CEAT Fiscal Year 2018 Active Awards

Architecture

Transitioning Students to Teacher-Researchers (TSTR)

The project's premise is that by learning the nature of science through authentic research experiences, preservice science teachers (PSTs) will strengthen their science literacy skills and be better equipped to engage their future students in science and engineering practices. This project will provide PSTs with multiple opportunities to conduct scientific research during their science methods courses. These new or modified science methods courses will be designed to enhance PSTs' skills in conducting research and teaching others to conduct scientific research. The PSTs will receive extensive mentoring from faculty and graduate students from multiple science and engineering disciplines across the university.
Sponsor: National Science Foundation
PI/PDs: Carissa Ramming
Education: Julie Angle
College of Arts & Sciences: Andrew Doust, Donald French

Center for Local Government Technology (CLGT)

Implementing Safe Work Zone Operations Strategies

Oklahoma State University's Center for Local Government Technology will provide 210 courses including worker courses, management courses and instructor courses over the next 3 fiscal years to improve operational understanding and planning for flagged, mobile, short duration and short term operations for public, tribal, private and educational sector employees including utilities (public and private), emergency response, towing and insurance personnel.
Sponsor: United States Department of Transportation – Federal Highway Administration
PI/PD: Michael Hinkston

Local Technical Assistance Program

Since its inception in 1982, the mission of Oklahoma LTAP has been to provide training, technology transfer and technical assistance to local government agencies responsible for transportation systems. The Center is one of four original LTAP centers in the nation. Oklahoma LTAP addresses four broad focus areas: Safety, Infrastructure Management, Workforce Development, and Organizational Excellence. LTAP also provides a Transportation Intern Program that places student interns with local government agencies in paid summer internships.
Sponsor: Oklahoma Department of Transportation for Federal Highway Administration
PI/PDs: Michael Hinkston, Darla Hisey

County Computer Assistance Program

With oversight provided by the Oklahoma Tax Commission (OTC), Association of County Assessors, and Association of County Treasurers, the Center for Local Government Technology provides software programs, support of software and hardware including installation, maintenance of software and hardware, data management, training programs and technical assistance for County Assessors and County Treasurers. CLGT also provides coordination with the OTC Ad Valorem Division in fulfilling mutual responsibilities to support State CAMA and Assessment Administration (AA) software systems. Network configurations are kept as consistent as possible from county to county so that county CAMA systems and AA systems can exchange data efficiently.
Sponsor: Oklahoma Tax Commission
PI/PDs: Gary Snyder, Scott Warren

Assessor Training and Assistance Program
CLGT, in cooperation with the Tax Commission, the County Assessors' Association and the County Treasurers' Association will execute the programs by providing computer software programs, support of software and hardware including installation, maintenance, data management and training, to counties currently using the services previously provided by the State Auditor and Inspector as mandated by legislation. CLGT will provide: hardware maintenance, software, software maintenance, and software support to County Assessors utilizing the program software systems; technical support and training to County Assessors; and assistance with data extraction for OTC statutory and other agency requirements.
Sponsor: Oklahoma Tax Commission
PI/PDs: Gary Snyder, Scott Warren

Southern Plains Tribal Technical Assistance Program (TTAP) Center
Funded by the FTA and in cooperation with the Bureau of Indian Affairs, this program provided a resource center to furnish information, training, and technical assistance related to road and bridge construction, repair, and maintenance to over 49 tribal governments in a four-state area. The TTAP mission is to meet the educational needs of tribal governments related to roads, bridges, public transit, transportation systems, inter-governmental coordination, and economic development. An important part of the mission is to provide training sessions, classes, and workshops geared to specific tribal needs.
Sponsor: United States Department of Transportation - Federal Highway Administration
PI/PD: Karla Sisco

Chemical Engineering

Southwest Center for Occupational and Environmental Health
Accurate information on how metal aerosol transmits and deposits in the human respiratory system is critically needed for more accurate health risk studies. An *In-silico* study using Computational Fluid-Particle Dynamics (CFPD) method is capable of providing high-resolution deposition data based on the natural laws of physics in a noninvasive manner. The

objective is to develop a novel noninvasive tool by integrating the reliable CFPD model and a virtual human system covering the entire conducting and respiratory zones, to simulate the transport and deposition of inhaled toxicants in metal fumes with different breathing patterns and fabrication activities.
Sponsor: The University of Texas Health Sciences Center at Houston for the Centers for Disease Control and Prevention
PI/PD: Yu Feng

Evaluation of Surface Wettability as a Parameter in Preferential Separation of Multi-Component Dissolved Gas Systems and Bubble Points of Pure Liquids
This work proposes a systematic experimental investigation on the influence of wettability on pressure-driven bubble nucleation. Experiments will be conducted to determine whether a specific gas can be preferentially liberated from a liquid solution containing multiple dissolved gases. Combinations of gases, aqueous and organic liquid phases will be used to test this hypothesis at a molecular scale using test facilities integrated with gas analysis. Well-controlled experiments will also be conducted to understand the effect of reservoir wettability on required supersaturation levels for bubble nucleation. The basic knowledge derived will be useful to control gas evolution rates from supersaturated liquids.
Sponsor: American Chemical Society Petroleum Research Fund
PI/PD: Prem Bikkina

Advanced Cement Characterization and Modeling to Evaluate Novel Additives to Improve Wellbore Integrity
The main deliverable from this project is to design new cement mixtures with nano-particle sized additives that have superior properties to prevent wellbore leakage. This will be reached by evaluating cement mixtures in the laboratory and incorporating the results in the FEM well integrity design software which can be used to determine the optimum additives for a given well design. The laboratory study will investigate cement slurry properties including dynamic fluid losses and thickening time, as well as advanced characterization of the cement compressive strength and bonding strength to rock and casing, and deformation properties including shrinkage.
Sponsor: National Academy of Sciences
PI/PDs: Geir Hareland, Runar Nygaard

Joint Industry Project for the Quantification of Fluid Phase Kinetics in Hydrocarbons
The purpose of the Joint Industry Project at OSU is to quantify fluid phase kinetics in hydrocarbons. The project will result in the development of a comprehensive data set of gas dissolution/evolution rates for model and real fluids as a function of pressure, temperature, interfacial tension, API, viscosity, and time.
Sponsor: ExxonMobil
PI/PDs: Clint Aichele, Sayeed Mohammad
Mechanical and Aerospace Engineering: Joseph P. Conner

Computational Modeling of the Onset of Diabetic Kidney Disease

The primary outcome of the project will be a computational model that incorporates biological uncertainty into the biochemical reaction networks involved in diabetic kidney disease (DKD). Simulation results using the computational model will be useful for understanding the synchrony of key events that lead to glomerular injury in DKD. This improved understanding has the potential to advance treatment options for diabetes and prevent the serious complication of end-stage kidney failure.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PD: Ashlee Ford Versypt

Generating Nonnative Structures in Binary Ionic Liquid Mixtures for Tunable Phase Equilibria Properties
At present, there is a lack of fundamental knowledge regarding the rules that can be applied to determine a priori if binary ionic liquid mixtures will exhibit molecular structure different from their pure ionic liquid counterparts and how the nonideal behavior manifests itself in the phase equilibria properties of ionic liquid with gases and solvents. This research project seeks to fulfill this gap in the ionic liquid field so that practically limitless opportunities offered by a large number of binary ionic liquid mixtures to design environmentally friendly chemical processes could be taken advantage of. REU supplement funding was also received.
Sponsor: National Science Foundation
PI/PD: Jindal Shah

Multi-Scale Dosimetry Modeling of Influenza Virus-Laden Droplets through the Pulmonary Route
A multi-scale dosimetry model will be developed by combining the Computational Fluid-Particle Dynamics (CFPD) model with an airway site-specific physiologically based pharmacokinetics (PBPK) model, which integrates state-of-the-art knowledge of human lung aerosol dynamics. The new CFPD-PBPK model will extend the capabilities and enhance the accuracies of existing biokinetic models for risk assessment, and enable simulations of extremely complex dynamic phenomena of the entire human respiratory system at detailed levels never undertaken before. The model can be used to investigate mechanisms for influenza virus to transport into the alveolar region, as well as the significance of their translocation into systemic regions.
Sponsor: National Institutes of Health
PI/PD: Yu Feng

Microfluidics Based IWAG Studies
The primary objectives of this research study are to: 1) conduct microfluidics experiments to quantify the effect of rock wettability on the enhanced oil recovery (EOR) potential of immiscible-water-alternating-gas (IWAG) flooding technique and 2) confirm or modify the Stone 1 equation for residual non wetting phase saturation by analyzing the experimental data.
Sponsor: G.E. Global Research
PI/PDs: Prem Bikkina, Clint Aichele

Ex Vivo Generation of Dendritic Cells from an Advanced Vascular Tissue Construct

The researcher's long-term goal is to develop dendritic cells (DCs)-based therapeutics to treat a variety of diseases and that can be custom made to meet the needs of an individual patient. The objective of this project, as an initial step to reach that goal, is to develop a novel method that can produce functional DCs to be used for further research of DCs and eventually for therapeutic treatment of disease. The research will include use of a novel tissue-engineered construct within a bioreactor with flow conditions.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PD: Heather Fahlenkamp

Differentiation of Human Hematopoietic Stem Cells to Lung Resident Immune Cells in a Tissue-Engineering Lung Model
The goal is to determine if the human lung environment fosters the differentiation of human HSCs into myeloid cells that display unique features of lung resident dendritic cells and macrophages. Researchers will seed $CD34^+$ HSCs into a 3D Human Tissue-Engineered Lung Model (3D-HTLM) and track their development into functional myeloid cells. The researchers will also determine the impact of inflammatory stimuli on this HSC differentiation pathway. If successful, this model could be used to study factors regulating the differentiation of HSCs into myeloid cells as well as the innate immune responses of those myeloid cells to pathogens or allergens.
Sponsor: Oklahoma Center for Adult Stem Cell Research
PI/PD: Heather Fahlenkamp

Design of Inorganic Membrane Systems for Advanced Oil-Water Separation
The primary objective of this work is to engineer microporous inorganic membranes to have excellent water flux and high rejection efficiency for efficient oil-water separation. The proposed research will develop inorganic membrane-based systems targeting oil rejection coefficient > 99% and a pure water flux > 50 $Lm^{-2}h^{-1}$ by exploiting its micron-level membrane thickness and extraordinary selectivity through control of hydrophilicity. These membrane engineering concepts are important to the development of membrane-based systems for industrial applications in clean and sustainable energy technologies.
Sponsor: OSU Foundation for National Energy Solutions Institute – Smart Energy Source Association (NESI-SES)
PI/PDs: Seok-Jhin Kim, Clint Aichele

Leakage risk assessment for plugged and abandoned oil and gas wells
The primary objective is to develop a methodology for evaluating the quality of the barrier system of a permanently plugged and abandoned well by expressing barrier system quality in terms of leakage probability and potential future leakage rates. Secondary objectives are: Establish a reliability model for the barrier system in a permanently plugged and abandoned well; Develop a leakage calculator for oil and gas escaping the barrier system; Develop a model for long- and short-term pressure forecasting in the well vicinity; Establish uncertainty quantification models for all phenomenological models developed and implement sensitivity analyses to understand critical factors.
Sponsor: International Research Institute of Stavanger AS

PI/PDs: Geir Hareland, Runar Nygaard

Multi-Scale Mechanisms for Wettability Alteration: Insight in the Development of Wettability Inversion Strategies
This project addresses reservoir wettability focusing on the impact of external factors such as salinity, surfactants, and CO2 on reservoir wettability. Reservoir wettability is a critical parameter for determining production potential of a field, and accurate prediction of this behavior is critical for predicting ultimate production. Objectives include: 1) Obtain high pressure/temperature contact angle and interfacial tension data to elucidate reservoir wettability at reservoir conditions for reservoirs of interest to ADNOC, 2) Elucidate wettability mechanisms as a function of salinity, CO2 concentration, surfactants, temperature, and pressure at reservoir conditions, 3) Incorporate the data into models to predict reservoir wettability.
Sponsor: Rice University for Abu Dhabi National Oil Company
PI/PD: Clint Aichele, Prem Bikkina

FRI Viscous Distillation
The project will quantify the impact of viscosity on mass transfer efficiency. An Oldershaw column will be constructed and operated in order to obtain efficiency data of viscous systems.
Sponsor: Fractionation Research, Inc.
PI/PDs: Clint Aichele, Sayeed Mohammad, James Whiteley

FRI De-entrainment Diagnostics
Deliverables include: 1) Develop PDI technique to quantify entrainment, 2) Validate entrainment characterization technique using glass beads. Entrain glass beads in column, use PDI to measure amount of entrainment, and compare PDI results to physically captured glass beads that were entrained, 3) Characterization of sprays in OSU column in back-scatter mode, 4) Characterization of impact of de-mister thickness on performance, 5) Procedures to take PDI from OSU laboratory to FRI facility, 6) Characterization of entrainment and sprays at FRI facility, 7) Quantification of spray behavior using patternator with focus on impact of pressure drop and surface tension on spray morphology.
Sponsor: Fractionation Research, Inc.
PI/PDs: Clint Aichele, James Whiteley

UNS: Collaborative Research: Non-Membrane, Low Temperature and Low Emission Water Desalination Using Directional Solvent
The objectives in this project are to: 1) design highly efficient directional solvents (DS) for a novel water desalination technology, and 2) based on these solvents, design and demonstrate a continuous desalination system which is clean, membrane-free and can utilize very low temperature heat sources. The research will be driven by the hypothesis that the water solubility in DSs can be tuned by varying their molecular structures. Monte Carlo and molecular dynamics simulations will be performed to calculate the phase-equilibria of DSs with salt and water as a function of temperature.
Sponsor: National Science Foundation

PI/PD: Jindal Shah

Building 3D Liver Organoid from Bottoms-Up for Drug Screening
In order to improve the screening and development of pharmaceuticals, many *in vitro* culture techniques have been explored. Developments in 3D cultures show that 3D space regulates localization and concentration of a variety of signals with the entire cell surface, similar to the *in vivo* environment. Based on these principles, this work uses a novel bioprinting technique to precisely pattern hepatocytes and sinusoidal endothelial cells to create 3D hepatic organoid layer-by-layer. This work aims at using chitosan-gelatin thermosensitive hydrogel for developing 3D hepatic tissue that can be used to print stable fibers less than 75 μm in thickness.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PD: Sundararajan Madihally

SI2-SSE: Development of Cassandra, a General, Efficient and Parallel Monte Carlo Multiscale Modeling Software Platform for Materials Research
Responsibilities of the OSU research team include: 1) PI Shah will lead the effort to describe the features, capabilities and performance of Cassandra in the form of a research publication; 2) The OSU team will incorporate slow growth methods such as continuous fraction component Monte Carlo methods for phase equilibria calculations; 3) Cassandra will be modified to enable Monte Carlo simulations of thermophysical and phase equilibria calculations in mesoporous materials such as zeolites, metal organic framework, carbon nanopores and carbon nanotubes; 4) PI Shah will contribute to the summer workshops as a part of the outreach efforts.
Sponsor: University of Notre Dame for NSF
PI/PD: Jindal Shah

