high degree of uncertainty associated with the modeling methodology, the uncertainties induced by the modeling process itself--model-form uncertainty--can become a significant source of uncertainty to the problem. This work demonstrates two model-form uncertainty quantification methods on an unsteady aeroelastic problem: Bayesian Model Averaging and the Adjustment Factors Approach. The uncertainty induced by disagreement between different models within a problem is quantified based upon the disagreement between varying models of the same design. The application to Bayesian Model Averaging is further explored through the addition of any available experimental data to the uncertainty quantification process. Finally, a modification of the traditional Adjustment Factors Approach is developed to further identify significant parameters in the model-form uncertainty quantification process.

2:40 PM - DESS10-0071

Aeroelastic Control using receptance frequency response functions

Laura McDonough
Miami University

Kumar Vikram Singh
Miami University

Aeroservoelastic control deals with the structure and aerodynamic coupling and control of potential dynamic instabilities, such as flutter, in aircraft structures. State space models are typically used to implement aeroelastic control in order to suppress flutter. However these models are subjected to several modeling or approximation errors, which may pose problems in controller implementation. In this research, an alternative control strategy is considered which is based purely upon receptance frequency response functions, hence circumventing the knowledge of system matrices. The receptance data can be obtained by extracting the frequency response functions associated with the response degrees of freedom corresponding to excitation input. Feedback control gains are computed based on numerical receptances for pole assignment. The closed loop poles are chosen to extend the flutter boundaries. The receptance based state feedback control method is demonstrated with the help of some numerical examples associated with rigid and flexible wing models.

Chair: Mitch Wolff, Wright State University

1:20 PM - DESS10-0052

CFD Tool for Analysis and Design of Ranque–Hilsch Vortex Tube (RHVT)

Salah Soliman
University of Cincinnati

Dr. S. Abdallah
University of Cincinnati

To date, there is no complete physical understanding or numerical modeling for analysis of energy separation mechanism in RANQUE–HILSCH vortex tubes (RHVT). Numerical solutions for the RHVT experience difficulties with numerical instability and convergence. The main source of these problems can be related to improper use of boundary conditions at the hot and cold exits. Researchers employed experimental pressure measurements or atmospheric at both ends in order to obtain converged results. In this study we developed a CFD model that employs the physical boundary conditions of atmospheric pressure at far downstream from both ends. Therefore the computational domain is extended about 80 orders of the tube diameter downstream. Numerical solutions are obtained without convergence or stability difficulties and the results are compared with experimental data. The prediction of the experimental measured pressures at both hot and cold exits using our computational model validates the technique.

1:40 PM - DESS10-0082

SOLVCON: New Python-Based Software Framework for Massively Parallelized Hyperbolic PDE Solvers Using the CESE Method

Yung-Yu Chen
The Ohio State University

Sheng-Tao John Yu
The Ohio State University

SOLVCON is a new software framework to solve hyperbolic partial differential equations (PDEs) by using the Conservation Element and Solution Element (CESE) method. SOLVCON intrinsically uses unstructured mesh of mixed elements to accommodate complex geometry. Conventionally, most of computer codes in a PDE solver are for supportive functionalities and repeatedly implemented. SOLVCON uses Python, a dynamic programming language, to eliminate the redundancy by providing extensible abstraction for the functionalities. As such, essential numerical algorithms can be implemented in a segregated solving kernel. Distributed-memory parallelization for networked computers is readily implemented in SOLVCON. Solving kernels can further implement shared-memory parallelization for hybrid parallelism. The two-layer approach paves the road for general-purpose graphic processing unit (GPGPU) computing to work with networked computers. SOLVCON has been applied to two-/three-dimensional problems of fluid and solid mechanics. 16 millions of elements and 512 4-core workstations at Ohio Supercomputer Center (OSC) have been utilized.

2:00 PM - DESS10-0087

Low Pressure Seeder Development for PIV in Large Scale Open Loop Wind Tunnels

Ryan Schmit
Air Force Research Laboratory

A low pressure seeding techniques have been developed for Particle Image Velocimetry (PIV) in large scale wind tunnel facilities was performed at the Subsonic Aerodynamic Research Laboratory (SARL) facility at Wright-Patterson Air Force Base. The SARL facility is an open loop tunnel with a 7 by 10 foot octagonal test section that has 56% optical access and the Mach number varies from 0.2 to 0.5. A low pressure seeder sprayer was designed and tested in the inlet of the wind tunnel. The seeder sprayer was designed to produce an even and uniform distribution of seed while reducing the seeders influence in the test section. ViCount Compact 5000 using Smoke Oil 180 was the seeding material. The results show that this low pressure seeder does produce streaky seeding but excellent PIV images are produced in the wake for a bluff body tested.

2:20 PM - DESS10-0102

CFD Analysis of NREL Phase VI Wind Turbine Rotor

Yen-Pin Chen
Wright State University

Dr. J. Menart
Wright State University

This work shows the result of a steady state, three-dimensional computational fluid dynamic (CFD) simulation of the air flow field around the moving blades of a wind turbine. The simulations are performed on the National Renewable Energy Laboratory (NREL) Phase VI wind turbine rotor with two blades using an S809 airfoil. Both blades and the hub, with rotation, are analyzed. The commercial software package SolidWorks is used to construct the geometrical model. SC/Tetra is used for simulations, a finite volume based CFD computer code, allows unstructured and discontinuous meshes that move with the turbine blades to simulate a rotating body. In this presentation, this model will be discussed. In addition, simulation results for the aerodynamic coefficients CL, CD, and CP will be presented. Initial results for the power generated by the rotor will be discussed and compared against data from a wind tunnel experiment done at NREL.

2:40 PM - DESS10-0078

Numerical Investigation of an Elliptic Cone at High Angle of Incidence in Nonequilibrium Flow

Michael Atkinson
Univeristy of Dayton

Jonathan Poggie and Jose Camberos
AFRL/RBAC

In order to investigate high angle-of-attack reentry for a simple configuration representative of a flight vehicle, a numerical investigation was carried out for a blunt-nosed elliptic cone configuration in hypersonic, laminar flow. The geometry and test conditions were selected for comparison to the experiments of Nowlan (Cornell Aeronautical Laboratory Report AM-1800-Y-2, 1963): a 2:1 blunt elliptic cone configuration at a Mach number of 14.5, Reynolds number based on length of 36000, and angles of attack ranging from of 0° to 60°. Nonequilibrium flow calculations were carried out using the unstructured-grid, Navier-Stokes code US3D, developed at the University of Minnesota. The leeside flow structure was examined in detail, and grid resolution studies and comparison to the available experimental data for surface pressure and heat transfer were carried out.

Chair: Raghavan Srinivasan, Wright State University

1:20 PM - DESS10-0021

Electron Microscopy Investigation of Carbon Nanotube Growth on Diamond Substrate

Betty Quinton
Wright State University

Varanasi, C.V.
Army Research Office

Xu. Y.
UES Inc.

Barnes, P. N.
Air Force Research Laboratory

Mukhopadhyay, S.M.
Wright State University

Carbon exists in different allotropic forms. Diamond crystals form with a SP3 hybridized bonding structure and carbon nanotubes (CNTs) form with a SP2 bonding structure. In our study, we demonstrated growth of CNTs onto commercial polished freestanding chemical vapor deposited (CVD) diamond substrate using three different growth methods. The three growth methods were: thermal CVD with pre-sputtered metal catalyst, microwave plasma enhanced CVD with pre-sputtered metal catalyst and floating catalyst thermal CVD with xylene and ferrocene liquid mixture without any prior catalyst deposition. The resulting samples were analyzed for growth mechanisms at the top surface and at the cross section of the interface using scanning electron microscopy and transmission electron microscopy.

1:40 PM - DESS10-0032

Multi-scale Hierarchical Interfaces to suppress Interfacial delamination in Composites

Anil kumar Karumuri
Wright State University

Sharmila M. Mukhopadhyay
Wright State University

Interfacial delamination is the primary mode of failure in common composites and reduces its performance. Recent research by this group showed that replacing a planar interface with a multi-scale hierarchical architecture may be the answer to preventing such failures. These types of interfaces are seen frequently in biological structures, but rarely in synthetic materials. Carbon nanotubes (CNT) were strongly attached on larger carbon core structures prior to bonding with polymeric matrix phase. It was seen that presence of nanostructures suppresses interfacial delamination and improves the mechanical performance of composite significantly. This improved performance is demonstrated in multiple types of composite geometry, and has been attributed to the transfer of load away from the planar interface caused by the nanoscale attachments. Brittle composite structures can be made ductile using this approach. This paper will present some of the experimental results obtained, and modeling approaches adopted to understand and refine this behavior.

2:00 PM - DESS10-0057

Carbon Nanostructure as Thermal Interface Material

Muhammad Omar Memon
University of Dayton Research Institute, Carbon Research Laboratory

Sylvain Halliot and Khalid Lafdi
University of Dayton Research Institute, Carbon Research Laboratory,

Carbon nanofiber (CNF) based buckypaper was fabricated to investigate its use as a compliant thermal interface material (TIM) in electronics. Materials were prepared by CNFs at different heat treatment temperatures (Pyrolytically stripped, LHT at 1500 ºC and HHT at 3000 ºC) and Polyvinyl Alcohol (PVA) as a binder. A test setup was designed to measure thermal impedance of these materials as a function of load and thickness. Results show that the thermal impedance at the interface decreased in conjunction with the increasing heat-treatment temperature of CNF. Buckypaper with CNF-HHT showed a significant decrement of 22.9% in thermal impedance in comparison with the direct contact. Overall results demonstrate that high heat treated CNFs, because of their graphitic nature, are highly conductive and hence can be used as a potential TIM for aerospace applications.

2:20 PM - DESS10-0058

Use of Carbon Nanonstructure in Transient Spike Power Applications

Muhammad Omar Memon
University of Dayton Research Institute, Carbon Research Laboratory

Khalid Lafdi
University of Dayton Research Institute, Carbon Research Laboratory,

Experimental and numerical characterization of carbon nanofiber (CNF) based buckypaper is presented in terms of thermal interfacial resistance and transient power spikes in electronics. Numerical simulations performed on Fluent CFD confirmed the validity of the experimental setup. A parametric study was carried out which showed significant decrement in the thermal resistance with the decrease in thermal interface material (TIM) thickness. A transient spike power system was designed with hot and cold plate method where three different types of TIMs (Pyrolytically stripped, LHT at 1500 ºC and HHT at 3000 ºC) were subjected to two techniques; uniform heat pulse of 24 Watts, and power spikes of 24-96 Watts under transient loads. The results show that the HHT-CNF TIM was 12% more temperature resistant than normal contact with a 47% increase in the heat transport across it.

2:40 PM - DESS10-0079

Electroless Ni Plating of Carbon Nanotubes for SiC Power Modules

Bang-Hung Tsao
University of Dayton Reserach Institute

Betty T.Quinton, James D. Scofield, and Paul N. Barnes
Air Force Research Laboratory

Jacob W. Lawson
University of Dayton Reserach Institute

Carbon nanotubes (CNTs) could be ideal materials for high temperature electronic packaging applications due to their excellent thermal and electrical conductivity. To ensure structural integrity, however, the CNTs would need to be used in a composite configuration with another material such as nickel. A novel way to form the composite is to impregnate a given array of nanotubes with Ni via electroless plating. To control the structure, composition, and properties of the Ni plating, processing parameters such as bath temperature, solution PH value, and Ni ion concentration etc. must be optimized. A detailed description of experimental parameters and preliminary results of Ni plating of CNTs grown on SiC substrate will be reported.

Chair: Jia Guo, Wright State University

1:20 PM - DESS10-0033

An Adaptive Filtering Technique for Video Stabilization

Varun Santhaseelan
University of Dayton

Vijayan Asari
University of Dayton

Video stabilization is used to cancel out the effects caused by high frequency motion of the camera. In the proposed method for video stabilization, motion of the camera is estimated by matching certain feature points across successive frames. Scale Invariant Feature Transform (SIFT) is used to identify the feature points in each frame. The movement of the camera between instances of capture is represented using an affine transformation matrix. The individual components in the transformation matrices are filtered using a zero-mean Gaussian filter whose variance is determined from the estimated motion of the camera. This idea is based on the observation that the instability present in video is reflected directly on the transformation matrix. In some frames, feature extraction is hampered by the presence of shadows or non-uniform lighting regions. Research work is in progress to incorporate a non-linear enhancement algorithm as a pre-processing step to resolve this problem.

1:40 PM - DESS10-0035

Depth Dependent Nonlinear Enhancement for Visibility Improvement of Hazy Images

Saibabu Arigela
University of Dayton

Vijayan Asari
University of Dayton

Color images captured in bad weather conditions such as fog or haze will be degraded due to poor contrast and distorted color. We propose a new depth dependent nonlinear function for the enhancement of image regions affected by haze or fog. The application of dark channel prior is the basis for estimating the thickness of haze to represent local region depth and for calculating the global atmospheric light components. The atmospheric color components in the captured image are eliminated and each pixel in the difference image is processed with a depth based nonlinear function locally to achieve good contrast enhancement. Experiments conducted on several images captured in hazy environment provide satisfactory results with appropriate visibility, details and natural color restoration. Research work is in progress to eliminate some of the artifacts present in the enhanced images due to the presence of any image regions at different distances from the camera.

2:00 PM - DESS10-0036

A Nonlinear Manifold for Color Restoration

Alex Mathew
University of Dayton

Ann Theja Alex and Vijayan Asari
University of Dayton

Images captured using a camera loses its dynamic range of colors as they are digitized. This problem is not encountered by the human visual system since it supports a wider dynamic range. Our enhancement model is based on the human visual system which involves three processing steps - color characterization, color enhancement and color correction. Each pixel in an image along with its neighborhood forms color manifolds in RGB space. In the proposed color characterization method, these manifolds are modeled as planes. In the color enhancement step, a hyperbolic tangent function compresses the dynamic range of the image. This nonlinear function enhances the image preserving its details but not the color relationships. Each enhanced pixel is projected to a point on the best fit plane of its respective manifold to restore the original color relationships. This is a single-step convergence algorithm, and it performs better than other iterative methods.

2:20 PM - DESS10-0037

A Projection Based Method for Illumination Correction

Ann Theja Alex
University of Dayton

Alex Mathew and Vijayan Asari
University of Dayton

The Human Visual System (HVS) enables accurate interpretation of scenes with varying background illumination. On the other hand, images captured using a camera may appear in different colors under different lighting conditions. To ensure accurate scene understanding, these images need to be transformed to an acceptable reference illumination. The proposed model imitates HVS and effectively addresses this problem. The image with the reference illumination is operated with a wide Gaussian to extract the global illumination. The illumination information for the entire image is modeled as a manifold in the RGB color space. The color relationships in the illumination information are best approximated by a best fit plane in the manifold. To correct the illumination in an input image, its global illumination information is captured and projected to the plane that defines the reference illumination. The corrected illumination is applied to an input image to transform it to the reference illumination.

2:40 PM - DESS10-0049

Recurrence Time Distribution, Renyi Entropy, and Pattern Discovery

Jianbo Gao
Wright State University

Wen-wen Tung
Purdue University

Qian Han
Wright State University

Entropy and recurrence times are two of the most important complexity measures for both random fields and nonlinear dynamical systems. We prove a fundamental theorem relating the Renyi entropy of all orders to the moments of recurrence times and the logarithm of recurrence times. This opens up an effective avenue of detecting weak signal changes using recurrence time statistics, including structural health monitoring. As illustration of applications, we consider (1) speech endpoint detection, (2) epileptic seizure detection/prediction from continuous EEG measurements, and (3) analysis of DNA sequences on the whole genomic scale.