Gas Evolution Rates in Hydrocarbons as a Function of Flow, Temperature, and Pressure for Gas/Liquid Separator Applications
The long range goal is to develop a methodology to measure gas evolution rates in the field for gas/liquid separator design and troubleshooting applications. This project is the first step toward achieving this goal. The work objectives are to establish an experimental protocol to measure gas evolution rates in flowing conditions, create a milestone roadmap for developing a gas evolution test program, and propose a commercially viable experimental methodology for further field testing. Completion of this work will provide the necessary information to perform the longer range work for a larger project that might include the establishment of a JIP.
Sponsor: Chevron U.S.A., Inc.
PI/PDs: Clint Aichele, Sayeed Mohammad, Rob Whiteley

Advanced Characterization of Hydrate and Emulsion Formation in Flowing Systems for Flow Assurance Applications
This research addresses the petroleum industry's need for strategies to mitigate hydrate formation in crude oil production systems. This project directly applies to multi-phase flow, rheology, fundamental particle behavior, and dynamic interfacial phenomena. Hydrate formation will be quantified both in emulsified systems and on pipe surfaces in flowing conditions using an inflow microscope. The thickness of hydrate layers and the rate of crystal

growth on pipe surfaces will be quantified to elucidate hydrate attachment mechanisms to pipe walls for a variety of surfaces. These data will provide quantitative insight regarding the relationship between hydrate attachment and surface treatments on pipes.
Sponsor: American Chemical Society Petroleum Research Fund
PI/PD: Clint Aichele

CAREER: Multifunctional Polymer Coatings of Virus Particles for Safer and More Efficient Gene Delivery
The study will investigate the effects of both PEG and PLL on overall gene delivery efficiency of a targeted polymer/adenovirus hybrid vector by exploring a library of grafted copolymers with varying polymer molecular weights and grafting ratios. The study also aims to better understand why some of the PEG-PLL copolymers perform better than others by elucidating the limiting step(s) in the gene delivery process. The investigator will study and compare the mechanisms by which the hybrid vectors and native adenovirus transform cells and compare the efficiency and rate at which the viral and hybrid vectors overcome barriers to gene delivery.
Sponsor: National Science Foundation
PI/PD: Josh Ramsey

Nanocarrier-mediated Targeting of Bioscavengers to the Red Blood Cell for Prolonged Circulation and Projection
Parenteral administration of butyrylcholinesterase (BChE) is effective against organophosphorus anticholinesterase (OP) toxicity but its efficacy is hampered by rapid clearance from circulation. Red blood cells (RBCs) have been used as a carrier for drugs, peptides and enzymes following external manipulations and subsequent reinfusion. The hypothesis is that cationic poly(l-lysine)-graft-poly(ethylene glycol) copolymer nanoparticles (NPs) containing both an antibody to the RBC membrane protein glycophorin A and a cell-penetrating peptide can deliver electrostatically encapsulated BChE molecules to the circulating RBCs in situ. Once bound to, or internalized into RBCs, the NPs will circulate for prolonged times providing long-term protection against OP challenge.
Sponsor: Defense Threat Reduction Agency
PI/PDs: Josh Ramsey
Center for Veterinary Health Sciences: Casey Pope
Division of Agricultural Sciences & Natural Resources: Steve Hartson

Oklahoma Center for Respiratory and Infectious Diseases
OSU is the lead institution of this multi-institutional research center. The center's central theme is infectious diseases of the respiratory system with a focus on respiratory syncytial virus (RSV), influenza virus, and bacterial infections. Interdisciplinary projects cover disease pathogenesis, therapeutics, molecular mechanisms, and bioengineering. One aim of the center is to mentor junior investigators in becoming independent NIH-funded investigators and thus create a critical mass of multi-disciplinary investigators in respiratory infectious diseases. A second aim is to build up research infrastructure, and a third aim is to foster inter-institutional collaborations in Oklahoma by promoting scientific interactions through the center.
Sponsor: National Institutes of Health

PI/PDs: Heather Fahlenkamp
Center for Veterinary Health Sciences: Lin Liu

Spray Characterization Equipment
This project consists of characterizing sprays using a Phase Doppler Interferometer. Fractionation Research Incorporated (FRI) will contribute toward the purchase of the instrument. The instrument will support several fundamental and applied research projects at Oklahoma State University and FRI. Through the use of solid state lasers, the instrument has the ability to resolve a wide range in droplet diameter (0.5 μm – 2 mm). In addition, the instrument measures droplet velocity. Through the characterization of both droplet size and velocity, the measurements will provide insight to both fundamental and applied applications of spray phenomena.
Sponsor: Fractionation Research, Inc.
PI/PDs: Clint Aichele, Rob Whiteley

CAREER: An Advanced 3D Tissue Model for the Detection and Study of an Allergic Inflammatory Response
This NSF CAREER development plan seeks to use an advanced 3D tissue model to investigate the key aspects of an allergic inflammatory response, more specifically the cellular components at the site of inflammation and mediators, such as growth factors, chemokines, cytokines, and extracellular matrix components that regulate inflammation. The proposed transdisciplinary research will be complimented by the PI's education plan, which will integrate science and engineering research into curriculum at high school, undergraduate, and graduate levels.
Sponsor: National Science Foundation
PI/PD: Heather Fahlenkamp

Center for Interfacial Reaction Engineering
Knowledge of the phase behavior and the thermophysical properties of organic mixtures encountered in biomass and petroleum conversion processes is essential to the proper design, operation and optimization of such processes. The project will build upon the research team's previous work in order to further develop theory-framed, structure-based phase behavior models for biphasic catalytic systems and identify improved organic solvents to optimize product separation in these systems. Completion of this research will provide the required modeling capability to develop effective bi-phasic catalytic processes for upgrading and refining of complex feed stocks including bio-oils.
Sponsor: University of Oklahoma for Department of Energy
PI/PDs: Brian Neely, Clint Aichele
Department of Chemistry: Jeffery White

Civil and Environmental Engineering

An Integrated Framework for Prediction of Fatigue Crack Propagation Under Random Sea Loading Through Coupled Experimental and Numerical Analysis
The research will include 1) small-scale experimental testing to collect data that can reduce uncertainty in crack growth parameters in marine steels, 2) large-scale testing to characterize the crack growth in stiffened box girders subjected to variable amplitude sea loading, and 3) developing an integrated numerical approach using finite element analysis and fracture mechanics approaches to predict crack growth under realistic conditions often encountered in ships.
Sponsor: Office of Naval Research
PI/PD: Mohamed Soliman

Transportation Consortium of South-Central States (Tran-SET): Developing Implementable Climatic Input Data and Moisture Boundary Conditions for Pavement Analysis and Design
This project is to develop realistic climatic input data for identifying surface and subsurface moisture boundary conditions, and to develop a practical numerical model for predicting the moisture regime within the pavement subgrade system.
Sponsor: Louisiana State University and A&M College for the United States Department of Transportation
PI/PD: Rifat Bulut

Engineering Biocatalysts Consortium for Efficient Conversion of Lignocellulosic Biomass and Greenhouse Gas Mixture to Fuels and Chemicals
The overall goal of this study is to increase butanol yield by more than 30%. Dr. Lampert's role will include performing a life cycle assessment to compare the environmental impacts of petroleum and corn-based butanol and jet fuel production pathways to those from switchgrass using novel co-fermentation processes with the new biocatalysts in this project.
Sponsor: South Dakota State University for National Institute of Food and Agriculture
PI/PD: David Lampert
Biosystems and Agricultural Engineering: Hasan Atiyeh

FAST Act Emergency Vehicle (EV-3) Load Rating
The Fast Act made certain emergency vehicles including fire trucks legal on the Interstate and within reasonable access to the Interstate. These vehicles can generate greater load effects in bridges as compared to other legal vehicles. These EVs now must be considered when load rating and posting bridges on the Interstate and within the range of reasonable access to the Interstate (generally taken to be one mile from an Interstate interchange). The existing bridge in the Cooper Lab at OSU provides a unique opportunity to study the actual stresses and strains on a full scale load from an EV3 loading.
Sponsor: Oklahoma Department of Transportation for the United States Federal Highway Administration
PI/PD: Bruce Russell

Protecting Piers of Overhead Structures from Degradation Due to Snow and Ice Chemical and Material Usage, Phase II

Degradation of piers due to corrosion of reinforcing bar is a major maintenance problem for Ohio DOT districts. This corrosion is largely caused by plows throwing chloride laden ice and snow onto the piers and by chloride laden spray from vehicle traffic. This Phase II project will evaluate the effectiveness of two products in providing a barrier to protect the piers from chloride laden ice, snow and spray. The Poly Salt Armor product and the polyaspartic product will both be evaluated. The cost effectiveness of both products will also be addressed.
Sponsor: University of Cincinnati for the Ohio Department of Transportation for the Federal Highway Administration
PI/PD: Norb Delatte

Development of Maintenance Equipment Rental Rates for ODOT
When utilizing equipment or vehicle fleet assets for maintenance operations, the Oklahoma Department of Transportation (ODOT) must be able to accurately measure the monetary effects on depreciable equipment budgets. Equipment "rental rates" were internally adopted to track and adjust this depreciable equipment budget, but the rates have not been updated since Fiscal Year 2010. The objective of this project is to develop a guide to calculate equipment rental rates as well as a methodology to continuously update the rate for ODOT's use.
Sponsor: Oklahoma Department of Transportation for the United States Federal Highway Administration
PI/PDs: Yongwei Shan, Gouranga Banik

Determining Concrete Patch Locations Other Than Visual
This project concerns patch locations in concrete and asphalt-on-concrete pavements in Indiana It is difficult from visual inspection alone to determine the health of an existing pavement patch. Concrete pavement patches are frequently overlain with asphalt, effectively concealing the location until failure is well underway. The research goal is to find methods to locate and classify three types of concrete patches and to deliver a corresponding patching table. The approach will use the 3D imaging system to create a 1 mm resolution image of the pavement surface and develop an artificial intelligence based technique to narrow the patch search area.
Sponsor: Purdue University for Indiana Department of Transportation
PI/PDs: Kelvin Wang, Joshua Li

Decreasing the Energy Use in Wastewater Treatment
The technical aims of this P3 student design project are to: (1) construct a lab-scale experiment to analyze the relationships between critical biological process parameters including dissolved oxygen, biochemical oxygen demand, and aeration; (2) build a simple, automated process control to adjust aeration inputs as oxygen and organic levels fluctuate; (3) simulate the lab-scale results using a mathematical model that can be extended to the full-scale facility; and (4) assess the potential energy, greenhouse gas emissions, and cost savings associated with this design using life cycle analysis.
Sponsor: United States Environmental Protection Agency
PI/PD: David Lampert

Concrete Pavement Mixtures with High Supplementary Cementitious Materials (SCM) Content

The principal objectives of phase I of this project are to first validate/calibrate existing fly ash compositional equations that predict properties of concrete materials for pavements and then extend and/or develop new characterization protocols for high SCM replacement rates of cement (fly ash and slag) available in the State of Illinois. The goal is to have simple characterization and testing protocols that will allow the use of high volume SCMs in concrete pavement without compromising workability, air content, initial setting time, early strength gain, long term mechanical properties, and durability.

Sponsor: The Board of Trustees of the University of Illinois for the Illinois Department of Transportation for the United States Department of Transportation

PI/PD: Tyler Ley

Performance Engineered Concrete Paving Mixtures – TPF 5(368)

Tasks include: 1) Prepare slides for workshops and webinars, 2) Webinars – Prepare overview of the PEM specification and give annual update on new tests and lessons learned, 3) Guide states in the use of specification, 4) Test support – Demo at NC2 – Guidance documents, 5) Shadow Project Support – Project level education with workshop and testing demonstrations, 6) Set up database, 7) Collect, save and publish field data and pavement performance, 7) Update AASHTO – Annual update on system performance and revise specification, 8) Water content – develop/improve test method, 9) Review constructability.

Sponsor: Snyder & Associates, Inc. for Iowa State University for Iowa Department of Transportation

PI/PD: Tyler Ley

Surface Resistivity Testing for Quality Control of Concrete Materials

The goal is development of guidelines using resistivity as a means for mixture approval and acceptance in addition to current specifications. Within the scope of ODOT's ongoing project, SP&R 2266, there is a need to expand the new test method to include different materials than those currently evaluated for ODOT: class A and AA mixtures containing fly ash. Tasks include evaluation of materials commonly used in Southern Plains states such as different cement types and supplementary cementitious materials. The developed test method would be revised to include additional mixture types. This research could lead to national acceptance of the method.