SESSION 19: Combustion	1:20 - 3:00 PM	Room 157B

Chair: Waruna Kulatilaka, Spectral Energies LLC

1:20 PM - DESS10-0090

A Shock Tube Experimental and Kinetic Modeling Study of Ignition delay times of hydrogen combustion under fuel-rich conditions

Aditya Nagulapalli
University of Dayton

Giacomo Flora
University of Dayton

Saumitra Saxena, Moshan Kahandawala, and Sukh S. Sidhu
University of Dayton Research Institute

There have been many studies on the ignition-delay times for the hydrogen–oxygen–argon using reflected shock-tube technique under a wide range of conditions. However, there hasn't been any study on the ignition-delay of hydrogen under the fuel-rich conditions. In the current study, hydrogen as a fuel and oxygen was tested at an equivalence-ratio of 3 and 93% argon. Ignition-delay times were measured using pressure rise and optical diagnostics. The velocity of the shock at the end wall and the initial pressure were used as an input to Chemkin program and the temperature behind the reflected shock tube was estimated. The experimental ignition-delay times were simulated using Hydrogen Combustion model (Dryer et al.).The constant volume assumption based Chemkin modeling fails under lower temperature conditions. However, a newly developed in-house code SHOCKIN produces better agreements under identical conditions. A detailed chemistry CFD-code was also validated using current set of data

1:40 PM - DESS10-0106

Simulation of Reflected Shock Tube Combustion Experiments Using Multiple Computational Approaches

Giacomo Flora
University of Dayton

Saumitra Saxena, Moshan S. P. Kahandawala, and Sukh S. Sidhu
University of Dayton Research Institute

Shock tube ignition delay times constitute a global parameter for the validation of predictive kinetic models of combustion of fuels. In this study, several computational tools were developed and utilized to help better interpret the experimental ignition delay measurements using the shock tube. The ignition delay times of selected fuels have been modeled using three different approaches: Closed Homogeneous Batch Reactor model of Chemkin-Pro, which assumes constant volume and internal energy; a newly developed in-house modified Chemkin code, SHOCKIN, which takes experimental pressure profile as input for kinetic chemical calculation and corrects for non-ideal gas dynamic effect; a 1-D CFD code, for simulation of shock tube flow with detailed chemistry developed by Bilyeu et al.

2:00 PM - DESS10-0095

A Shock Tube Ignition Delay Study in the Combustion of Selected Surrogates for Jet Fuels

Giacomo Flora
University of Dayton

Saumitra Saxena, Moshan S. P. Kahandawala, and Sukh S. Sidhu
University of Dayton Research Institute

Ignition delay times of potential surrogate jet fuels n-dodecane, m-xylene, and a blend of n-dodecane and m-xylene (77: 23 (% volume)), were investigated behind reflected shock waves using our heated-single pulse shock tube facility at UDRI. The experimental conditions covered a temperature range of 900–1600 K, at a pressure of 20 atm, and at equivalence ratios of 0.5, 1, and 3. Ignition delay measurements were made using the end plate pressure profile and the onset of visible broadband and CH*, OH* chemiluminescence emissions at the end plate of the shock tube. This data provides an important source for the refinement of predictive kinetic models for jet fuels.

2:20 PM - DESS10-0096

Characterization of Vortex-Shedding Transitions using Proper Orthogonal Decomposition

Stanislav Kostka
Spectral Energies, LLC.

Sukesh Roy
Spectral Energies, LLC

Amy C. Lynch, Barry V. Kiel, and James R. Gord
Air Force Research Laboratory/ RZTC

Bluff-body flame stabilization as a means for augmenting combustion in gas-turbine engines has been of great interest for many decades. The current research effort is focused on the investigation of vortex-shedding mechanisms related to stable flames and flames undergoing acoustic instabilities. Two modes of shedding, Kelvin-Helmholtz and Von-Karman, have been described to play a role in flame stability. However, current state-of-the-art measurements are based mainly on qualitative visualizations and do not provide the quantitative characterization of the vortex-shedding behavior in presence of unsteady heat release. We propose to use proper orthogonal decomposition for quantitative characterization of vortex-shedding dynamics in presence of unsteady heat releases. Proof-of-concept measurements have been performed in an augmentor test rig with a 1.5" v-gutter flame holder placed in an air flow with propane used as a fuel. The fuel flow was used to vary the equivalence ratio to investigate transitions between unstable and stable flame conditions.

2:40 PM - DESS10-0043

Comparison of Numerical and Ground-Test results of the HiFire-2 Combustor

Robert Yentsch
The Ohio State University

Faure J. Malo-Molina
AFRL-RBAC

Datta V. Gaitonde
The Ohio State University / AFRL-RBAC

In this presentation, we show a preliminary analysis of the flow field obtained from three-dimensional, high-fidelity simulations of a scramjet combustor. Comparisons are made with ground-test experiments conducted at the NASA Langley Arc-Heated Direct-Connect Scramjet Test Facility. The combustor being analyzed is part of the Hypersonic International Flight Research Experimentation (HiFire) program Flight 2, the goal of which is to explore the principal phenomena encountered in ramjet-scramjet mode transition as well as flame extinction limits encountered as a function of fuel delivery patterns. These simulations were performed to validate the chosen numerical method's ability to accurately analyze the very stiff problems posed by hypersonic internal flow. Also, the legitimacy of the comparison as a platform for calibration of a tractable combustion model, and its subsequent use in understanding the complex dynamics associated with inlet-combustor interactions, including distortion, mixing, and thrust generation efficiency, will be briefly discussed.

Chair: Jamie Gengler, Spectral Energies LLC

1:20 PM - DESS10-0128

Biomechanics of ACL Injury

Kelly Estes
Wright State University, Boonshoft School of Medicine

Tarun Goswami, D.Sc.
Wright State University

Anterior cruciate ligament (ACL) tears are one of the most frequent soft tissue injuries of the knee. A torn ACL leaves the knee joint unstable and at risk for further damage to the knee. A better understanding of the dimensional details of knee joints suffering ACL tears and a prediction model for individuals susceptible to tears is needed. Magnetic resonance images (MRIs) of 32 patients with ACL tears and 40 patients who did not have ACL tears were evaluated from a physician group practice. Digital measurements of femoral condyle length, femoral notch width, ACL width in the frontal and sagittal plane, and the ACL length in the sagittal plane were taken in both groups. Empirical data correlations were performed and trends identified. A prediction equation was developed involving BMI and the ACL measurements in the sagittal plane that establishes the critical dimensions for normal and torn ACLs.

1:40 PM - DESS10-0129

Statistical Analysis of Dimensional anatomy of the vertebral body in the Cervical Spine of Chinese Singaporeans and projection on U.S

Susan Schweitzer
Wright State University

Mary Blackmore, PhD and Tarun Goswami, D.Sc
Wright State University

The objective of this study was to perform a statistical analysis on the dimensional anatomy of the vertebral bodies present in the cervical spine. The different dimensional aspects that were analyzed were based on the anthropometric measurements completed from a published study on Chinese Singaporeans by Tan (2004). The current study involved anthropometric measurements of linear, area, and angular aspects. Analysis was completed using the concepts of linear regression, ANOVA, and parameter estimation. Investigation into any relationship that might be present between the previous anthropometric measurements in each vertebra singly was completed (i.e. Comparing C3 measurements to C3 only, C4 to C4 only, and so on). The result of this statistical modeling will help provide more accurate modeling of this section of the spine, and a better understanding of cervical spine functionality and its susceptibility to failure.

2:00 PM - DESS10-0130

Effects of anthropometric geometry on the outcome of finite element models of vertebral endplates

Isaac Mabe
Wright State University

Dr. Tarun Goswami, D.Sc.
Wright State Universtiy

Vertebral endplates play an important role in the health and stability of the spinal column. Endplates are a thin layer of bone that acts as a boundary between the intervertebral disc and vertebral body. Without the endplate the intervertebral disc would herniate into the vertebral body. Extrusion of the disc into the vertebral body reduces the spinal column height, alters stress distributions of the vertebral body, impinges on the spinal cord and can cause pain. Due to the complex geometry, boundary conditions and load scenarios finite elements methods are used to analyze the endplate for stress. More often then not the endplate is simplified and idealized as a uniformly thick and flat. This report will analyze the endplate with more anthropometrically correct geometry. Comparisons will also be made between curvature and thickness differences. The goal of this study will be to further understand the biomechanics of the vertebral body endplates.

2:20 PM - DESS10-0131

Hip Implant Stem Interfacial Motion, a finite element analysis analysis

Mbulelo Makola
Wright State University

Dr. Tarun Goswami
Wright State University

A key factor in hip implant fixation is the amount of interfacial motion between implant stem and the femur. A finite element analysis of hip implant stem designs was performed to determine the effect on stem interfacial motion. Implants of distinct cross section and stem profile were analyzed. Implant material property effects were studied by modeling implants as made up of CoCr, SS316L, and Ti6Al4V. Each implant was subject to a static loading simulating the weight of an average U.S. male (189 lb) taking a step forward. Implant profile and stem design along with material property played an important role in the amount of interfacial motion observed.

2:40 PM - DESS10-0051

Position and Weight Distribution of Grocery Bags to Minimize Center of Pressure Displacement

Melissa Taylor
University of Dayton, Engineering Wellness and Safety Lab

Erin Sutton, Julia Schaeffer, Deborah Kinor, and Dr. Kimberly Edginton Bigelow
University of Dayton, Engineering Wellness and Safety Lab

The aim of this study was to determine the most effective positioning and weight distribution of grocery bags in order to minimize postural instability in the elderly. Twenty independent adults each held 10 pounds of bagged groceries in various positions and with various weight distributions for seven 60-second trials. A force plate measured changes in each subject's center of pressure, which was used to calculate Anterior-Posterior Sway Range, Medial-Lateral Sway Range, Sway Velocity, and Medial-Lateral Sway Velocity. The data showed that the weight distribution between bags held at the sides caused no significant changes in sway, though carrying groceries in a backpack worn by the subject was slightly worse than all other conditions. In conclusion, the results indicate that the way groceries are carried does not play a meaningful role in increasing medial-lateral sway while standing, with work underway to test a larger number of subjects.

SESSION 21: Energy Management	1:20 - 2:40 PM	Room 163B

Chair: Kevin Hallinan, University of Dayton

1:20 PM - DESS10-0010

Estimating Industrial Building Energy Savings using Inverse Simulation

Franc Sever
University of Dayton

Dr. Kelly Kissock
University of Dayton

Dan Brown and Steve Mulqueen
Cascade Energy Engineering

Estimating energy savings from retrofitting existing building systems is traditionally a time intensive process. This presentation describes a less time-intensive method of estimating energy savings in industrial buildings using actual monthly energy consumption and weather data. The method begins by developing a multivariate three-parameter change-point regression model of facility energy use. Next, the change in model parameters is estimated to reflect the proposed energy saving measure. Energy savings are then estimated as the difference between the base and proposed models driven with typical weather data. The development of statistical inverse energy signature models and how to modify the models to estimate savings are discussed. Expected savings from inverse simulation are compared to savings predicted by detailed hourly simulation, and sources of error are discussed. The method is demonstrated in a case study example from the industrial sector.

1:40 PM - DESS10-0068

Campus Energy Inventory

Bob Chasnov
Cedarville University

Mark Gathany
Cedarville University

Data was gathered from across campus in order to develop an energy inventory. Inventory inputs included stationary consumption, electricity purchased, campus vehicle usage, commuter vehicle usage, and transportation and distribution (T&D) expenses. Whereas the student population has increased by only 8% since 2000, the dollar amount budgeted for energy expenses on campus has risen by 50% over the same time period. Emissions from the various energy inputs were analyzed. Since Congress is currently debating “Cap and Trade” legislation, it behooves the university to take a serious look at its energy conservation practices. Recommendations to the university administration include the following: (1) line-item the energy cost to students as a part of their bills, (2) increase the rate of replacing older equipment with high-efficiency units, and (3) sponsor a project which integrates environmental, business, engineering, and technical writing majors to produce a “Green Guide” for the campus.

2:00 PM - DESS10-0034

Tracking Energy Use in University of Dayton Student Housing

Nathan Lammers
University of Dayton

Franc Sever, Brian Abels, and Patrick Bruketa
University of Dayton

The University of Dayton (UD) leases over 500 houses and apartments to students during the school year. Currently UD pays all of the utility bills. This presentation will describe how to accurately predict the energy use for each house and provide a way for UD to track energy performance. This method could be then used to incentivize or bill students for how much energy they use.

2:20 PM - DESS10-0004

GSHX by RCL

Joel Baetens
University of Dayton

University of Dayton Joel Baetens 8-16-2010 SYNOPSIS Building can utilize an open-loop ground source heat pump system with 3.5<COP<4.77. INTRODUCTION Renewable and Clean energy presents an open-loop Ground Source Heat Exchange system. Storing energy in the earth/water is effective as a heat pump application increasing the performance of the HVAC system past the designed range of 80% - 96%. HYPOTHESIS “There fails to exist significant evidence that the proposed heat pump system will increase the system efficiency of the building”. OBJECTIVE The goal is to reject the null hypothesis in favor of an alternative.

SESSION 22: Structures/Damage Prediction	3:20 - 5:20 PM	Room 156A

Chair: Vipul Ranatunga, Miami University

3:20 PM - DESS10-0006

Application of the Campbell Diagram Concept to Identification of Fatigue Cracks in Bladed Disk Assemblies

Josh Gaerke
Wright State University

Dr. Joseph C. Slater
Wright State University

Dr. Oleg Shiryayev
Petroleum Institute, Abu Dhabi, United Arab Emirates

The proposed effort of this research is to further develop an improved Structural Health Monitoring (SHM) system for detection of fatigue cracks in blades and bladed disks using harmonic responses caused by crack nonlinearities. Driving weakly nonlinear systems, such as a cracked object, results in excitations away from resonance to cause resonant responses under specific conditions. Analytical and experimental work will be performed investigating the response of both a beam and eventually a pseudo-blisk to appropriate excitations and using the resulting sensor measurements to identify the crack location. Frequency response functions of sine-sweeps will be generated and displayed as a Campbell diagram for a range of sensor locations. The combined processed data will allow identification of scale and location of the fatigue damage.

3:40 PM - DESS10-0011

Probability of Fracture Nomographs using Cohesive Zone Modeling

Venkateswaran Shanmugam
Wright State University

Dr. Ravi Penmetsa
Wright State University

Dr. Eric Tuegel
AFRL/RBSM

In the recent years Cohesive Zone Models (CZM) have gained increasing popularity for modeling the fracture process and also in other applications like composite de-lamination, solder failures in circuits, etc. The CZM parameters that represent the material behavior in the vicinity of the crack are non-deterministic in nature resulting in random fracture strength estimates. Since fracture toughness data is available, this research is aimed at determining the probability density functions for the CZM parameters that would give the same scatter in fracture strength as that obtained from the test statistics. This paper also presents evidence that material scatter can be isolated from the geometric effects to determine a normalized PDF of fracture strength. This normalized PDF can then be scaled, using mean fracture strength, to any crack configuration to develop a nomograph that can be used to rapidly assess risk without the need for a probabilistic fracture analysis.

4:00 PM - DESS10-0018

Cohesive Zone Model Based Multiscale Structural Damage Evolution

Michael Thomas
Wright State University

The objective of the research is to provide a framework for macro scale material property degradation by homogenizing the damage characteristics from a two-dimensional statistically equivalent microstructure. The loads on the microstructure are determined from the stress and strain states of the macro model at the integration points. A random two-dimensional micro model realization, containing particles and grains is used in this research. Cohesive elements are automatically inserted in the micro model using an adaptive mesh technique. The CZM properties are then degraded based on the applied fatigue load. At a critical degradation value the damage metrics of the micro model are obtained. The material properties of the macro model are then updated accordingly. This process is used to integrate the macro and micro models to simulate damage initiation and evolution.

4:20 PM - DESS10-0059

Determining Most Likely Flight Profiles from Aircraft Usage Data for Damage Prognosis

Jia Guo
Wright State University

Benjamin P. Smarslok and Eric J. Tuegel
Wright-Patterson Air Force Base

Ravi Penmetsa
Wright State University

Future military aircrafts experience multiple types of fatigue damage caused by various factors, including thermal effects and structural loads. Damage prognosis for such aircrafts will require more comprehensive usage information than traditional structural loading spectra can provide. The desired predicted usage data should be sufficient to reconstruct flight environments and will consist of multidimensional time-varying correlated flight parameters. Existing techniques for loading spectra fail to model such data due to the complex correlations between flight parameters and the associated uncertainty. In this work, three probabilistic approaches are proposed to identify the most likely flight profiles from past aircraft usage data. The identification procedures in these approaches are developed by addressing three different aspects of usage data, which are variations in main trends, variability in pilot control, and cumulative damage. The performances of these approaches are compared and demonstrated by their applications to the data collected from a set of Touch-and-Go's.