Sponsor: University of Oklahoma for the Southern Plains Transportation Center for the US Department of Transportation

PI/PD: Julie A. Hartell

Behavior of Steel Connections with Bolts and Welds in Combination

This project investigates the behavior of steel connections that are both bolted and welded, with the bolts and the welds sharing loads. The research is a collaborative effort between OSU and W&W/AFCO Steel Co. which will provide the fabricated samples to be tested at the Bert Cooper Engineering Laboratory at OSU. Additionally, W&W/AFCO Steel Co. will provide technical expertise and technical support to help ensure the overall success of the research

program. The goal of the project is to provide design guidance for realistic configurations of connections employing bolts and welds that may exist in steel buildings and bridges.
Sponsor: American Institute of Steel Construction
PI/PDs: Mohamed Soliman, Bruce Russell

Development of PCR Based Source Tracking of Fecal Coliform Contamination
Instead of targeting fecal coliforms, this project focuses on the DNA from the host itself. One specific target is the hosts' mitochondrial DNA (miDNA). The benefit of miDNA is that though every animal cell has just 1 copy of the animals nucleic (core) DNA, it contains up to thousands of mitochondria (and associated DNA sequences). Thus, this miDNA can more easily be detected than animal nucleic DNA. The objective is to develop a PCR and a qPCR based method to detect mitochondria DNA from various animals for the purpose of fecal coliform source tracking.
Sponsor: Accurate Environmental LLC
PI/PD: Mark Krzmarzick

Developing Standard Definition for Comparable Pavement Cracking Data
In order to unify data reporting, sharing, and evaluation, standardization of pavement cracking definitions is needed. The objective of this project is to develop standard, discrete definitions for common cracking types in flexible, rigid, and composite pavements. The standard definitions shall be used to facilitate comparable measurement and interpretation of pavement cracking. The definitions shall be of sufficient detail to serve as the basis to meet user and system requirements for developing automated cracking software, and for being compatible with both existing and emerging image-based data collection technologies.
Sponsor: National Academy of Sciences for the Federal Highway Administration
PI/PDs: Kelvin Wang, Joshua Li

Development of Aggregate Characteristics-Based Preventive Maintenance Treatments Using 3D Laser Imaging and Aggregate Imaging Technology for Optimized Skid Resistance of Pavements – Phase II
The project studies the aggregate used in maintenance treatments of pavements. In Phase I, a significant amount of pavement performance data was collected for more than 40 field test sites, which were selected considering the commonly used aggregates, typical Oklahoma preventative treatments, different surface ages, and various traffic conditions. In order to develop more reliable and accurate skid resistance deterioration models, the project is extended to collect additional field data sets and refine the deterioration models and life cycle cost analysis. The objective is to develop an aggregate selection procedure for preventive maintenance treatments of pavements in Oklahoma.
Sponsor: Oklahoma Department of Transportation for the Federal Highway Administration
PI/PDs: Joshua Li, Kelvin Wang

Continuous Friction Measurement Equipment (CFME) for Highway Safety Management in Oklahoma

Objectives are: 1) Evaluate Grip Tester capabilities for continuous friction measurements (CFME), and 2) Provide information for Oklahoma Pavement Safety Management. Sub-objectives are: 1) Compare CFME measurements from Grip Tester with data from ODOT locked-wheel trailers. 2) Use Oklahoma pavement surfaces to investigate effect of operational factors on CFME friction measurements. 3) Provide guidance for ODOT to implement CFME for pavement management programs for surface treatment selection. 4) Use CFME data to develop crash rate prediction model and use PaveVision3D technology to collect 1mm 3D data. 5) Develop software that allows users to visualize and analyze continuous pavement friction data.
Sponsor: Oklahoma Department of Transportation for the Federal Highway Administration
PI/PDs: Joshua Li, Kelvin Wang

Implement Balanced Asphalt Mix Design in Oklahoma
The project will result in development of draft specifications and draft supplemental specifications for a balanced mix design procedure for the Oklahoma Department of Transportation, which will move ODOT away from a voids based mix design procedure, allowing more innovative design concepts and producing longer lasting more durable and rut resistant pavements.
Sponsor: Oklahoma Department of Transportation for the Federal Highway Administration
PI/PDs: Stephen Cross, Joshua Li

Biofilm and Water Treatment Discovery
An education module targeting a K-5 grade audience will be constructed. This module will incorporate an activity of cleaning 'dirty' water through coagulation and filtration. Microscopes will be used to evaluate the water samples before and after treatment. Additionally, drinking water pipe sections with biofilm will be used to demonstrate how bacteria live in biofilms. The budget includes resources for the microscopes and materials needed to build this module. The goals of the activity will be to excite young kids about science and environmental engineering, and teach them about drinking water treatment and biofilms.
Sponsor: Association of Environmental Engineering and Science Professors Foundation
PI/PD: Mark Krzmarzick

Collaborative Research: WERF: GOALI: Bioaugmentation-Enhanced Anammox for Mainstream Nitrogen Removal
The project involves collaborative research between the University of Arizona, Oklahoma State University and an industrial partner, Pima County Regional Wastewater Reclamation Department. The university collaboration will combine engineering expertise on nonconventional biological nutrient-nitrogen removal with expertise on metagenomics/transcriptomics to gain insights and biomarkers to improve the process. The project directly addresses the National Academy of Engineering's grand challenge of improving the management of the nitrogen cycle by developing technology to control the load of excess nutrient nitrogen into the environment.
Sponsor: National Science Foundation
PI/PD: Mark Krzmarzick

Long-Term Performance Monitoring of High Friction Surfacing Treatments (HFST) Sites
The OSU team will identify the influential factors in HFST service life, select approximately 30 sites for data collection across 11 states based on a comprehensive experimental design considering these factors, and develop an overall data collection method for each site. The OSU team will also develop a software package for collection of field cracking, profiling, texture, geometric data, and use of grip tester for friction. Relevant data sets will also be gathered from state agencies. The OSU team will conduct a comprehensive analysis of the time series performance data collected in the field and also in the laboratory environment.
Sponsor: Texas A&M Transportation Institute for Federal Highway Administration
PI/PDs: Kelvin Wang, Joshua Li

Using Medical X-ray Machines to Determine the Service Life of Concrete
Medical X-ray machines will be used to image the penetration of fluids containing a tracer into concrete. This information is used to calculate the diffusion coefficient of the concrete. This is an indication of how easy it is for outside fluids to penetrate the concrete and is useful to predict the service life of the concrete structure. A software package developed in this project will take the raw data and use standards to determine the rate of penetration of the fluid. The software then can calculate the service life of the structure by using two different well established models.
Sponsor: National Academy of Sciences for the Federal Highway Administration
PI/PD: Tyler Ley

Using In Situ Chemical and Structure Mapping of Calcium Sulfoaluminate Cement to Control Hydration
The goal is to understand the mechanisms that control formation of the microstructure of concrete that uses calcium sulfoaluminate cement. 3D in-situ structure and chemistry imaging techniques will be used at multiple length scales in combination with microstructural modeling to characterize, quantify, and understand the structure, chemistry, and properties of concrete over the first 12 hours. The focus will be on initial formation of the microstructure over the first hours of reaction with water, including evaluation of the role of crystal defects on dissolution rate, identification of nucleation sites, and characterization of evolving density and composition of phases that precipitate.
Sponsor: National Science Foundation
PI/PD: Tyler Ley

Updated Analysis of Michigan Traffic Inputs for Pavement ME Design
The OSU team will provide technical support to assist the Michigan State University (MSU) team in conducting a weigh-in-motion (WIM) data check aiming to obtain new Level 1 WIM data with high data quality with the Prep-ME software. The OSU team will investigate how Prep-ME can be used to support the new cluster development, and to provide traffic clustering outputs for subsequent Pavement ME Design analyses by the MSU team. The OSU team will also evaluate the Michigan cluster operations in the Prep-ME software and identify necessary updates or corrections from the previous task findings.

Sponsor: Michigan State University for the Michigan Department of Transportation for the Federal Highway Administration
PI/PDs: Joshua Li, Kelvin Wang

Transportation Consortium of South-Central States (Tran-SET): Sustainability-based Long-term Management of Bridges under Multi-hazards Exposure
In this research, a sustainability-based framework for the optimum management of bridges under multi-hazard exposure will be developed. The simulation-based framework will consider the effect of climate change by using downscaled data from global climate modeling to establish sustainability-based long-term risk profiles. Next, multi-criteria optimization will be implemented to establish optimum retrofit and repair activities (e.g., optimum times and types) which simultaneously minimize life-cycle cost and maximize sustainability metrics.
Sponsor: Louisiana State University and A&M College for the United States Department of Transportation
PI/PD: Mohamed Soliman

Transportation Consortium of South-Central States (Tran-SET): Promoting Economic Development in the Baton Rouge Area, LA: Improving the Performance of the Transportation System through Supply-Oriented, Demand-Oriented and Economic Measures for Mitigating Traffic Congestion
This study aims to perform macro-level network analysis to identify the extent of the congestion problem in the Baton Rouge area. Based on that, the research team will (a) identify potential supply-oriented and demand-oriented solutions in each problematic location, (b) investigate the anticipated benefits from each solution, and (c) investigate the economic feasibility of each solution.
Sponsor: Louisiana State University and A&M College for the United States Department of Transportation
PI/PD: M. Samir Ahmed

The Use of Resistivity Testing for Quality Control of Concrete Mixtures – Phase 2
The project will investigate the potential of resistivity testing in assessing the performance of typical concrete mixtures used in bridge and pavement infrastructure. The efforts are concentrated towards development of guidelines using resistivity as a means for mixture approval and compliance in addition to ODOT's current specifications. Strength would no longer be the only value used to accept a concrete mixture; instead, a measurement of permeability could be included. Based on the outcomes of Phase 1 research activities, a systematic approach using resistivity testing for Classes A and AA concrete mixture design compliance control during construction will be developed.
Sponsor: Oklahoma Department of Transportation for the Federal Highway Administration
PI/PDs: Julie Hartell, Tyler Ley, Mohamed Soliman

Shrinkage Induced Deformation in Steel Bridges Made Composite with Concrete Deck Slabs – Phase 3

The project will further investigate the phenomena of concrete shrinkage and other volume changes, and assess their effects on deflections in steel bridges made composite with concrete decks. Tasks include: 1) ongoing review of relevant research, 2) perform forensic investigation of known bridges, 3) build prototype to test bracing systems for formwork and screeds, 4) build, monitor and test full-sized prototype bridge, 5) laboratory testing, 6) field bridge instrumentation and monitoring, 7) computational analysis of shrinkage and other effects, 8) identify likely causes for excessive or unpredicted deflections, 9) develop and refine design and construction methods for ODOT bridges.
Sponsor: Oklahoma Department of Transportation for the Federal Highway Administration
PI/PD: Bruce Russell

Resource Recovery from Produced Water using Forward Osmosis and Membrane-assisted Regeneration of Draw Solutions
The objective is to identify and develop novel, feasible, cost effective produced water treatment processes that are comparable in cost to the disposal of produced water by underground injection. Specifically, the research will optimize a newly developed produced water treatment technology based on a Forward Osmosis process to recover valuable materials, purified water and recyclable brine from an integrated operation that can be used as a trailer mounted modular field unit.
Sponsor: Frosty Cooling Systems, LLC
PI/PDs: Mark Krzmarzick, Seok-Jhin Kim

Performance Engineered Mixes
This is a subcontract to evaluate new testing equipment and develop mix prequalification tests.
Sponsor: Snyder & Associates, Inc. for Iowa State University for Portland Cement Association
PI/PD: Tyler Ley

Participation of OSU Faculty in SPTC's Non-Research Activities
As a regional University Transportation Center, the Southern Plains Transportation Center is not only engaged in research but other activities including education, workforce development, outreach, technology transfer, and diversity. Activities of OSU faculty include: 1) advising the Transportation Leadership Council at OSU, 2) co-organizing the SPTC summer symposium, 3) organizing the poster session at the Oklahoma Transportation Research Day, 4) assisting in editing of SPTC newsletter, and 5) mentoring students in preparing a presentation for the Transportation Climate Summit.
Sponsor: University of Oklahoma for the Southern Plains Transportation Center for Oklahoma Department of Transportation
PI/PDs: Kelvin Wang, Tyler Ley

Load Test Monitoring of I-235 Bridge Repairs
Based on inspections of grouted post tensioned bridges, ODOT discovered some durability issues with the I-235 bridge. ODOT hired a company to plan and implement repairs. The faculty at OSU have significant experience in structural health monitoring and will help ODOT in the

assessment of these repairs by performing an array of nondestructive tests including live load testing, strain monitoring, and acoustic emissions monitoring.
Sponsor: Oklahoma Department of Transportation for the Federal Highway Administration
PI/PDs: Robert Emerson, Julie Hartell, Bruce Russell

Evaluation of Maintenance Procedures for Bridge Spalling on Parapet Walls – Phase II
Deliverables include: 1) Evaluation of polyaspartic materials, including tests to assess the material durability, the practicality of using this material in the field, and whether the material can provide containment of loose concrete. 2) If the polyaspartic material is found feasible, a standard operating procedure for application of polyaspartic material will be developed. 3) Evaluation of the use of a hydrodemolition robot for removing loose and damaged concrete from parapet walls. 4) If the robot is determined to be feasible, a standard operating procedure for use of the robot will be developed. 5) Provide information about other parapet protection systems.
Sponsor: University of Cincinnati for the Ohio Department of Transportation for the Federal Highway Administration
PI/PDs: Norbert Delatte, Julie Hartell

Design of an Airplane Transporting System
The goal of this project is to complete the full research, conceptualization and design for a 90 degree curve that is bounded on each end with a 15 meter straight section of the underground airplane conveyance system presented to Oklahoma State University by Airplane Transport Systems. The design process will be completed in 18 months with all documentation necessary to fabricate and install the system for testing with an aircraft.
Sponsor: ATC World Wide, LLC
PI/PDs: Julie Hartell, Mohamed Soliman
Electrical and Computer Engineering: Nishantha Ekneligoda
Mechanical and Aerospace Engineering: James Kidd
New Product Development Center: Robert Taylor

ECDP Project: Prioritizing Bridge Maintenance and Repairs Considering Geospatial and Climatological Factors
The objective of the research is to develop a framework for ODOT to prioritize bridge maintenance and repairs through consideration of geospatial and climatological factors. As a result of the research, ODOT will be able to be more proactive in developing climate-adaptive bridge preservation plans as well as achieve the goal of "zero deficient bridges" with the most economical solution.
Sponsor: University of Oklahoma for the Southern Plains Transportation Center for Oklahoma Department of Transportation
PI/PD: Yongwei Shan, Joshua Li

ECDP Project: Application of Fiber Optic Sensors for Monitoring Prestressed Concrete Bridges
Fiber optic strain measurement will be used as an efficient, reliable, and accurate alternative to traditional strain measurement (mechanical strain gage, electrical resistance, and vibrating

wire) in prestressed concrete members. The sensors will be used for internal strain monitoring in prestressed concrete beams, which in turn can provide an indication on the condition of the prestressed element. This would be useful to bridge owners as an initial quality control method and a long-term monitoring technique. The proposed sensor can provide a measure of the effective prestress force and its variation over time, which are important indicators of bridge girder performance.
Sponsor: University of Oklahoma for the Southern Plains Transportation Center for Oklahoma Department of Transportation
PI/PD: Mohamed Soliman

2017 Summer Bridge Program Engineering and Design and Fabrication Project: Design and Build an MSE Wall with Sand and Paper
The purpose is to support OSU faculty and students to develop and implement a transportation-related student project in the 2017 OSU Summer Bridge program. OSU Summer Bridge is a one-month outreach program designed to guide incoming OSU engineering students through the transition from high school to collegiate learning environment. As part of the program, the students participate in three engineering design and fabrication projects in different engineering disciplines. For one of the projects, the students will work in small teams to design and build a prototype mechanically-stabilized earth wall with sand and paper in a wood box.
Sponsor: University of Oklahoma for the Southern Plains Transportation Center for Oklahoma Department of Transportation
PI/PDs: Xiaoming Yang, Greg Wilber, Bruce Russell
CEAT Student Services: Lance Millis

Risk-Based Life-Cycle Management of Deteriorating Bridges
The project will lead to a risk-based life-cycle management technique for bridges susceptible to failure due to scour and floods. Probabilistic analysis necessary for quantifying the effect of climate change on future river flow characteristics will be performed. Probabilistic simulations will be implemented to evaluate the risk of failure due to scour and flood-induced damage. These simulations coupled with finite element analysis, will be used to establish the failure risk profile of the bridge as a function of time. Time-variant risk associated with structural failure will be quantified by integrating the probability of failure and the consequences of this event.
Sponsor: University of Oklahoma for the Southern Plains Transportation Center for US Department of Transportation
PI/PDs: Mohamed Soliman, Julie Hartell

Advance Innovative Concrete Materials and Mixture Designs
In this subcontract, the OSU investigator will provide the following scope of work: Dr. Ley will work with a graduate student and will hire an outside consultant to assist him with evaluating new testing equipment, and will work with AASHTO for Provisional Specifications. Dr. Ley will attend oversight ETG meetings and quarterly TAC meetings by phone.
Sponsor: Snyder & Associates, Inc. for Iowa State University for Federal Highway Administration
PI/PD: Tyler Ley

Development of Guidelines for High-Volume Recycled Materials for Sustainable Concrete Pavement

Incorporating a high volume of recycled materials in concrete production can reduce cost and decrease the carbon footprint without compromising performance and service life. The objective is to produce concrete for conventional pavement construction that incorporates at least 50% recycled materials. For this project, the OSU investigator is collaborating with OU and will be conducting investigations to evaluate the durability performance of concrete mixtures designed and fabricated at OU. This entails determining the resistivity and chloride diffusivity parameters for concrete samples. Also, a series of freeze-thaw testing on concrete beam samples and salt scaling on slab samples will be conducted.

Sponsor: University of Oklahoma for the Southern Plains Transportation Center for Oklahoma Department of Transportation

PI/PD: Julie Hartell

Development of statewide WIM data quality control and axle load spectra and traffic volume adjustment factors for Oklahoma

Oklahoma Department of Transportation operates weigh-in-motion (WIM) stations and is actively adopting portable WIM programs. No comprehensive study has been conducted before to evaluate the quality of WIM data in Oklahoma. In this project, quality control metrics and associated software interfaces will be developed for checking the quality of statewide WIM data. Site-specific, region-specific, and statewide traffic inputs required for Mechanistic-Empirical based pavement design in Oklahoma will also be developed. Deliverables include: WIM data software, a guideline on how often and under what circumstances a WIM station should be calibrated, comprehensive database and software interface, software training and technical support.

Sponsor: University of Oklahoma for the Southern Plains Transportation Center for Oklahoma Department of Transportation

PI/PDs: Joshua Li, Kelvin C.P. Wang, Cheng Chen

Incorporation of Speed Data Sets in Traffic Performance Analysis (SPTC 15.2-8)

The goal is to develop a Travel Time Reliability Monitoring System (TTRMS) to improve the reliability of network and highway travel times by mitigating the effects of events that cause travel times to fluctuate unpredictably. The TTRMS complements the capabilities of existing transportation management centers (TMC) as a new module that plugs into an existing TMC platform. The TTRMS relies on the TMC to gather infrastructure-based and vehicle-based sensor data, manage data processing and storage, and communicate the findings to system users. The OSU investigator will act as Co-PI and consultant based on his expertise and experience in the topic.

Sponsor: University of Oklahoma for the Southern Plains Transportation Center for Oklahoma Department of Transportation

PI/PD: M. Samir Ahmed

Development of a SFE Database for Screening of Mixes for Moisture Damage in Oklahoma

As subcontractor on an OU project, the OSU investigator will: 1) Acquire five aggregate and five asphalt binder samples from OU. 2) Prepare the aggregate and asphalt binder specimens for contact angle measurements using the sessile drop device. 3) Prepare the binder specimens by exposing them to pre-determined aging times with consultation with the OU team. 4) Measure contact angles on the prepared specimens of aggregates and binders. 5) Assist OU team in analyzing the test results for the final project report.
Sponsor: University of Oklahoma for the Southern Plains Transportation Center for Oklahoma Department of Transportation
PI/PD: Rifat Bulut

Development of Aggregate Characteristics-Based Preventive Maintenance Treatments Using 3D Laser Imaging and Aggregate Imaging Technology for Optimized Skid Resistance of Pavements
The objective is to develop an aggregate selection procedure for preventive maintenance treatments of pavements in Oklahoma based on physical aggregate properties such that the skid resistance of pavements is maintained or improved while the economics are optimized. The most recent developments in 3D laser imaging technology will be used to collect 3D pavement surface texture data at highway speed at 1 mm accuracy without interfering with the traveling public. The project also uses other laboratory and field data collection instruments, including the Aggregate Imaging System and a portable 3D surface analyzer to collect ultra-high resolution aggregate morphological characteristics data.
Sponsor: Oklahoma Department of Transportation for the Federal Highway Administration
PI/PDs: Joshua Li, Kelvin Wang
University of Oklahoma: Dominique Pittenger

Development of Concrete Mixtures to Mitigate Bridge Deck Cracking; Validate Using 3D Bridge Deck Surface Evaluations
In task one, a workshop over bridge deck cracking technologies will be held at ODOT. In task two, the researchers will investigate concrete mixtures with different technologies to minimize cracking with Oklahoma materials. In task three, the researchers will work with ODOT to construct different spans of a bridge deck that use these technologies. The forth task will use 3D crack mapping technology to follow field performance of these mixtures for three years. In task five, a specification will be authored to implement these technologies on ODOT bridges. The sixth task will be the completion of a final project report.
Sponsor: Oklahoma Department of Transportation for the Federal Highway Administration
PI/PDs: Tyler Ley, Kelvin Wang, Joshua Li, Bruce Russell, Julie Hartell

Performance of Moisture Barriers to Enhance Pavement Performance over Swelling Soils
The state-of-the-art knowledge on the application of moisture barriers indicates that performance of the moisture barrier needs to be investigated by considering properties of the site soils and climatic boundary conditions. So, the investigation will consist of laboratory soil testing, field monitoring, and computer modeling. Laboratory testing will be conducted to characterize soil types and variability at test sites and determine soil properties necessary for determining input parameters for modeling moisture migration. In addition to the basic soil

index properties, the moisture diffusion characteristics of the subgrade soils will be critical for realistic modeling of the performance of moisture barriers.
Sponsor: Oklahoma Department of Transportation for the Federal Highway Administration
PI/PD: Rifat Bulut

UNS: Priming of Organohalide-Respirers to Degrade Chlorinated Ethenes with Natural Organochlorines
Organochlorine pollutants such as trichloroethene (TCE) are some of the most widely distributed toxic contaminants at Superfund sites and pose significant risk to human health. This research seeks to determine the feasibility and effectiveness of using naturally-occurring organochlorines as biostimulants for *in situ* remediation of these organochlorine pollutants. The central hypothesis is that organohalide respiring bacteria will be stimulated and dechlorinate TCE faster and more completely in response to natural organochlorine amendments. The rationale is that with this knowledge, chlorinated pollutants may be more thoroughly and quickly remediated, thus removing major threats to human health.
Sponsor: National Science Foundation
PI/PD: Mark Krzmarzick

Long Term Pavement Performance (LTPP) Monitoring of Six LTPP SPS-10 Sections in Oklahoma with 3D Laser Imaging
Results of this research will be an evaluation of the long-term field performance of warm mix asphalt (WMA) mixtures through a five-year performance monitoring effort using the OSU 1mm 3D technology and several other instruments. The outcome of this project will assist ODOT and the industry in understanding WMA performance, its suitability for field implementation, and corresponding desired engineering properties.
Sponsor: Oklahoma Department of Transportation for the Federal Highway Administration
PI/PDs: Kelvin C.P. Wang, Joshua Li

Highway Construction Materials Technician Training and Certification Program
The College of Engineering, Architecture, and Technology (CEAT) at OSU is partnering with the Oklahoma Department of Transportation for the administration, management and delivery of the Training and Certification Program (HCMTP) for the Oklahoma Highway Construction Materials Technician Certification Board. This program serves ODOT, the Oklahoma Turnpike Authority, and the transportation construction industry. OSU CEAT assumes responsibility for all aspects of HCMTP training and certification including program training, certification, program administration, record keeping, and equipment upkeep and maintenance.
Sponsor: Oklahoma Department of Transportation
PI/PDs: Stephen A. Cross
Professional Development: Clayton Moorman

Alternative Cementitious Materials for Development of the Next Generation of Sustainable Transportation Infrastructure
As part of a collaboration with Georgia Tech on a Federal Highway Administration project, OSU is responsible for completing freeze thaw durability testing of the materials, mCT and mXRF

scans of laboratory and field based samples to investigate deterioration, and surveys of several different sites where ACMs have been used to evaluate their performance. Samples will be taken from these sites and evaluated with mCT and mXRF as needed.
Sponsor: Georgia Institute of Technology for Federal Highway Administration
PI/PDs: Tyler Ley, Paul Tikalsky

Use of a Novel Controlled Release Surface Curing Agent for Bridge Decks
The project involves a novel curing technique that can be rapidly applied to the surface of fresh concrete and not cause deformations in the concrete surface. The research is expected to show that the material has equal or better curing performance than typical wet curing methods and is sustainable and safe for the environment. Project objectives include: 1) Develop a field application method for the novel curing material; 2) Develop specifications for the quality control and usage of the novel curing material; 3) Work with contractors in Oklahoma to implement this technology in the field and evaluate the effectiveness.
Sponsor: Oklahoma Department of Transportation for the Federal Highway Administration
PI/PDs: Tyler Ley, Kelvin Wang, Julie Hartell

Improving Specification to Resist Frost Damage in Modern Concrete Mixtures
Objectives include: 1) Determine the necessary properties of the air-void system to provide satisfactory frost durability in laboratory testing of laboratory and field concretes with different combinations of admixtures, cements, and mixing temperatures in salt environments; 2) Determine the accuracy of a field test method that measures air void system quality with field and laboratory concrete; 3) Determine critical combinations of absorption and the critical degree of saturation on the frost durability in accelerated laboratory testing in the presence of deicer salts; 4) Establish test methods and specifications for fresh and hardened concrete to determine frost durability and field performance.
Sponsors: Oklahoma Department of Transportation for FHWA SPR Pooled Funds, Ready Mixed Concrete Research & Education Foundation
PI/PD: Tyler Ley
Oregon State University: William Weiss

Determining the Long-Term Performance of Petroleum Storage Tank Foundations through the Use of Case Studies
The aim is to build a database of past tank foundation performance that can be interrogated to determine the successful characterization of varying types of foundations and double bottom repairs in different environments. The team proposes to use owner inventory, construction and inspection records of tank foundations in combination with historical weather and soil information, and geotechnical reports for the existing foundations and combine this information into a single database. This database can be investigated to determine which foundations perform best in different situations. Another focus will be to determine the expected life of a double bottom tank foundation repair.
Sponsors: American Petroleum Institute, International Liquid Terminals Association
PI/PDs: Tyler Ley
Division of Agricultural Sciences and Natural Resources: Wade Brorsen

Surface Characteristics with 3D Data and Improved Airport PCI Survey Solutions
The project includes two technological developments that will provide the National Airport Pavement Test Facility with innovative tools to evaluate surface characteristics of Construction Cycles and airport pavements, and to improve airport condition survey efficiency via Pavement Condition Index. The research team will produce a white paper detailing use of new 3D imaging techniques to conduct surveys of relevant airfield pavement surface characteristics. Software modules for macro-texturing and grooving analysis will be developed as part of the updated ProGroove software. 3D pavement surface imaging data and innovative software algorithms will be used to expedite data processing for Pavement Condition Index.
Sponsor: Federal Aviation Administration
PI/PD: Kelvin Wang

Southern Plains Transportation Center
OSU is a subrecipient of the Southern Plains Transportation Center, a Regional University Transportation Center headquartered at the University of Oklahoma. OSU will conduct three research projects funded with the 2013 Regional UTC grant: embedded MEMS sensor system in pavement materials; precast concrete slabs for pavements; 3D 1mm imaging for automated assessment of pavement surfaces. In addition, OSU will conduct education and workforce development activities within the theme of the 2013 Regional UTC proposal.
Sponsor: University of Oklahoma for Southern Plains Transportation Center for U.S. Department of Transportation
PI/PD: Kelvin Wang

CAREER: Increasing the Effectiveness of Mineral Additives in Concrete through Novel Particle Characterization
The aims of this project are 1) develop a strong research program focused on increasing the use of supplementary cementitious materials (SCMs) as construction binders in concrete through new levels of chemical characterization, 2) involve underrepresented undergraduates in research and mentoring, and 3) increase awareness of science and engineering by underrepresented elementary students in low income schools.
Sponsor: National Science Foundation
PI/PD: Tyler Ley

Electrical and Computer Engineering

Structured Low-Energy High Performance Application-Specific Computer Architectures
The research emphasis is on designing a complex VLSI processor architecture and signal systems using an elaborate design flow or sequence of steps while optimizing constraints for energy, power, and speed given a complex set of OCV issues. Design flows and tools will be created to assist designers in specific computer architectures that are robust, have high amounts of performance, and are considered mobile in that they consume small amounts of

power and energy. The objective for these design flows is to create an implementation that outperforms similar architectures in terms of propagation delay, yet produces savings in power consumed.
Sponsor: United States Air Force
PI/PD: James Stine

Airborne Wideband Satcom Antenna System Reverberation Chamber Assessment
In this project, OSU will support the testing of an Airborne Wideband SATCOM Antenna System (AWSAS). OSU will provide access to and use of a reverberation chamber for the purpose of high power radiated susceptibility testing; electrical power (208 V AC single phase 30 A); personnel to operate the reverberation chamber and provide test oversight.
Sponsor: The Boeing Company
PI/PDs: Chuck Bunting, Jim West

Investigation of Focused Ultrasound Mediated Enhancement of Chronic Non-healing Wound Antimicrobial Therapy in Client-owned Dogs
Acute and chronic wounds typically require treatment with a combination of antibiotics administered systemically and locally. They often require extensive surgical debridement, including amputation in patients. The team's previous studies have shown that focused ultrasound-induced local warming decreases resistance within vascular beds to elevate local intravascular concentration of systemically-administered drugs within the solid tumor. This method has not heretofore been adapted to wound therapy in client-owned dogs. Unlike murine models, canine models replicate the infection profile in humans, and thus a demonstration of focused ultrasound efficacy in a veterinary clinical trial would provide an easier path for human clinical trials.
Sponsor: Focused Ultrasound Foundation
PI/PDs: Daqing Piao
Center for Veterinary Health Sciences: Ashish Ranjan

Cognitive Radio Systems for Small Satellites Communication Networks
The long-term goal is to develop effective and adaptive strategies for the design and deployment of space-based CR communication systems with optimal spectral- and power-efficiency to enhance the data rate, reliability and latency of the RF communication links in NASA Space Communications and Navigation (SCaN) network. The overall objective is to develop the scientific foundation and associated algorithmic tools for adaptive and efficient CR interference management and spectrum access methods that operate in dynamic cluster formations with limited sensing information and cooperation level between satellites.
Sponsor: University of Oklahoma for the Oklahoma Space Grant Consortium for the Oklahoma State Regents of Higher Education
PI/PD: Sabit Ekin