4:40 PM - DESS10-0055

Accounting for Induced Defects Using DARWIN

Ashley Whitney-Rawls
Damage Tolerance and Probabilistic Lifing of Materials Center

Dr. Tarun Goswami
Wright State University

Dr. Paul Copp
Wright State University

Jace Carter
Wright State University

Design Assessment of Reliability With INspection (DARWIN) is a probabilistic fracture mechanics program that quantifies the risk as the probability of fracture of a component subject to inherent defects and cyclic loading. DARWIN is a Federal Aviation Administration approved design certification tool and can be used to quantify the risk of component life extension. A DARWIN overview will be presented covering probabilistic sampling, linear elastic fracture mechanics, effect of component inspection, anomaly distributions, and probability of fracture calculation. Evidence will be presented to show that DARWIN only accounts for initial defects and that induced defects need to be accounted for the consideration component life extension. A methodology will be presented to account for induced defects using DARWIN analysis and conditioned anomaly distributions.

5:00 PM - DESS10-0047

Adaptive multiscale and nonlinear methods for structural health monitoring

Jianbo Gao
Wright State University

Wen-wen Tung
Purdue University

Qian Han
Wright State University

We propose an adaptive multiscale detrending, denoising, and decomposition algorithm for analyzing complex data. The technique can readily reconstruct quasi-stationary signals from highly transient, fast-decaying signals, thus enabling application of many chaos theory and information theory based methods even in such highly nonstationary scenarios. While the methodology is applicable in a broad range of problems including aircraft safety monitoring, we illustrate its usefulness by examining an example of building response to earthquakes.

Chair: Roger Kimmel, AFRL

3:20 PM - DESS10-0005

HIFiRE-1 Overview and Preliminary Results

Roger Kimmel
AFRL/RBAH

David Adamczak
AFRL/RBAH

The Hypersonic International Flight Research Experimentation (HIFiRE) Project is a collaboration between the United States Air Force Research Laboratory and the Australian Defence Science and Technology Organisation. Its purpose is to develop technologies critical to next-generation hypersonic aerospace systems. The HIFiRE-1 flight was launched from Woomera, Australia on 22 March 2010. It gathered data on two fluid dynamics experiments, boundary layer transition (BLT) and shock boundary layer interaction (SBLI). Both phenomena are critical to the design of thermal protection systems, and neither can be tested satisfactorily in wind tunnels. The payload telemetered surface temperature and pressure data at up to 60 kHz. Preliminary BLT results showed transition from turbulent-to-laminar flow during ascent, and laminar-to-turbulent transition during reentry. The SBLI experiment showed movement of the separation-induced shock upstream of a flare. HIFiRE-1 represents a major demonstration of our ability to do research-level flight tests using relatively low-cost sounding rockets.

3:40 PM - DESS10-0054

Flow and Acoustic modifications for Military Aircraft Noise Reduction

David Munday
University of Cincinnati

Nick Heeb and Ephraim Gutmark
University of Cincinnati

Junhui Liu and K. Kailasanath
Naval Research Laboratory

This paper presents observations and simulations of several technologies modifying the flow field and acoustic emissions from supersonic jets from nozzles typical of those used on military aircraft. The flowfield is measured experimentally by shadowgraph and particle image velocimetry (PIV). The acoustics are characterized by near and far-field microphone measurements. The flow and near-field pressures are simulated by monotonically integrated large-eddy simulation (MILES). Use of unstructured grids allows accurate modeling of the nozzle geometry. Nozzle geometries used in this research are representative of practical engine nozzles. The emphasis of the work is on "off-design" or non-ideally expanded flow conditions. Technologies applied to these nozzles include chevrons, fluidic injection and fluidically enhanced chevrons. The fluidic injection geometry and fluidic enhancement geometry employ jets pitched 60° into the flow, impinging on the shear layer just past the tips of the chevrons, or in the same axial position when injection is without chevrons.

4:00 PM - DESS10-0045

Numerical Study of a MHD-Heat Shield

Nicholas Bisek
Ohio Aerospace Institute

Jonathan Poggie
Air Force Research Laboratory

Iain Boyd
University of Michigan

Newly developed computational tools are used to compute hypersonic flow around a hemisphere-cylinder which utilizes a magnet located within the body. The magnetic force generated opposes the incoming flow thereby increasing the shock standoff distance and providing heat mitigation to the stagnation region. Several surface temperature scenarios are explored, though none result in significant change to the shock standoff distance. The Hall effect and ion slip phenomena are added to the plasma model through the electrical conductivity tensor and are validated by simulating channel flow between infinitely repeating electrodes with an applied magnetic field. The Hall effect stretches the current in the streamwise direction while ion slip reduces the stretching for the channel flow scenario. In the hemisphere-cylinder scenario, the strong Hall effect significantly lessens the effectiveness of the magnet at increasing the shock standoff distance while Joule heating reduces the effectiveness of heat mitigation observed in the stagnation region.

4:20 PM - DESS10-0044

High-Order Numerical Methods for Electrical Discharge Modeling

Jonathan Poggie

Air Force Research Laboratory

A new computer code has been developed to model the behavior of weakly-ionized gases through a three-species fluid model coupled to either the Poisson equation or the full set of Maxwell's equations. The three-dimensional numerical implementation involves compact spatial differences of up to sixth order accuracy, driven by a fourth-order Runge-Kutta time marching scheme. Sample calculations are presented here for three test cases: a DC discharge in one dimension, a three-dimensional rectangular waveguide problem, and a one-dimensional wave propagation problem in a warm, collisional plasma. In all cases, good agreement was obtained between the numerical solutions and either analytical solutions or previously-published numerical solutions.

4:40 PM - DESS10-0127

Computational Investigation of Laminar Flow of Shear Thinning Non-Newtonian Fluids Through a Circular-to-Rectangular Transition (CRT) Duct

Sowmya Krishnamurthy

University of Cincinnati, Computational Fluid Dynamics Research Laboratory

Dr. Urmila Ghia

University of Cincinnati, Computational Fluid Dynamics Research Laboratory

Flow of Newtonian fluids, like air, through CRT ducts has been investigated for over 60 years, due to their occurrence in aircraft engine exhaust. Non-Newtonian flows through CRT ducts are commonly seen in industries, and improper design of these ducts can result in flow and phase separation in multiphase non-Newtonian flows, clogging of highly viscous fluids, and particle deposition in multi-species non-Newtonian fluid flow. 3-Dimensional, steady, incompressible Navier-Stokes equations is solved using the commercially available CFD code Fluent, to simulate laminar flow of three fluids, two non-Newtonian (PAA0.125%, PAA0.175%) and one Newtonian (water), of varying inlet Reynolds number through three CRT ducts of increasing outlet rectangle aspect ratio. Preliminary results indicate that, in a given duct, pressure drop for a Newtonian fluid is approximately five times higher than that for a non-Newtonian fluid; effect of outlet rectangle aspect ratio and inertia on wall pressure, fluid viscosity will also be presented.

5:00 PM - DESS10-0137

Progress in Modeling Supersonic Boundary Layer Bleed with Computational Fluid Dynamics

Albert Morell
University of Cincinnati

Awatef Hamed
University of Cincinnati

Boundary layer bleed is an important means used to help control the undesirable shockwave- boundary layer interaction in supersonic aircraft inlets. During computational fluid dynamics studies, it is desirable to model the effects of bleed without having to include individual holes in the computational grid. Therefore, it is important to be able predict the mass flux through the hole. Presently, a computational study was performed using the WIND-US CFD code. Single rows of bleed holes with inclinations of 90, 40, and 20 degrees were modeled with a freestream Mach number of 1.27 and approaching boundary layer thicknesses on the order of the bleed hole diameter. It has been found that the physics governing bleed hole flow can be approximated with elementary principles, such as Prandtl-Meyer expansion, shock waves, etc. Results will be discussed, along with implications for the development of an overall bleed model.