Ditch Witch EMC Modeling, Simulation, and Validation Research
The statement of work includes: 1) Both parties (student & Ditch Witch®) to learn the modeling process (Importing 3D models into CST, simulation, and validation); 2) To develop professional

relationships and share knowledge between groups; 3) Ditch Witch® to gain predictability of EMC issues before final certification testing.
Sponsor: The Charles Machine Works, Inc. dba Ditch Witch Compliance Testing Service
PI/PDs: Charles Bunting, Jim West

Optimization and Exploration of Trusted Low-Power High Performance Computer Architectures
This project's goal is to design, develop, and evaluate hardware support for secure computer architectures at the nanometer level. This will be accomplished by designing complete design flow integration with commercial and open-source Electronic Design Automation tools. The design flow will take a high-level system-level architecture description as inputs along with area, critical path delay, and power dissipation constraints. Based on the SoC architecture description and design constraints, the tools will automatically generate synthesizable HDL models, embedded memories, and custom components to implement the specified VLSI architecture.
Sponsor: United States Air Force
PI/PD: James Stine

Magnetic Hyperthermia Combined Antimicrobial Targeting of Bone Pathogens
The goal is to achieve on-demand rapid, thermally-targeted antimicrobial agent release within infected bone tissue, using a novel dual-platform technology that combines Low Temperature-Sensitive Liposomes (sLTSL) with Alternating Magnetic Field (AMF)-induced mild local hyperthermia, generated using sLTSL loaded with superparamagnetic iron oxide. Such sLTSL permit induced release of liposome-borne antimicrobial agent using mild local elevations in tissue temperature. Therefore, the hypothesis is that localized AMF-induced mild tissue warming combined with microbicide-loaded sLTSL, administered either systemically or locally, can elicit targeted antimicrobial release in a millisecond time scale, permitting synergistic bacterial killing of poorly-accessible biofilm bacteria within bone.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PD: D. Piao

Test and Evaluation Data for Statistical Characterization of Electromagnetic Complex Cavities Study
The objective of this study is to provide higher fidelity validation of a previous study entitled, "Statistical Characterization of Electromagnetic Complex Cavities Study." The current study requires the team to provide computational 3D models, test data and expert review of the previous study.
Sponsor: ai solutions Inc. for National Aeronautics and Space Administration
PI/PDs: Chuck Bunting, Jim West

Investigation of an Absorption/Reflection Based Chlorine Sensor
The proposed product is a non-invasive, non-destructive, long life sensor that measures active or "free" chlorine content in water or aqueous solutions using photometric quantitative analysis techniques. The end uses for this product are water monitoring and treatment industries.

Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PDs: Keith Teague
New Product Development Center: Robert Taylor

Intra-spinal Multi-site Dual Modal Dosimetry for Assessing the Feasibility of Transcutaneous Photo-bio-modulation of Spinal Cord
The long-term goal is to develop a protocol of percutaneous photo-bio-modulation for treating conditions concerning the spinal cord in large companion animals. The specific objective of this project is to devise the sensor and equipment technologies that will culminate in quantitating the treatment dose reaching the spinal canal of large dogs under clinically relevant surface dose.
Sponsor: LiteCure LLC
PI/PDs: Daqing Piao
Center for Veterinary Health Sciences: Lara Sypniewski, Daniel Burba

Design of an Airplane Transporting System
The goal of this project is to complete the full research, conceptualization and design for a 90 degree curve that is bounded on each end with a 15 meter straight section of the underground airplane conveyance system presented to Oklahoma State University by Airplane Transport Systems. The design process will be completed in 18 months with all documentation necessary to fabricate and install the system for testing with an aircraft.
Sponsor: ATC World Wide, LLC
PI/PDs: Nishantha Ekneligoda
Civil and Environmental Engineering: Julie Hartell, Mohamed Soliman
Mechanical and Aerospace Engineering: James Kidd
New Product Development Center: Robert Taylor

32NM Hafnium (IV) Oxide (HfO2) Negative Metal Oxide Semiconductor (NMOS) Electrically Erasable Programmable Read-Only Memory (EEPROMs) for Open Systems Computer Appliances
Key to the elimination of physical and eavesdropping attacks on trusted platforms is placing EEPROM memory on chip deeply embedded within the trusted system architecture and its peripheral I/O. “On chip” EEPROM blocks can be freely available to the designer as cache or SRAM. As a result we can expect to find nonobservable, BIOS, boot loaders, and encryption key storage not only embedded in the CPU but within all I/O interfaces. This eliminates “open” data and code observability along all points of communications vulnerable to external observation. Encryption key dispersion across the platform further reduces trusted system vulnerability.
Sponsor: United States Air Force
PI/PD: Chris Hutchens

Smart Inverter Voltage Control for Distribution Systems with Photovoltaic Generators
The purpose of this project is to demonstrate the benefits of inverter voltage control on a fast timescale to mitigate rapid and large voltage fluctuations due to the high penetration of photovoltaic generation and the resulting reverse power flow.

Sponsor: OSU Foundation for the National Energy Solutions Institute
PI/PD: Yuanxiong Guo

SHF: Small: Collaborative Research: Multi-level Non-volatile FPGA Synthesis to Empower Efficient Self-adaptive System Implementations
The contributions of this project are two-fold. First, this project aims at incorporating non-volatile memories (NVM) characteristics into FPGA design and synthesis. Considering the needs of self-adaptive applications, the investigator will fine-tune various steps on the FPGA synthesis flow, including high-level synthesis, logic synthesis, and placement and routing. Novel techniques will be used to optimize task scheduling, data allocation, logic mapping, placement, and routing to improve reconfiguration speed, energy efficiency, reliability, and endurance of NVM FPGAs. Second, the researcher will explore the rich NVM design space and set different optimization goals for look-up tables, flip-flops, and on-chip memories.
Sponsor: National Science Foundation
PI/PD: Jingtong Hu

CRII: CSR: Enabling Efficient Non-Volatile Processors on Energy Harvesting Powered Embedded Systems
The tasks in this project will study compiler optimizations for different checkpointing strategies under different energy harvesting sources. Both compiler optimization and runtime support will be exploited. The work will develop: 1) new lifetime analysis, register allocation, and instruction scheduling algorithms, aiming at reducing the number of registers that need to be checkpointed; 2) a novel dynamic checkpoint position identification technique to find the best checkpoint position; 3) a systematic approach to identify and correct possible errors caused by program checkpointing and resumption; and 4) an adaptive checkpoint frequency adjustment technique to minimize the overall overhead while providing system reliability.
Sponsor: National Science Foundation
PI/PD: Jingtong Hu

NRI: Considerate Co-robot Intelligence through Ubiquitous Human State Awareness
The objective is to develop a new theoretical/algorithmic framework and an open hardware/software platform for considerate co-robot intelligence, enabling a co-robot to assist humans in their daily lives in a proactive way while still having the freedom to do its routine work. The research consists of four parts: co-robot semantic mapping through human environment interaction; human activity and location inference using minimal motion sensor data; activity prediction and behavioral anomaly detection based on human state awareness; experimental evaluation using open hardware/software platforms and a case study evaluating the effectiveness of considerate co-robot intelligence in elderly fall prevention, detection and intervention.
Sponsor: National Science Foundation
PI/PDs: Weihua Sheng, Guoliang Fan

Secure High Performance Multi-Core Computer Architecture Design and Exploration

The goal is to research and develop high-level synthesis tools for SoC platforms in nanometer CMOS technologies that: 1) provide ability to efficiently integrate embedded memories, low-power/high-performance circuits and processors, mixed-signal designs, and communication structures, 2) combine synthesis and layout information to accurately estimate area, delay, and power from high-level SoC architecture descriptions, 3) facilitate rapid design-space exploration of secure SoC solutions, and 4) are well documented, easy to use, and publicly available for AFRL personnel. It is anticipated that project outcomes will aid in development and deployment of silicon architectures for any division that employs trusted foundry fabrication capabilities.
Sponsor: United States Air Force
PI/PD: James Stine

Fire Protection Publications

USFA Publications Revision
This project involves the revision of three United States Fire Administration (USFA) publications. These USFA publications are in need of revision to provide the most current and accurate information as the selected publications are well over a decade old. The selected publications would provide the most current information to an audience of local level emergency responders, primarily the fire service.
Sponsor: Department of Homeland Security Federal Emergency Management Agency
PI/PDs: Nancy J. Trench, Mike Wieder

Fire Safety Solutions for Oklahomans With Disabilities
The goal of this program is to improve the safety of Oklahomans who are deaf, have a hearing loss, are blind, or use a mobility device. Fire Protection Publications is collaborating with ABLE Tech and Fire Service Training to provide technical support, train, implement and evaluate a smoke alarm installation program for Oklahomans statewide who have a disability.
Sponsor: Oklahoma Assistive Technology Foundation for the United States Department of Homeland Security – FEMA
PI/PDs: Nancy J. Trench

Fire Service Training

Targeted Training for Grain Handling Operations
Fire Service Training (FST) will use existing OSHA-approved training materials (developed in FST's previous OSHA grant) to provide on-site Grain Bin Safety Awareness level training (4 hours) and Grain Bin Operations level training (8 hours) to agricultural workers. The Awareness level training will also be converted into an online format to specifically target the 16-24 year old age group with online training. The Awareness level training is focused on prevention. The

Operations level training focuses on how to rescue someone trapped in grain. FST estimates that 315 workers will be trained in 1631 contact hours during the one year grant.
Sponsor: US Department of Labor -- OSHA
PI/PDs: Caroline Reed, Steve George
Biosystems and Agricultural Engineering: Carol Jones

Oklahoma Emergency Response System Stabilization and Improvement Revolving Fund Grant FY 2018
OSU Fire Service Training will leverage this grant funding with other resources to provide regional training classes on key public safety topics at locations throughout the state, including: Oklahoma Trauma Education Program, Traffic Incident Management System, Emergency Vehicle Operations Course, Vehicle Extrication, Narcan Administration for First Responders, Wildland Fire Rehab, and Rope Rescue.
Sponsor: Oklahoma State Department of Health
PI/PD: Caroline Reed

AFG to Purchase Mobile Grain Engulfment/Confined Space Rescue Simulator
OSU Fire Service Training will purchase a Mobile Grain Engulfment and Confined Space Rescue Training Simulator System to provide safe and comprehensive practical skills training in the areas of grain engulfment rescue, confined space rescue, and rescue in grain storage structures. Training components of the simulator shall be designed to meet applicable nationally recognized training standards for rescue and confined space. The simulator shall be designed to be transported as one unit towed by an existing over-the-road tractor. This simulator will allow OSU FST to provide training in rural areas where training facilities are not available to fire departments.
Sponsor: Department of Homeland Security Federal Emergency Management Agency
PI/PD: Caroline Reed

Grain Bin Safety Program – Capacity Building
The project is a joint effort of Fire Service Training and Biosystems and Agricultural Engineering. OSU's FST and BAE departments will jointly develop a comprehensive hands-on agricultural safety awareness level training program as well as an operations level agricultural rescue training program, both emphasizing grain-related hazards. The target audience will be agricultural workers. The awareness level training will be focused on prevention. The operations level training will be focused on rescue.
Sponsor: United States Department of Labor – Occupational Safety and Health Administration
PI/PDs: Caroline Reed, Steve George
Biosystems and Agricultural Engineering: Carol Jones

National Fire Academy State Fire Training Grant
OSU's Fire Service Training will deliver a series of training programs in cooperation with the Federal Emergency Management Agency (FEMA) and the U.S. Fire Administration's National Fire Academy (NFA) to enhance the capabilities of the fire service in Oklahoma. Courses for Emergency Responders will be provided throughout the state in both conference settings as

well as single course deliveries. The trainings will be provided in rural and metropolitan settings in an effort to bring the training to the responder locally.
Sponsor: Department of Homeland Security Federal Emergency Management Agency
PI/PD: Caroline Reed

Industrial Engineering and Management

Optimization-based Aggregate Master Planning Tools for Bay Valley Foods, LLC
The project focuses on the master planning/scheduling activity, which is a key driver of current operations as it guides production by setting monthly production targets. The goal is to develop analytical approaches for guiding master planning decisions. The objectives are: 1) design and formulate mathematical optimization models that recommend aggregate-level master production schedules; and 2) develop computer implementations of the mathematical models that can be solved using a commercial optimization solver. This integrated approach using costs and revenues to drive the plan while simultaneously considering the various resource constraints can lead to better master planning decisions that result in savings.
Sponsor: Big Valley Foods, LLC
PI/PDs: Baski Balasundaram, Austin Buchanan, Sunderesh Heragu

Phase 3: Flow Visualization and Risk Assessment of Hazardous Material Movement in Oklahoma
The plan is to first refine and then integrate the statistical models and network routing and flow assignment models within the HazM3 framework. Ways to visualize the hazmat flow will be developed by combing the type of EHS, amount of flow, and the frequency of transport to convey the hazard level on a particular roadway. The hazmat flow related data will be fused with historical HazMat incident data for highway collisions involving a HazMat Placarded Vehicle from 2007-2016 to perform a risk assessment of roadway segments and intersections for hazmat incidents.
Sponsor: Oklahoma Emergency Management for the USDOT – Pipeline and Hazardous Materials and Safety Administration
PI/PDs: Manjunath Kamath, Farzad Yousefian
Biosystems and Agricultural Engineering: R. Scott Frazier

Collaborative Research: Enhancing Power System Resilience Via Data-Driven Optimization
A new class of data-driven optimization methodologies is proposed to assist power system operations under contingency. This project studies probabilistic modeling of power grid contingency based on meteorological and historical transmission availability data. The data analytics is incorporated in distributionally robust optimization models to (a) conduct risk assessment analysis, (b) harden pre-disaster power grid, (c) take corrective actions during disasters, and (d) conduct post-disaster self-healing and system restoration. Successful implementations of the research can provide data-driven approaches to address critical resilience issues facing the nation’s power system infrastructure.