Chair: Feng Liu, Wright State University

3:20 PM - DESS10-0015

Functionalization of Nanomaterials for Biosensor Applications

Elizabeth Maurer
Wright State University

Dr. Sharmila Mukhopadhyay
Wright State University

Dr. Saber Hussain
711 HPW AFRL/RHP

The goal of the present study was to develop a novel sensor to detect bacteria based on carbon nanotubes functionalized with gold nanoparticles with a ribonucleic acid (RNA) sequence attached as a capture element. Carbon nanotubes and gold nanoparticles have been utilized due to their unique electrical properties as well as small size to enhance the overall sensitivity. Their dispersion on the carbon nanotubes, shape, and composition has been characterized. Preliminary data shows RNA that is specific to a surface protein of the DH5á E. Coli bacterial strain, has successfully attached to gold nanoparticles through a thiol (SH) interaction. Further, the DH5á strain was exposed to RNA modified gold nanoparticles in solution and attachment was observed. From this preliminary data, it has been shown that the use of this unique sensor is possible in bacterial detection and identification utilizing novel nanostructures for the application of a handheld device.

3:40 PM - DESS10-0110

Experimental studies of hydrogen generation from the aluminum-water reaction using aluminum nanoparticles

Faizan Ahmad
University of Dayton Research Institute

Moshan Kahandawala and Sukh Sidhu
University of Dayton Research Institute

One method of producing on-demand hydrogen for fuel cells is through the use of nano-aluminum particles which react with water under certain conditions to produce hydrogen. This can be used for applications as small as portable handheld devices, onboard generation for vehicles, or as large as a hydrogen refueling center. However, the utilization of aluminum for generating on-demand hydrogen is critically dependent on the control of the rate of hydrogen generation from the reaction. Results of ongoing research are presented with regards to identifying and quantifying the effects of particle size, reagent quantities, temperature and pressure on the hydrogen generation rate.

4:00 PM - DESS10-0089

High Temperature Stability of Amorphous Si-B-C-N Thin Films

Jamie Gengler
Spectral Energies, LLC

John Jones and Andrey Voevodin
Air Force Research Labs, Materials & Manufacturing Directorate, Thermal Sciences and Materials Branch

Petr Steidl and Jaroslav Vlcek
University of West Bohemia, Dept. of Physics

Thermal conductivity trends of several ceramic thin films were characterized with a time-domain thermoreflectance (TDTR) technique. Samples containing different silicon, boron, carbon, and nitrogen (Si-B-C-N) chemical composition were created by reactive magnetron sputtering and then subjected to annealing at temperatures up to 1400 0C. The thermal conductivity of the samples prepared via a 50% Ar /50% N2 gas mixture remained constant near 1.4 W m-1 K-1, while samples prepared via a 75% Ar /25% N2 gas mixture exhibited an increase in thermal conductivity of 2.2 W m-1 K-1 (or higher). X-ray diffraction data demonstrated that the former samples were unstructured, while the latter samples formed silicon nitride (Si3N4) crystals. The experiments reveal which chemical composition remains stable in the amorphous state at high temperatures, thereby retaining lower thermal transport properties. These material aspects are ideal for thermal barrier applications such as non-oxide ceramic coatings for cutting tools.

4:20 PM - DESS10-0132

Anisotropic electrical resistivity properties of nanostructured metallic thin films grown using oblique angle deposition technique

Piyush Shah
University of Dayton Research Institute

Andrew Sarangan, Said Elhamri, and Mo Ahoujja
University of Dayton

Elena Guliants
University of Dayton Research Institute

High surface area, porous, Ti, nanorod thin films can be deposited using conventional physical vapor deposition technique of E-beam evaporation. The technique relies on the physical vapor deposition onto a static substrate oriented in a position where flux from the source material (Ti) arrives at oblique angle. The adatoms provides geometrical shadowing which results in growth of nanorod columns in the direction of vapor source. Deposition conditions such as angle of the incoming vapor flux, substrate temperature, surface diffusion etc. has strong influence on the shape and arrangement of the columnar thin films. In this work, we demonstrate the growth and electrical resistivity characterization of these nanostructured thin films. Preliminary results on these films exhibit electrical resistivity anisotropy, when characterized by measuring their electrical resistivity using conventional van der pauw method. Origin and possible causes of this resistivity anisotropy is discussed.

4:40 PM - DESS10-0124

Characterization of Bulk Mechanical Complex Modulus of a Thermal Barrier Coating at Various Temperatures Using a Free-Free Beam Apparatus

Oliver Easterday
Air Force Institute of Technology

Dr. Anthony Palazotto, Lt. Col. Richard Branam, and Dr. William Baker
Air Force Institute of Technology

Dr. Tommy George
Air Force Research Laboratory, Turbine Engine Fatigue Facility

Thermal barrier coatings are used in turbo-machinery hot-sections to prolong service life using favorable thermal properties. Early on in service it was noted they had beneficial damping qualities that suppressed high cycle fatigue, the leading driver of engine component design life. It is of interest to characterize these materials for their loss factor and storage modulus in a bulk material fashion which would allow employment of them in numerical and/or analytical models of engine components. The materials are non-linear in nature and are used in a thin air plasma spray coated layer. Since modern high bypass ratio engine cold sections at 40:1 compression can get upwards of 800-900 degF the free-free technique developed by previous authors has been refined and employed in recent testing of 8%-Yttrium stabilized zirconium (8YSZ), the most common TBC in use. Recent findings that support and extend the work of the previous authors will be presented.

5:00 PM - DESS10-0121

Sensor and Membrane Materials Based on Molecularly Imprinted Polymers

Raj Makote
University of Dayton Research Institute

Moleculary imprinted polymers (MIP) are polymers having known shape and size of pores in it. The template based porosity generation in polymer matrix have been increasingly used for separation processes, lab-on-chip, immunoassays, artificial enzymes, biosensor materials. In this research we present MIP composite material coatings for sensor applications. Thin films were derived from alkoxysilanes and methacrylates as functional monomers to form polymer matrix around and template molecules of interest. The selectivity of synthesized MIP sensor coating material towards analyte of interest (nicotine, glucose, pesticides etc) was improved. The problems, challenges and factors affecting MIPs are discussed to enhance interest in this promising field.

SESSION 25: Computer Science II	3:20 - 4:40 PM	Room 157A

Chair: Tzung-Tza Shen, Wright State University

3:20 PM - DESS10-0083

Hierarchical Genetic Algorithms

Jennifer Seitzer
University of Dayton

A Hierarchical Genetic Algorithm (HGA) converges on a solution at both the atomic and structural level. These algorithms are effective in domains where both fundamental building blocks and optimal configuration among the building blocks is sought. Classical genetic algorithms (GAs) represent a problem as a binary string or chromosome that is iteratively improved by the "create, measure, and select" cycle. This cycle continues until a near-optimal solution has been generated. HGA's use this algorithm in both the small and the large. By strategically ordering and retaining unselected chromosomes of the building block, HGA's form overall systems that structurally depict the evolutionary process of the building block. Moreover, for certain domains, we employ composite chromosomes (i.e., systemic chromosomes comprised of atomic-level chromosomes) which are simultaneously evolving systemic structure as they participate in an outer iterative cycle of "create, measure, and select". In this talk, we present HGA applications, systems, and algorithms.

3:40 PM - DESS10-0066

Texture Photogrammetry Surface Reconstruction of Membrane Wings Using Tracking Cameras

Chris Allen
Air Force Institute of Technology

Alan Jennings and Dr. Jonthan Black
Air Force Institute of Technology

To validate research into the aerodynamics of ornithopters, a tracking camera system was developed to provide high quality images for photogrammetry. Flapping wing aerodynamics are complicated to analyze due to unsteady flow and aeroelasticity. Flapping wings are lightweight and have large amplitude motions preventing mounting sensors or using fixed, noncontact sensors. For this reason, a tracking noncontact sensor was developed using high speed, digital cameras. A motion capture system is used to locate the ornithopter in realtime so that the cameras automatically pan, tilt and zoom as needed. Texture based photogrammetry is used to generate a dense surface profile of the wing in ight. Results of this system on a stationary commercial dragon fly are shown to show the system resolution. Next, a surface is tracked as it moves and surfaces are reconstructed as the camera parameters change. Results show that high resolution reconstructions are possible when tracking deformable structures.