Sponsor: National Science Foundation
PI/PDs: Chaoyue Zhao

Transportation Consortium of South-Central States (Tran-SET): Study the Impacts of Freight Consolidation and Truck Sharing on Freight Mobility
The goal is to show the impacts of online freight consolidation on freight mobility, congestion and emission reduction. The project includes the following tasks: 1) Literature review of truck sharing initiatives in the U.S. 2) Identification of truck-sharing data available. 3) Develop and validate freight demand models for shared freight hauling. 4) Develop and validate models for quantifying the impacts of truck sharing on network capacity, congestion, environment, etc. 5) Apply the models in Tasks 3 & 4 to forecast freight moved by truck sharing by commodity type and estimate the resulting benefits of truck sharing.
Sponsor: Louisiana State University and A&M College for the United States Department of Transportation
PI/PDs: Tieming Liu, Chaoyue Zhao

Phase 2: Developing a Modeling Framework for Hazardous Material Movement in Oklahoma
The objective in this phase is to develop a modeling framework that can ultimately provide rough estimates of annual hazardous material (HazMat) transportation in Oklahoma. The framework will include models that will be developed based on data from surveys that will be distributed to facilities that ship and/or receive HazMat in Oklahoma. In addition statistical models and network flow assignment models will be developed to estimate the HazMat flow on highway segments. The team will explore ways to combine historical HazMat incident data with the estimated HazMat flow data for risk analysis to be conducted in future phases.
Sponsor: Oklahoma Emergency Management for the USDOT – Pipeline and Hazardous Materials and Safety Administration
PI/PD: Manjunath Kamath, Farzad Yousefian
Biosystems and Agricultural Engineering: R. Scott Frazier

Imposing Connectivity Constraints in Large-Scale Network Problems
Previous approaches to solve vertex-centric connectivity problems use additional edge (and possibly flow) variables, which overburden IP solvers, or rely on simple, weak inequalities, leading to the exploration of a large number of branch-and-bound nodes. This research is expected to overcome these limitations and lead to a rich body of knowledge regarding connectivity problems, and, in particular, to faster approaches for solving vertex-centric connectivity problems. The work will likely generalize existing results about edge-centric connectivity and will have consequences for hop-constrained and survivable network design problems. An REU supplement has been received for student support for this project.
Sponsor: National Science Foundation
PI/PD: Austin Buchanan

Collaborative Research: Data-Driven Risk-Averse Models and Algorithms for Power Generation Scheduling with Renewable Energy Integration

The objective is to derive data-driven risk-averse stochastic optimization models and discover strong formulations with efficient decomposition algorithms for the power generation scheduling problems with renewable energy integration, so as to ensure cost effectiveness and system robustness. In this project, an innovative approach will be explored that integrates statistics and optimization methods to derive a reliable and cost-effective power generation scheduling decision. Starting from the historical data, the project team will develop data-driven risk-averse stochastic optimization models and explore efficient algorithms for both system operators and market participants.
Sponsor: National Science Foundation
PI/PD: Chaoyue Zhao

MRI: Acquisition of Shared High Performance Compute Cluster for Multidisciplinary Computational and Data-Intensive Research
Under this Major Research Instrumentation project, OSU HPC Center will acquire, deploy and maintain an HPC cluster supercomputer named Pistol Pete to support computing- and data-intensive research and research training, across a broad range of Science, Technology, Engineering and Mathematics (STEM) disciplines. As a campus-wide shared resource, Pistol Pete will be available at no charge not only to all OSU faculty, staff, postdocs, graduate students and undergraduates, but also to researchers across Oklahoma. The current HPC system is considerably oversubscribed, as are major national resources; thus, this project will enable substantial transformative STEM research across a broad variety of disciplines.
Sponsor: National Science Foundation
PI/PDs: Baski Balasundaram
Arts & Sciences: Dana Brunson, Christopher Fennell, Mario Borunda
Division of Agricultural Sciences & Natural Resources: Peter Hoyt

Collaborative Research: Risk-Averse Cluster Detection in Network Models of Bigdata Under Measurement Uncertainty
This project will establish theoretical and computational foundations that lead to polyhedral and probabilistic approaches for detecting low-diameter clusters in network models of social and biological big-data that are subject to measurement errors and incomplete information. The proposed polyhedral study of the "k-club" cluster model is novel as it is the first nonhereditary graph property to be investigated in the polyhedral combinatorics literature. Conditional-value-at-risk-constrained k-club detection models in a random graph will be studied to produce risk-averse solutions. Sampling-free exact decomposition algorithms will be investigated that exploit the combinatorial structure of the sample space.
Sponsor: National Science Foundation
PI/PD: Baski Balasundaram

Industrial Assessment Center Program
The mission of the IAC is to assess energy, waste, and productivity practices with the purpose of enhancing the management of the same within the clients enterprise and to share best practices with other IACs, while educating and training the next generation of energy, waste, and productivity professionals. The IAC will continue to serve clients throughout Oklahoma,

Arkansas, Kansas, and north and northwest Texas, including the Texas Panhandle. The latest technology will be employed to perform assessments that focus on energy, waste, and productivity issues in the clients' facilities.
Sponsor: Department of Energy
PI/PDs: William Kolarik, Terry Collins
Mechanical Engineering Technology: Hitesh Vora

Materials Science and Engineering

Loading-rate and Constraint Dependent Hydraulic Fracturing of Shale: Optimizing Resource Extraction
This study investigates the fracture response of shale as a function of loading rate and constraint to formulate a predictive model for failure mechanisms. It is speculated that the interplay of loading rate and constraint can affect a ductile-to-brittle transition in the failure process. Systematic evaluation involving specimens from petrologically distinct basins will be covered to determine failure of shale as a function of its microstructure and mineral content. The overall objective of this project is to build real-time predictive models of shale fracture as a function of mineral constituent, prevailing confinement pressure, and rate of loading employed during fracking.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PDs: Raman Singh
School of Geology: James Puckette

Smart Sensor Development Using Infrared Sensible OLEDs
OSU is collaborating with the Korea Institute of Technology for smart sensor development using infrared sensible OLEDs. OSU's part of the work will include: 1) fabrication of organic infrared photodetectors, 2) characterization of photodetectors, 3) fabrication of all-organic IR-to-visible up-conversion OLEDs, 4) characterization of up-conversion OLEDs.
Sponsor: Korea Institute of Industrial Technology
PI/PD: DoYoung Kim

Assessment of Radiation Shielding Properties of Novel and Baseline Materials External to ISS
The project will test and measure the radiation shielding and other properties of the multifunctional materials developed in previous awards. In this project, the materials will be tested in the actual space environment external to the International Space Station.
Sponsor: National Aeronautics and Space Administration
PI/PDs: Ranji Vaidyanathan
Mechanical & Aerospace Engineering: Andy Arena
Department of Physics: Eric Benton

Static: Coupon Level Testing and Reporting

Nordam will supply 10 different sets of specimens of different materials for two types of testing namely flatwise tensile (ASTM C297) and tensile lap shear (ASTM D1002). Each set of specimen will be machined and polished according to ASTM standard. After testing, pictures of each specimen will be taken to check the validity of the failure. Load-displacement data will be collected from the raw data files. Data will be analyzed to obtain the strength values from the ASTM standards.
Sponsor: The NORDAM Group
PI/PDs: Kunal Mishra, Raman Singh

SBIR Phase I: Tough Polymer Composite Materials Through iLAMB, or Interlaminar Modifications Through Master Batching
MITO and its University research partner (OSU) will develop and demonstrate the toughness enhancing nanofiller-resin "Master Batch" system with no manufacturing process changes, resulting in an increasing toughness at significantly lower addition levels compared to state of the art nanofillers to enhance the performance of carbon-epoxy systems.
Sponsor: MITO Material Solutions
PI/PDs: Ranji Vaidyanathan, Raman Singh

Lightning Strike Mitigation Materials
LMS Composite's research has led to a simple and affordable manufacturing step based on highly conductive flexible films that can be introduced either on the surface or inside the composite to enhance the through-thickness conductivity of composite materials, leading to composite materials that can withstand multiple lightning strikes as well as provide enhanced conductivity. This blend can be dispersed directly into different resin systems used for fabricating a composite or placed between laminates of the composite to enhance its electrical or thermal conductivity, depending on the nanofiller content added. This project will further validate the hypothesis and demonstrate commercial viability.
Sponsor: National Collegiate Inventors & Innovators Alliance (NCIIA) d/b/a/ VentureWell
PI/PD: Ranji Vaidyanathan

Cryocel-Lightweight Composites for Cryogenic Fuel Storage for Transportation
In this OARS Accelerated Project, a team from Oklahoma State University (OSU) – CleanNG LLC doing business as Infinite Composites Technologies (ICT) is developing a lightweight, novel "Cryogenic Composite Engineered Laminated (*CryoCEL*™)" tank for storage of low-temperature, pressurized fuels. The ideal application for this project is fuel containers for transportation applications, where the technology addresses the need for low-cost, lightweight technologies and the ability to keep the fuel stored at cryogenic temperatures without boil off. The project is projected to result in $15.90 million in revenues and 104 jobs to ICT/CleanNG and additional wages in the state of $8.82 million.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PD: Ranji Vaidyanathan

Nanostructured Materials for Li-Ion Batteries with High Capacity and Performance

The purpose is to develop state-of-the-art Li-ion battery materials with enhanced capacity and performance. It is anticipated that the research will result in new anode and cathode materials with at least 2X enhancement in capacity and performance. The research relies on quick and easy to implement experimental techniques to develop the battery materials. The end users of this technology include Li-ion battery materials manufacturers, alternative energy, portable electronics, and automobile industries. Three local OK commercial partners have been identified who are interested in commercializing the technology upon demonstration of the proof-of-concept.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PDs: Raj N. Singh, Nirmal Govindaraju

Reduced Cost, Repeatable, Improved Property Washout Tooling for Composite Fabrication
The purpose of the project is to collaborate with ACM LLC to develop and manufacture new water-soluble tooling materials that can meet the needs for future composite systems.
Sponsor: Advanced Ceramics Manufacturing, LLC for Office of Naval Research
PI/PD: Ranji Vaidyanathan

Loading-rate and Constraint Dependent Hydraulic Fracturing of Shale: Optimizing Resource Extraction
The long-term objective is to build real-time predictive models of shale fracture as a function of mineral constituent, prevailing confinement pressure, and rate of loading employed during fracking. These models could then be calibrated using historical data collected during hydraulic fracturing and subsequently used for maximizing resource extraction efficiencies. In this project, the researchers will quantify the fracture response of shale as a function of loading rate and constraint to formulate a predictive model for failure mechanisms. It is speculated that the interplay of loading rate and constraint can affect a ductile-to-brittle transition in the failure process of shale.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PDs: Raman Singh
Geology: James Puckette

High Performance Composites Using Graphene Oxide POSS as Fillers
The OSU MITO Materials Solutions team has developed a toughening additive that can be blended directly into an epoxy resin at concentrated levels to create a “Master Batch,” which can be incorporated into the current composite manufacturing process without any process changes. The purpose of this project is to demonstrate that the Master Batch system can result in increased toughness at significantly lower addition levels compared to state of the art nanofillers to enhance the performance of carbon-epoxy systems. New formulations as well as new POSS molecules will be evaluated for reduced cost and improved performance.
Sponsor: MITO Material Solutions
PI/PD: Ranji Vaidyanathan

EAGER: Damage Evolution at the Fiber-Matrix Interphase for Early Failure Characterization in Composites

This proposal will investigate the mechanics-based failure and deterioration of a fundamental aspect of composites that has received only limited attention to date, namely the influence of the fiber-matrix interface and interphase region. Using a set of unique experiments and analysis procedures the team will quantify constituent-level failure mechanisms that occur at the fiber-matrix interface and within the interphase region at nano/micro-length scales.
Sponsor: National Science Foundation
PI/PD: Raman Singh

Development of STEM Teaching Aids for Low-income Schools
This project seeks to develop low-cost teaching aids for low income schools in the Tulsa, OK area. The teaching aids developed are concept driven and hence can be transplanted with ease to other schools and scaled nationally.
Sponsor: Materials Research Society Foundation
PI/PD: Nirmal Govindaraju

Cryocel-Lightweight Composites for Cryogenic Fuel Storage for Transportation
In this OARS Accelerated Project, a team from OSU – CleanNG LLC doing business as Infinite Composites Technologies (ICT) is developing a lightweight, novel "Cryogenic Composite Engineered Laminated (CryoCEL™)" tank for the storage of low-temperature, pressurized fuels. The ideal application for this project is fuel containers for transportation applications, where the technology addresses the need for low-cost, lightweight technologies and the ability to keep the fuel stored at cryogenic temperatures without boil off.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PD: Ranji Vaidyanathan

Innovation Corps Site Program
The vision for the Oklahoma State University I-Corp Site is to increase the number of STEM-related startups and licensing opportunities emerging from the OSU campus. The OSU I-Corp Site will accelerate startup activity on campus not only by providing funding and training to startup teams, but by helping create a faculty and student population that is familiar with the business startup process. It will also provide a pathway for underrepresented students to participate in STEM-related business startups. The grant will provide 90 teams (over a three year period) $3,000 in funding per team along with training in the startup process.
Sponsor: National Science Foundation
PI/PDs: Ranji Vaidyanathan
Spears School of Business: Bruce Barringer

Materialsient
At the OSU Next Generation Materials lab, a student-led team has been investigating innovative technologies based on combining the latest advances in improving the interlaminar properties of carbon fiber reinforced polymer composites towards realizing affordable and effective point of toughening so that they may be used for multiple applications in the automotive and aerospace fields. The team's on-going research has led to a simple and affordable additional manufacturing step based on nano-interfacial modification using safe and affordable nanofillers

that can be incorporated into existing manufacturing processes. This modification has a high commercialization potential based on limited customer discovery.
Sponsor: National Collegiate Inventors & Innovators Alliance (NCIIA) d/b/a/ VentureWell
PI/PD: Ranji Vaidyanathan

Electromagnetic Strategies for Locatable Plastic Pipe
Oklahoma State University will provide access and expertise for the operation of the labscale extrusion system located in the Helmerich Advanced Technology Research Center.
The partially supported graduate student will run extrusion experiments and help the University of Tulsa researchers optimize extrusion parameters to meet the technical needs of the proposed research project.
Sponsor: The University of Tulsa for the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration
PI/PD: Raman P. Singh

Mechano-chemical Recovery of Platinum Group Metals (PGMs) from Metal-Foil Supported Spent Auto Catalysts
The objective is to develop a new mechano-chemical method for efficient and improved recovery of Platinum Group Metals (PGMs) from used metal-foil supported auto catalysts. It is proposed that using a mechano-chemical approach the catalyst washcoat can be “peeled” off from the metal-foil substrate. This method will offer a significant improvement in recovery of the PGMs in comparison to the mechanical separation methods. Moreover, as the wash coat with precious metals will be the only constituent requiring further processing, a far smaller quantity of material will need to be refined and thus will translate into significant savings.
Sponsors: Oklahoma Center for the Advancement of Science and Technology, Duncan Recycling & Refining, LLC
PI/PDs: Pankaj Sarin, Ranji Vaidyanathan

REU Site: Interdisciplinary Research Experience for Undergraduates Interested in Materials Science and Engineering
The award will enable cutting edge research projects encompassing the broad area of materials science and engineering and how this knowledge is being used in the industry. The faculty working in broad areas related to materials science and engineering at the Helmerich Research Center at Oklahoma State University in Tulsa, OK and their graduate students will mentor 10 undergraduate students recruited nationally and guide the students in areas ranging from aerospace, energy and biomaterials. They will learn techniques related to materials processing, testing and characterization and understand how technology commercialization could transition from the lab-scale to the real world.
Sponsor: National Science Foundation
PI/PDs: Ranji Vaidyanathan, Pankaj Sarin

Modification of the Coefficient of Thermal Expansion Analysis Suite (CTEAS)
Support from GE Global Research will be used to improve the existing Coefficient of Thermal Expansion Analysis Suite (CTEAS) software developed as a freeware by the principal investigator

Dr. Sarin. Some areas for improvement of CTEAS software include: 1) Matlab based GUI interface for the CTEAS software, 2) Ability to install and run the CTEAS without the requirement for a Matlab license, 3) Corrected and updated user manual.
Sponsor: GE Global Research
PI/PD: Pankaj Sarin

Radiation Smart Structures with H-rich Nanostructured Multifunctional Materials
Through this NASA EPSCoR award, radiation smart structures and materials with H-rich nanostructured multifunctional materials will be developed and built for shielding astronauts from ionizing radiation during human missions beyond low-Earth orbit. The approach is interdisciplinary and involves research groups in Materials Science and Engineering at OSU Tulsa, the Dept. of Physics and Mechanical and Aerospace Engineering at OSU Stillwater. The research will find applications in a number of radiation based industries including medical physics and nuclear power generation in which high-strength, lightweight radiation shielding materials and appliances are needed.
Sponsors: University of Oklahoma for NASA EPSCoR, University of Oklahoma for Oklahoma State Regents for Higher Education
PI/PDs: Ranji Vaidyanathan
Mechanical and Aerospace Engineering: Raman Singh
Physics: Eric Benton

Direct Ink Writing Process Improvements
The goal is to investigate and enhance the direct ink writing process (also known as "3D printing" and "robocasting") to enable fabrication of 3D objects with microscale features. This project will expand the design space for many applications and will lead to high-impact publications describing both the processes and resulting materials and structures. OSU researchers will design and fabricate a mixing nozzle device capable of mixing two or more ink materials at arbitrary compositional ratios. OSU researchers will also develop and provide custom software for running the mixing nozzle printhead.
Sponsor: Lawrence Livermore National Security, LLC
PI/PDs: James Smay

Nano-Particles for Drug Delivery and Treatment of Urinary Tract Infections
A critical unmet need exists for the development of nanotherapeutics that can serve as targeted molecular agents for eradicating a variety of persistent intracellular infections of the urinary tract. Therefore, there is an urgent need to develop targeted, low-dosage antibiotic treatments for eradicating a variety of persistent intracellular infections of the urinary tract. The research lays the foundation for such treatments by demonstrating that diamond nanoparticles (DNPs) are viable platforms for efficient delivery of antibiotics such as amoxicillin to kill bacteria in cells. It is envisaged that the research will lead to novel targeted low-dosage DNP-based UTI treatments.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PDs: Raj Singh
Center for Health Sciences: Rashmi Kaul, Anil Kaul

RDIP: Interns for Liquefied Fuel Composite Tanks
The interns will work on a project that could revolutionize the automotive industry. Traditionally vehicles have used high-pressure cylindrical tanks to store natural gas for fuel, which have the disadvantage of being heavy, bulky, and potentially dangerous. This project is focused on solving these problems by way of a low-pressure tank that can store various fuels at cryogenic temperatures. The low pressure allows for the tank to be constructed lighter and conformable to non-cylindrical shapes. Additionally, storing the fuel at cryogenic temperatures means that it can store the fuel at 30% lower space for the same volume of fuel.
Sponsors: Oklahoma Center for the Advancement of Science and Technology, CleanNG LLC dba Infinite Composite Technologies
PI/PD: Ranji Vaidyanathan

Self Repairable Seals by Crack Healing of Glass and Glass-Ceramic Composites for Solid Oxide Fuel Cells
A study of the crack-healing in glasses and glass-ceramic composites of varying composition and reinforcement/ceramic phase is proposed to show a systematic correspondence with the physical properties, such as glass transition and softening temperatures, coefficient of thermal expansion, modulus, viscosity, surface energy/tension and creep behavior, thereby elucidating the key materials parameters affecting crack-healing mechanisms.
Sponsor: National Science Foundation
PI/PD: Raj N. Singh

Viscous Heating Demonstration for Helminth Deactivation
Fecal sludge contamination with helminthes causes many health issues in poor countries that lack sophisticated waste treatment facilities. The most problematic is contamination of soil when solid human waste is scattered on the topsoil where residents may become (re)infected with helminthes through ingestion of contaminated food or through direct contact by open wounds in the skin. Our technology is designed to heat a fecal sludge stream by pumping it through an intense shear zone reactor where viscous (friction) heating is used to uniformly heat the feedstock above a threshold temperature to kill the helminth eggs.
Sponsor: Curators of the University of Missouri at Kansas City for Bill & Melinda Gates Foundation
PI/PD: Jim Smay

Mechanical and Aerospace Engineering

Horizon: Attachment, Carry and Release Mechanism
As the subcontractor, OSU will perform activities required to design, develop and integrate an attachment, carry and release mechanism capable of carrying a 1.6 pound object and accurately place the object onto a vertical surface. This mechanism will use a Commerical-Off-The-Shelf unmanned air vehicle.

Sponsor: Cambridge International Systems, Inc. for the National Institutes of Health
PI/PD: Jamey Jacob

General Atomics Acoustic Measurements
The PI will be conducting Static Acoustic Measurements and collecting data for General Atomics.
Sponsor: General Atomics
PI/PD: Rick Gaeta

Finite Element Simulations on the Large Deformation of Films Near the Forming Shoulder of a Vertical Packaging Machine
The research project objective is to develop a 3D finite element model for obtaining the strain and stress distribution in the flexible packaging films traveling through different formers. The 3D finite element model will use the material properties of the film, two representative former shapes, and simulate the tension applied on the film under working condition, as well as the effects of the base roller distance.
Sponsor: PepsiCo
PI/PD: Shuodao Wang

Space-borne Antennas & Circuits for Condensed Radars and STEM (SPACERS)
Goals of the project include: 1) development of a transmit/receive module for a space-borne version of NASA's EcoSAR, 2) innovative circuits for space-borne antennas, 3) scientific validations of goals 1 and 2 via engineering experiments, and 4) future workforce STEM education.
Sponsor: National Aeronautics and Space Administration
PI/PD: Andy Arena

Research on Inflatable Kite Technology
This visiting research scholar program will include: 1) inflatable technology development, 2) kite dynamics modeling, 3) designing and building up the flight system, 4) validation of the system.
Sponsor: Toyota Motor Corporation
PI/PD: Jamey Jacob

Assessment of Radiation Shielding Properties of Novel and Baseline Materials External to ISS
The project will test and measure the radiation shielding and other properties of the multifunctional materials developed in previous awards. In this project, the materials will be tested in the actual space environment external to the International Space Station.
Sponsor: National Aeronautics and Space Administration
PI/PDs: Andy Arena
School of Materials Science & Engineering: Ranji Vaidyanathan
Department of Physics: Eric Benton

Blind Deconvolution of Massively Separated Turbulent Flows
The project will develop a new turbulence modeling framework that will improve the prediction of separated flows, which is of critical importance to NASA. The main innovation is the blind

deconvolution algorithm, which discovers appropriate closures from resolved data rather than purely physical conjecture and bridges the consistency gap between physical arguments and mathematical approximations, with the goal of developing more robust and accurate closure models for such complex phenomena. This project will transform the state-of-the-art turbulence models by offering a new machine learning-enabled predictive turbulence modeling approach for coarse-grained simulations to understand massively separated turbulent flows in many NASA relevant applications.
Sponsor: University of Oklahoma for NASA
PI/PD: Omer San

Atmospheric Turbulence Modeling and its Impact on sUAS for Unmanned System Traffic Management
This project targets the technical gap of modeling navigation performance of sUAS in the presence of turbulence and creating sUAS encounter models. In particular, the investigators will pursue a tight integration of reduced-order modeling of turbulence with sUAS dynamics models to understand performance and limitations of current navigation solutions onboard sUAS. Both fixed-wing and quadrotor UAS will be studied. The anticipated research results will contribute towards developing encounter models of sUAS and minimal navigation performance specifications for sUAS operating in the National Airspace Systems.
Sponsor: University of Oklahoma for NASA
PI/PDs: He Bai, Balaji Jayaraman

Flow Field Velocimetry and Mixing of Impinging Gas Jets
The experimental setup will provide information about the flow field and mixing performance of impinging jets, which will accelerate testing, and development of new burners at John Zink Company. The nozzle generating two impinging jets will be manufactured by John Zink Company to fit the gas jet test facility at the PI's lab. The two jets will be tested at chocked conditions and will share the same injection plane. The 2D Particle Image Velocimetry setup will be used to generate the velocity field at the impinging jets plane. The seeding particles loading will be increased to investigate the mixing qualitatively.
Sponsor: John Zink Company
PI/PD: Khaled A. Sallam

Application of Raman and Infrared Microscopy for the Forensic Examination of Automotive Clear Coats and Paint Smears
Current approaches by PDQ, the largest forensic automotive paint database, to identify clear coats have been unsuccessful because the FTIR spectra of clear coats are too similar to generate accurate hit lists by searching clear coat FTIR spectra alone. Recent studies of pattern recognition methods applied to FTIR spectra of clear coats show that information about the line and model of the vehicle can be obtained from these spectra. To enhance the discrimination power of clear coats, Raman spectroscopy and pattern recognition techniques will be investigated as a solution to the problem of extracting investigative lead information from clear coats.
Sponsor: U.S. Department of Justice

PI/PDs: Kaan Kalkan
Arts & Sciences: Barry K. Lavine

Reducing Time to Market for Commercial AC Equipment through Development of a Simulation Platform for Multi-Circuit Evaporator Coil Performance
The research focuses on the development of a new heat exchanger simulation model for multi-circuited heat exchangers. This model will include consideration of cross-fin conduction for multi-circuited coils. The new model will be implemented into Johnson Controls International's (JCI's) simulation platform to allow usage for coil design with graphical user interfaces. The model will allow JCI a more competitive product development process.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PDs: Christian Bach, Craig Bradshaw

Truth Measurement of Signal Strength Task 0002
The FAA provides opportunities for educating and training future aviation electronics professionals through theoretical studies and practical applications. The scope of work may include: 1) Predict 3D radiation patterns for various installed antennas on the flight inspection aircraft; 2) Design, develop, and certify a UAS that can serve as a reference measurement system for certifying new aircraft Flight Inspection Systems; 3) Use the UAS as a platform for testing new flight inspection sensors and antennas; 4) Design, develop and research feasibility of using rotary wing UAS to support more precise and efficient ILS flight inspection; 5) Other tasks agreed upon.
Sponsor: Federal Aviation Administration
PI/PDs: Jamey Jacob, Gary Ambrose
Electrical and Computer Engineering: Jim West

Collaborative Research: The Roles of Inter-limb Jets and Body Angles in Metachronal Swimming of Crustaceans
This project examines how small-scale interactions between adjacent limbs of crustaceans coalesce with large-scale flow past the body. Recent robotic models show the formation of suction and expulsion jets between adjacent paddles due to their time-varying geometry that is dictated by the phase difference in motion. Self-propelling metachronal swimming robots will be developed to examine swimming of individuals and aggregates. The findings will provide insight into crustacean foraging, and how schooling behavior in krill is influenced by hydrodynamic cues. Understanding functional roles of pleopod kinematics and body shape on swimming performance will identify biomimetic design principles for autonomous underwater vehicles.
Sponsor: National Science Foundation
PI/PD: Arvind Santhanakrishnan

Fundamental Study of the Ultra Precision Machining and Near Surface Damage Evolution in Single Crystal Fluorides for Advanced Optics
The objective is to test the hypothesis that degradation in optical performance of single crystal calcium fluoride which has been finished by ultra-precision machining is directly related to the

nature and extent of the near surface damage introduced. The research will utilize specially designed cutting experiments on single crystal calcium fluoride to investigate the crystal response to machining with single crystal diamond tools. Three cutting geometries will be considered. After surface generation, the resulting subsurface damage will be investigated with Rutherford backscattering spectrometry and cross sectional transmission electron microscopy. Changes caused by machining to transmissivity and birefringence will be quantified.
Sponsor: National Science Foundation
PI/PD: D.A. Lucca

UAS Component Development and Testing for Autonomous Utility Inspections
The statement of work includes: 1) Integrate and test autonomous navigation technologies into SUAS; 2) Integrate software systems for airborne compatible image capture and Analysis; 3) Develop and test low-cost sense and avoid system; 4) Develop easy-to-use and adaptable situational awareness software for ground control; 5) Integrate full system into unmanned aircraft platforms and evaluate in different commercial environments; 6) Test in relevant environments, including complex infrastructure elements.
Sponsor: OSU Foundation for National Energy Solutions Institute – Smart Energy Source Association (NESI-SES)
PI/PD: Jamey Jacob

Development of "Optimized" FME UAV Platform – Raven Clone Supplement
GE's Project Raven is a UAV modified with visual reconnaissance and CH4 laser sensing. OSU will provide the assembly of this UAV with the GE provided sensor, the testing facility of this prototype, and demonstration of system.
Sponsor: Avitas Systems Inc.
PI/PD: Jamey Jacob

Photolytic Nanoconjugate Fuel Generators
The long-term goal is to develop a novel fuel-generating (H_2 and CO from water and CO_2) photoelectrochemical (PEC) device, which consists of a metal oxide semiconductor nanowire decorated with metal nanoparticles. The investigator hypothesizes electronic, electrostatic and plasmonic mechanisms, which are unique to the nanoconjugate device structure and materials. These hypothetical attributes will be verified and elucidated by designed experiments. Based on encouraging preliminary results using sol-gel prepared vanadium oxyhydrate nanowires coated with nanogold (5.6% light-to-hydrogen efficiency with H_2 to O_2 ratio of 2.0 under 445 nm radiation), the project aims at high conversion energy and stability.
Sponsor: National Science Foundation
PI/PD: Kaan Kalkan

The Efficacy and Safety of Silicone O-ring Intrauterine Devices as a Horse Contraceptive Through a Captive Breeding Trial
The purpose is to complete research on the safety and efficacy of an IUD device that has high potential value in feral horse population management and control. Earlier research has shown near 100% contraception when the devices are retained in mares. We are testing a modified

IUD, designed for higher retention in the mare. Two years of research have been completed (FY16-17) on the work described in the supporting CESU agreement (G16AC00050) and project study plan, and this agreement will enable two additional years of direct evaluation of IUD retention rates and biophysical reaction of female horses to IUDs.
Sponsor: U.S. Geological Survey
PI/PDs: Shuodao Wang
Center for Veterinary Health Sciences: G.Reed Holyoak, Candace Lyman

Unmanned Airspace Innovation Challenge – Hack A Thon
The purpose of the funding is for a student competition for undergraduate and graduate teams to push the boundaries of unmanned aircraft system operations and improve safety within the National airspace through exploitation. The challenge tasks include: 1) Report GPS location of target drone, 2) Hijack the target drone, and 3) Disable the target drone.
Sponsor: ASRC Federal Analytical Services, Inc.
PI/PDs: Jamey Jacob
CEAT: Gary Ambrose