4:00 PM - DESS10-0050

Multiscale Analysis of Biological Signals

Jianbo Gao
Wright State University

Wen-wen Tung
Purdue University

Qian Han
Wright State University

Rapid accumulation of complex data in all areas of life sciences has made it increasingly important to develop complexity measures that incorporate the concept of scale explicitly, so that different behaviors of signals on varying scales can be simultaneously characterized. The scale-dependent Lyapunov exponent (SDLE), which is a highly non-trivial generalization of the classic Lyapunov exponent and can readily classify all known models of complex signals including chaos, stochastic oscillations, random 1/f processes, random Levy processes, and complex dynamics with multiple scaling behavior, is capable of achieving this goal. Its power is illustrated by analyzing heart-rate variability (HRV) as well as electroencephalogram (EEG) data.

4:20 PM - DESS10-0140

Scalable Techniques for Semantic Web Reasoning

Raghava Mutharaju
Wright State University, Kno.e.sis center

Frederick Maier and Pascal Hitzler
Wright State University, Kno.e.sis center

Reasoning is the process of inferring new knowledge from existing knowledge. Description Logics are used for formal knowledge representation and reasoning. Reasoning algorithms have a very high runtime complexity, typically exponential relative to the size of input. When run on huge amounts of data, such as the Linked Open Data cloud, these algorithms could run for days or weeks without producing any results. As such, there is a definite need to minimize execution time. One way to achieve this is to parallelize the algorithms. We have investigated several approaches to parallelization for description logics (especially EL+). These can be broadly divided into two categories based on their underlying memory models, distributed memory and shared memory. MapReduce and distributed queue approaches are examples of the first. Multi threaded graph approach is an example of the second. Each type of approach has its pros and cons, which we discuss in the presentation.

Chair: Larry Byrd, AFRL

3:20 PM - DESS10-0126

Numerical Study of Heat Transfer Performance of Two – Layered Microchannel Heat Sinks using Nanofluids as Coolants for Microelectronics Cooling

Sri Priyanka Tunuguntla
University of Cincinnati, Computational Fluid Dynamics Research Laboratory

Dr. Urmila Ghia
University of Cincinnati, Computational Fluid Dynamics Research Laboratory

Liquid cooling technology is necessary to meet the ever-increasing thermal challenges in the field of microelectronics cooling. In liquid cooling systems, microchannel heat sinks provide high performance and compact cooling but have a high pressure drop penalty. To address this issue, multi-layered microchannels have been proposed in literature. Further, increase in cooling performance of multi-layered microchannels can be achieved using coolants such as nanofluids, having high heat transfer coefficients. In this study, thermal performance of two-layered microchannel heat sink with water and nanofluids(water-Al2O3 and water-CuO) is analyzed numerically. Flow rates ranging from 50 – 320ml/min are considered to study the effect of varying flow rate on the thermal performance. Also,different volume fractions of nanoparticles are considered to investigate their effect on the heat transfer enhancement. The results demonstrate that two-layered microchannel heat sink with nanofluids form an efficient cooling system that have low thermal resistance and low pressure drop.

3:40 PM - DESS10-0077

Transient Thermal and Structural Analysis of a SiC Power Module Using Ansys Workbench

Katie Sondergelt
University of Dayton Research Institute

Jacob W. Lawson and Bang-Hung Tsao
University of Dayton Research Institute

James D. Scofield
Air Force Research Laboratory

A 3D transient model of a high temperature SiC power module was analyzed using Ansys Workbench to determine the maximum temperature and the maximum deformation over a period of 600s. The maximum temperature was calcuated using Ansys Fluid Flow (CFX) analysis, while the maximum deformation was determined using the Transient Structural (ANSYS) analysis. Three different tests were completed varying the input powers at 5, 25, and 60 W/cm2, which lead to maximum temperatures of 323K, 420K, and 590K, respectively. Corresponding mechanical models showed deformations of 4.41e-6 m, 1.57e-5 m, and 3.65e-5 m. The thermal results obtained from using Ansys Fluid Flow (CFX) were compaired to results obtained experimentally.

4:00 PM - DESS10-0065

Thermal and Hydraulic Performance of an Ice Slurry Thermal Energy Storage System

Joshua Hartman
University of Dayton Research Institute

Lanchao Lin, Roger Carr, and Richard Harris
University of Dayton Research Institute

Levi Elston
Air Force Research Laboratory, Propulsion Directorate

A laboratory scale ice slurry thermal energy storage (TES) system for high power device cooling is demonstrated. The TES rate is greater than 60 kW in a 30 s discharge period. The primary water flow as the heat source with a designed flow rate of 1.44 kg/s and a temperature of 20 to 30C is cooled down to a desired temperature by the TES system. A coaxial coil heat exchanger (HX) is used for the ice slurry TES heat transfer. The thermal and hydraulic performances of the water-ice slurry HX with counter flow and parallel flow layouts are evaluated by experiment and calculation for steady state. The model predicted heat rates are lower than the experimental values by 10% to 22%. The predicted dimensionless pressure drops are within +-12% of the experimental data for the ice slurry flow and within +-6% for the water flow.

4:20 PM - DESS10-0093

Non-Equilibrium Thermodynamics of Coupled Unsteady Power and Thermal Management Systems

Justin DelMar
Univeristy of Dayton

Dr. John Doty
University of Dayton

A simple dynamic, non-equilibrium electrical system is studied from a thermodynamic perspective. The relationship between power, energy (both component and system-level), exergy destruction, and thermal system load is characterized. Design of Experiments (DoE) is employed to establish design points for Resistance (R), Inductance (L), and Capacitance (C) values for a series RLC circuit. Standard electrical dynamic responses are combined with the 1st and 2nd Laws of Thermodynamics for a unique interpretation of the responses. A multi-variate objective function is developed to optimize combined system-level electrical and thermodynamic inputs and outputs subject to system constraints. Results indicate that robust system performance is obtained that improves electrical system response while simultaneously minimizing thermal load. Compared to the critically-damped case (typically interpreted as system optimal) the slightly under-damped case (1.9% overshoot) is more robust, has 29% faster metastable response, and reduces thermal load by nearly 43%..

4:40 PM - DESS10-0100

Enhancement of droplet heat transfer by time-periodic electric field

Mohamed Abdelaal
University of Cincinnati

Dr. Milind Jog
University of Cincinnati

A numerical study of transient heat transfer to a spherical drop of a dielectric fluid suspended in another dielectric fluid in the presence of steady and time periodic electric fields (both uniform and non-uniform) is carried out. The bulk of the thermal resistance is considered to be in the droplet. The energy conservation equation is solved to obtain the transient temperature distribution and the overall Nusselt number for different drop Peclet numbers and dimensionless frequencies using a fully implicit finite volume method. Results show that for low to moderate Peclet numbers the steady electric field is more effective in enhancing heat transfer compared to non-uniform time periodic field which in turn is more effective than the uniform time periodic field. However, at high Peclet numbers, the non-uniform time periodic field provides significantly higher rate of heat transfer relative to that with stationary uniform electric field.

5:00 PM - DESS10-0017

Generic Aircraft Thermal Tip-to-Tail Modeling and Simulation

Scott Eastbourn
Wright State University

Dr. Rory Roberts
Wright State University

A system-level thermal management aircraft model has been developed in a multidisciplinary modeling and simulation environment. Individual subsystem models, developed in MATLAB/Simulink, representing the vehicle dynamics, propulsion systems, and thermal systems are combined to investigate the thermal management issues in a typical long range strike platform. A thermal "tip-to-tail" model will allow conceptual thermal trades of various subsystems, resulting in an aircraft that is thermally optimized at a system-level, rather than a subsystem-level. Special attention is paid to the development of transient models, including the integrated power package, heat exchangers, and engine/thermal system interactions. In addition, thermal and power challenges faced by modern aircraft can be addressed, increasing the performance capabilities of future tactical aircraft. Results obtained through these modeling and simulation efforts will lead into design trade studies, quantifying performance gains across the aircraft.

Chair: Ravi Penmetsa, Wright State University

3:20 PM - DESS10-0013

Analyzing Range of Motion in Total Hip Arthoplasty

Dishita Patel
Wright State University

Tarun Goswami, D.Sc.
Wright State University

Background: Component placement and prosthetic design parameters affects the range of motion of prosthetic hip. Aim: The aim of this study is to evaluate the effectiveness of design parameters of the given prosthetic models by testing a combination of stem and cup positions with respect to neck shaft angles to achieve desired range of motion after Total Hip Arthoplasty (THA). Methods: Solid computational softwares such as Solidworks, ANSYS are used to simulate models and perform stress analysis. Mathematical models developed by Yoshimine, Ginbayashi, Widmer et,al are used to define the optimal range of motion for Activities of Daily Living. Results: Range of Motion obtained for the given prosthetic implants are predicted and compared with optimal range of motion obtained by other authors. Discussion: Optimal range of motion would vary based on patient needs and history. Each design parameter and component position are subject specific.

3:40 PM - DESS10-0139

Mechanical Comparison of Cadaver Femurs Implanted with Various Intramedullary Nails

Alyssa George Whitney
Wright State University Department of Biomedical, Industrial, and Human Factors Engineering

Chris Gayton, MD and Michael Prayson, MD
Wright State University Department of Orthopedic Surgery, Sports Medicine, and Rehabilitation

Greg Gould and Tarun Goswami, DSc
Wright State University Department of Biomedical, Industrial, and Human Factors Engineering

Intramedullary nails are commonly used for the fixation of femurs that have broken proximally. Even after healing of the initial fracture, failure of the femur bone can occur with intramedullary nail fixation. These failures often happen during a twisting motion of the body while standing or due to falls onto the side of the body. It is important to understand how these failures occur and which devices are more susceptible to such failures in order to prevent them in the future. In order to fulfill this, a cadaveric study is being conducted to simulate both standing (torsion with a constant axial load) and falling (four-point bending) failures so that various intramedullary nail sizes and materials can be compared. For this study, 28 pairs of frozen cadaver femurs are implemented with one of four intramedullary nails including short and long nails made of stainless steel and titanium.

4:00 PM - DESS10-0136

Constitutive Modeling of Bovine Brain Tissue at High Strain Rates

Bhargava Sista
University of Cincinnati

Dr. Kumar Vemaganti
University of Cincinnati

Understanding the mechanics of soft tissue injury is critical to mitigating traumatic brain injury (TBI) that may occur due to vehicular accidents, blasts and sports injuries. In particular, for the case of brain tissue, modeling the response at high strain rates is needed to simulate TBI. In the current study, a visco-hyperelastic model is developed for brain tissue response at high strain rates using the continuum mechanics framework. The model uses an integral formulation to capture the large deformation and nonlinear viscoelastic rate-dependence, and is motivated by the experimental data available in the literature. The novel material model is able to accurately predict the mechanical behavior at very high strain rates (upto 3000%/s), unlike other material models available in the literature which are restricted to very slow strain rates. Such a model can be used for applications such as injury mechanics, where impact loads are predominant.

4:20 PM - DESS10-0138

Characterization and Improvement of a Cone-Beam CT Scanner for Quantitative Imaging

Jimish Joshi
Wright State University

Thomas Hangartner, PhD
Wright State University

Computed tomography (CT) has various applications in different fields. To allow appropriate assessment of the images, we characterized the scanner and also corrected for the beam-hardening effect. To do this, the linearity of the detector was tested and a precise collimator was designed to limit the size of the cone beam and reduce scatter. Beam-hardening correction was applied to the projection images which were then reconstructed. The modulation transfer function (MTF) of the scanner was also measured. Over 5000 pixels were found to be irregular in the detector but these were being corrected by the vendor’s software. The collimator successfully limited the beam size and reduced scatter. The beam hardening correction removed the cupping artifact associated with the beam-hardening effect. The MTF cut-off value were higher closer to the source, this was expected because of the beam profile.

4:40 PM - DESS10-0142

Hyperspectral Imaging (HSI) to Track Functionalized Gold Nanorods to Target and Identify Specific Biomolecules in a Cellular Environment

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711 HPW/PHPB

Hyperspectral Imaging (HSI) is a unique technique that combines microscopy and spectroscopy for real-time detection and identification of nanoparticles by measuring the light scattering spectra. Research in gold nanorods (GNRs) has shown that the longitudinal scattering wavelength can be tuned to the near infrared region by changing the aspect ratio (AR), which is ideal for identification in a cellular environment. To optimize the optical properties, the AR was manipulated during the synthesis process by changing the temperature and concentration of benzalkonium chloride (BDAC). Adjusting the concentration of BDAC and keeping the reaction isothermal produced the best results for controlling the AR. Collected HSI data showed distinct spectral peaks outside the intrinsic biological light scattering spectrum for ARs of 2.5 and 5 that could be uniquely identified for use in an intracellular targeting system. Future research will be performed in functionalizing the GNRs with targeting moieties and tracking them in vitro using HSI.

SESSION 28: Environmental	3:20 - 4:20 PM	Room 163B

Chair: Kevin Hallinan, University of Dayton

3:20 PM - DESS10-0107

Toxic Organic Pollutants from Combustion of Printed Circuit Board Laminates

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Printed circuit boards (PCBs) are found in consumer and industrial electronic products such as computers and cell phones.PCBs contain flame-retardants for fire prevention safety measures. The Purpose of this study was to use a cone calorimeter to measure emissions from fully ventilated combustion of printed circuit board laminates. The Cone calorimeter at the University of Dayton Research Institute (UDRI) was modified to sample the total gas from the combustion of the PCBs. All combustion effluents are sampled across the filters and PUF cartridges. All the samples collected were extracted and analyzed at the EPA Research Triangle Park laboratory. Collection and determination of emissions of poly chlorinated dibenzo-p-dioxins and furans (PCDD/Fs), polyaromatic hydrocarbons (PAHs),hexachlorobenzene (HCB),polychlorinated biphenyls (PCBs) and other pollutants of concern from burning of electronic waste were conducted according to USEPA method T09A.

3:40 PM - DESS10-0097

Identification and Quantitation of Hazardous Air Pollutants (HAPs) from Aircraft Engines

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Edwin Corporan
Air Force Research Laboratory, Fuels and Energy Branch (AFRL/RZPF)

Aircraft engines are a significant emission source for the release of major and minor gaseous and particulate species. The potential environmental and health effects related to these, specifically including trace gaseous emissions such as Hazardous Air Pollutants (HAPs) (e.g., formaldehyde), can be significant. Effective sampling and quantitation of these low-level species from a high-pressure aircraft engine is challenging. The present effort focuses on addressing these difficulties, by identifying potential methodologies for sampling and quantifying HAPs, and performing initial implementation and evaluation of viable options. This presentation will discuss the experimental techniques and analysis employed and preliminary results obtained.

4:00 PM - DESS10-0108

Use of algae for bioremediation of waste waster

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Nilesh Chavada, Moshan Kahandawala, Sukh Sidhu, and Jerome Servaites
University of Dayton Research Institute

Bioremediation of waste water using six different cultures of algae i.e. Chlorella, Botryococcus, Chlamydomonas , Neochloris oleoabundans, Phaeodactylum, Muriellopsis sphaerica is described. Nitrate and phosphate uptake from waste water is reported for six different strains over a period of two weeks. A decrease of 80%-90% in nitrate content and a decrease of (75%-85%) in phosphate content in waste water were observed. During this study, the algae growth was monitored by measuring the absorbance using a spectrophotometer. For most strains, a 200-300% increase in absorbance was observed at the end of two weeks. Effect of carbon dioxide on growth of algae and nitrate and phosphate uptake from waste water was also investigated. Supplementation of carbon dioxide increased the biomass yields but has no effect on nitrate and phosphate uptake from waste water. The data from this study indicate that nutrient rich waste water can be cleaned by cultivating algae in it.