Truth Measurement of Signal Strength
The purpose of this agreement between the FAA and OSU is for engineering support to promote the technological advancement of the FAA mission for flight inspection. OSU experience and expertise will be utilized initially to test and calibrate flight inspection system measurements using a combination of engineering analysis, lab testing, and UAS airborne measurements. Additional work may be advanced to testing of UAS for actual flight inspection tasks. OSU may also be tasked for testing, evaluation, measurement, and data analysis necessary to research additional flight inspection issues.
Sponsor: Federal Aviation Administration
PI/PDs: Jamey Jacob
Electrical and Computer Engineering: Jim West

SOFWERX PII
The Doolittle Institute @ SOFWERX is developing an Interceptor Drone with the goal of leveraging the high speed, highly maneuverable flight characteristics of FPV racing quadcopters. The Interceptor Drone will combine these characteristics in a robust and damage resistant design that protects the propellers, folds/compacts for travel, is capable of carrying a shotgun payload, contains flight aides, and has tool-less maintenance. OSU will design and prototype one or multiple Interceptor Drones to meet the design criteria.
Sponsor: DooLittle Institute at Sofwerx for USSOCOM
PI/PD: Jamey Jacob

Effect of Inlet Duct and Damper Design on ASHRAE 37/116 Fan Performance and Static Pressure Measurements
The objective of this project is to develop an inlet duct design guideline for inclusion into the AHRI and ASHRAE testing standards. This guideline will reduce the risk of false testing failures and lead to a higher integrity of the testing results across different laboratories. The guideline

will reduce the design space towards a set of configurations and report the resulting performance differences relative to reference configuration.
Sponsor: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
PI/PDs: Christian Bach, Omer San

Experimental Validation of Refrigerant Charge Models in Coils for Residential Split Systems
The goal of the project is to provide high quality data for oil retention and refrigerant charge in fin-tube heat exchangers. The objectives are: 1) Develop a test methodology for measuring both oil retention and refrigerant charge of round tube, plate fin (RTPF) heat exchangers, 2) Obtain oil retention and refrigerant charge data for several sets of 3-ton indoor/outdoor heat exchangers and reduce the results such that it can be used for validation of simulation models, 3) Determine local vapor-liquid fractions in subsections of the heat exchanger.
Sponsor: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
PI/PDs: Christian Bach, Craig Bradshaw

Update to Measurements of Office Equipment Head Gain Data
The purpose is to provide designers with updated information regarding heat gains from modern office equipment. This information, an outdated version of which is published in ASHRAE's Fundamentals Handbook (ASHRAE 2013), is used to estimate internal heat gains for office equipment and is an important input to cooling load calculations. The team will take measurements to provide updated data for office equipment which has changed due to technology advancements since the last time this information was updated in 2009. The results will be published as an ASHRAE paper, and updated information will be provided for the next ASHRAE Fundamentals Handbook.
Sponsor: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
PI/PD: Christian Bach

Transmission Loss Testing of a Sample Aircraft Panel with Proprietary Experimental Treatments
OSU will perform laboratory transmission loss testing on sample aircraft structural panels treated with multiple experimental blanket treatments. The main objective of this exercise is to determine transmission loss characteristics for each of the panels and treatment configurations for frequencies up to 10,000 Hz.
Sponsor: Textron Aviation
PI/PD: James Manimala

Robust Moving Target Handoff in GPS-Denied Environments
OSU will provide research and development to support UtopiaCompression Corporation's STTR Phase II program. The research and development will be specifically related to pose estimation between the target and handoff UAVs and the navigation algorithm used to guide the handoff UAV toward the target UAV. OSU will also support flight tests and integration activities associated with the Phase II program.
Sponsor: UtopiaCompression Company for Air Force
PI/PD: He Bai

Testing Unitary Equipment in a Psychrometric Facility
The project encompasses the following components: 1) Pickup of the unit to be tested at AAON's facilities; 2) Transportation of the unit to OSU's psychrometric chamber; 3) At the end of the test series, crane lifting of the unit onto AAON contracted trailer; 4) Instrumentation of the unit on the airside with calibrated sensors and connection to the VIRIAC power supply; 5) Control of the unit – single speed compressor to be controlled using DAQ digital outputs; 6) Execution of the test plan; 7) Test raw data will be returned to AAON.
Sponsor: AAON Heating and Cooling Products
PI/PDs: Christian Bach, Craig Bradshaw

SUAS Services for MFIX 2017
For the SIE 2, 3 and MFIX events, OSU will support those demonstrations with qualified pilots, UAS engineers and acoustic expert(s). OSU will investigate swarming techniques, GPS only flight profiles and operations in GPS denied environments. OSU will operate acquired platforms as well as provide their own internal platforms for technology insertions such as ADS-B command and control, swarming and other advanced flight profiles.
PI/PDs: Jamey Jacob
OSURF: Gary Ambrose

SNM: Roll-to-Roll Nanoimprint Manufacturing of Metasurfaces for Photonic and Optoelectronic Applications
Roll-to-Roll Nanoimprint Lithography is expected to overcome many limitations of current batch imprint techniques, including large area and high throughput patterning, easy demolding and lower cost. The potential for creating engineered surfaces leading to new products is significant, such as wire-grid polarizers, anti-reflective surfaces, and nanogratings for novel color filters for use in displays. This potential will be demonstrated in this project by manufacturing metasurfaces known to be useful in optical communication, information processing, laser systems and to improve the efficiency of LCD displays.
Sponsor: National Science Foundation
PI/PDs: James K. Good, Don Lucca

Simulation and Optimization System for Hard Milling with Tool Edge Effect in Aerospace Manufacturing
The objective of this proof-of-concept research is to quantitatively characterize the effects of tool edge geometry on tool wear and surface microstructure in the hard milling of AISI 4340M, with the outcome resulting in a simulation and optimization system to guide engineers in manufacturing aerospace components.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PD: Xiaoliang Jin

Modification of Near-Wall, High-Reynolds Number Velocity Profiles with Polymer Solution
This project experimentally examines how drag-reducing polymer solutions modify the near-wall region of a high-Reynolds number turbulent boundary layer. While this has been thought

to be well understood for decades, recent numerical and experimental data show significant deviation from the classical view. Available data shows a non-universal behavior when the drag reduction is above 40%, which can only be partially explained by a Reynolds number effect. Consequently, the behavior must be dependent on polymer properties. Thus this project measures the near-wall region at various values of drag reduction, Reynolds number and polymer properties (Weissenberg number, viscosity ratio, and length ratio).
Sponsor: National Science Foundation
PI/PD: Brian Elbing

Metamaterials Inspired Nonlinear and Inertant MEMS Devices
This project will investigate development of MEMS devices that incorporate metamaterial concepts. Further research on the mechanisms involved as well as interactive synergies between combinations of nonlinear and inertant microstructures along with a focus on practical strategies to scale and fabricate such designs could provide a promising first step in the direction of developing a new class of MEMS devices. Potential applications include vibration and shock isolation of sensitive electronics, broadband transduction and energy harvesting, frequency manipulation, wave steering and focusing, and amplitude-triggered mechanical encryption, all of which are significantly aligned with defense-related interests.
Sponsor: Defense Advanced Research Projects Agency
PI/PD: James Manimala

Inflatable Structures Feasibility Studies
OSU shall perform tasks in support of the development of inflatable structures on a scale model to evaluate and develop design, deployment, and control methods.
Sponsor: Toyota Motor Engineering & Manufacturing North America (TEMA)
PI/PD: Jamey Jacob

High Resolution Holographic Diagnostics for Liquid Atomization in Crossflow
In this subcontract, the investigator will perform two tasks: 1) Conduct data analysis for the large test matrix of digital holograms acquired during the summer of 2016, and 2) Improve the resolution of optical setup to reach 1 um to reduce the uncertainty in drop size measurements.
Sponsor: Taitech, Inc. for United States Air Force
PI/PD: Khaled Sallam

Enhancing the Oklahoma Alliance for Manufacturing Excellence with Applications Engineers in Rural Areas
The Applications Engineering Program works to increase the competitiveness of existing small and medium sized rural manufacturers by providing on-site, focused engineering assistance and technology transfer services. By placing a staff of engineers across the state, the program provides manufacturers with direct access to the latest in technology including access to the resources of Oklahoma State University's engineering faculty. The program is a cooperative effort between the University and the Oklahoma Manufacturing Alliance.
Sponsor: Oklahoma Alliance for Manufacturing Excellence, Inc. for National Institute of Standards and Technology

PI/PDs: Daniel E. Fisher,
Division of Agricultural Sciences & Natural Resources: Daniel Thomas

Design of an Airplane Transporting System
The goal of this project is to complete the full research, conceptualization and design for a 90 degree curve that is bounded on each end with a 15 meter straight section of the underground airplane conveyance system presented to Oklahoma State University by Airplane Transport Systems. The design process will be completed in 18 months with all documentation necessary to fabricate and install the system for testing with an aircraft.
Sponsor: ATC World Wide, LLC
PI/PDs: James Kidd
Civil and Environmental Engineering: Julie Hartell, Mohamed Soliman
Electrical and Computer Engineering: Nishantha Ekneligoda
New Product Development Center: Robert Taylor

Edge Aerodynamix Conformal Vortex Generators
The team will test and evaluate through qualitative and quantitative visualization the Edge Aerodynamix, Inc. Conformal Vortex Generators via various diagnostic techniques in aerodynamic facilities at OSU. The purpose of this effort is to conduct contract services to better understand the behavior of the flow control effects generated by the Edge technology.
Sponsor: Edge Aerodynamix, Inc.
PI/PDs: Jamey Jacob, Brian Elbing, James Kidd

C-RAM Flight Support
OSU will provide a minimum of two trained pilots and additional support personnel as needed for a flight test event at Yuma Proving Grounds in Yuma, AZ. In addition, OSU will assemble, integrate, and conduct training with multiple aircraft in preparation for the event.
Sponsor: ASRC Federal Holding Company for United States Army
PI/PDs: Jamey Jacob
OSURF: Gary Ambrose

CAREER: Surface Texturing of Bulk Metallic Glasses for Fabrication of Structured Micro Optics
The objective is to determine the microstructural evolution and material deformation modes of the workpiece in the diamond surface texturing of bulk metallic glasses (BMG) for fabricating structured micro optical molds. This research proposes a novel technique of fabricating the molding insert through direct surface texturing on BMG by diamond micro milling with planar vibration of the workpiece. This new process is expected to significantly reduce production costs by eliminating the need of producing the master mold, as well as increase process efficiencies by generating various geometric features through dynamically modifying the motion of the workpiece.
Sponsor: National Science Foundation
PI/PD: Xiaoliang Jin

Development of "Optimized" FME UAV Platform – MVP3

Previously, OSU conducted proof-of-concept testing of the UAV system, demonstrating that a UAV-based methane detection system is technically feasible. GE's MVP3 is an optimized methane-sensing UAV. GE will provide the sensor to OSU. OSU will provide the autopilot system and integrate it with the UAV platform, the testing facility of this prototype, and the CH4 leak source at the ground level.
Sponsor: GE Global Research
PI/PD: Jamey Jacob

Vision-Based Sense and Avoid Solution for Small UAS
The scope of this project includes developing maneuvering intruder ranging algorithms, integrating the existing algorithm with the developed maneuvering intruder ranging algorithm in an IMM filtering framework, evaluating the performance of the algorithms using simulations and flight test data, and refining the algorithms.
Sponsor: UtopiaCompression Company for DARPA
PI/PD: He Bai

Sensor and Information Research Center for Understanding Systems
The objective is to investigate properties of statistical observability and its interaction with controllability. When designing a statistical estimator, the goal is generally to minimize uncertainty of the output below some threshold amount. In linear systems, this is simplified by the fact that performance of the estimator is solely a function of the system itself and the inputs. In real-world systems, however, the control inputs can have a significant impact on performance of the estimator. This project will investigate tools to help estimate what the impact of different control inputs will be on statistical observability of a nonlinear system.
Sponsor: Wright State University for Air Force Research Laboratory
PI/PD: He Bai

UNS: Potomodulation of forster cycle in a Fluorescent Protein
Currently, super-resolution optical microscopy for subcellular imaging is in need of photoswitchable fluorophores with faster and more efficient switching and higher numbers of photons emitted prior to photobleaching. The goal of the research is to verify a unique photoswitching mechanism enabled by conjugating a Fluorescent Protein (FP) and a plasmonic nanoparticle (NP). The hypothesized photoswitching is based on modulation of the light scattering from NP by resonant energy transfer to FP, which is in turn controlled by photocreation of the intermediate state in the Förster cycle of the FP.
Sponsor: National Science Foundation
PI/PD: Kaan Kalkan

UNS: Collaborative Research: Role of Bristled Wings for Flying and Swimming at Low Reynolds Numbers
Although the aerodynamic principles of insect flight at the scale of fruit flies and above are reasonably well understood, the fluid dynamic mechanisms that enable very tiny insects to generate lift or thrust remain unclear. This research will elucidate the fluid dynamic principles used by tiny insects for lift and thrust production under substantial viscous resistance at low

Reynolds numbers (Re) from 1-100. Two types of insects will be examined, including: 1) thrips, which are capable of migration between orchards in air, and 2) parasitoid wasps with a focus on fairyflies capable of flying in air and swimming in water.
Sponsor: National Science Foundation
PI/PD: Arvind Santhanakrishnan

Lightweight, Compact, Structurally-Integrated Acoustic Liners for Improved Low-Frequency Performance
There is a need to develop alternative lightweight, compact techniques to improve low-frequency sound absorption within and transmission loss through structures for aerospace, military and civil infrastructural applications. An approach combining innovative internal geometries with high specific- strength Amorphous Metal Honeycombs and novel manufacturing processes is proposed to create lightweight, compact structurally-integrated acoustic liners with enhanced damage tolerance as well as unprecedented low-frequency acoustic performance. The work will forge a partnership directly involving two Oklahoma companies (MetCel LLC and Fail-Safe Solutions LLC) and Oklahoma State University at the proof-of-concept stage.
Sponsors: Oklahoma Center for the Advancement of Science and Technology, MetCel
PI/PDs: James Manimala, Jamey Jacob, Andy Arena

RII Track-2 FEC: Unmanned Aircraft System for Atmospheric Physics
Small Unmanned Aircraft Systems (SUAS) have the potential to become an invaluable diagnostic tool for atmospheric science and operational meteorology. However, many scientific, technical, societal, and regulatory challenges must be solved before this can happen. The team of four universities across three EPSCoR jurisdictions, including atmospheric scientists, meteorologists, engineers, computer scientists, geographers, and chemists, will develop integrated smart unmanned aircraft technologies including advanced sensing and imaging, robust autonomous navigation, enhanced data communication capabilities, and data management tools. The team will also address public policy challenges related to adoption of UAS technology and integration of unmanned aircraft into the NAS.
Sponsor: National Science Foundation
PI/PDs: Jamey Jacob, Brian Elbing, Girish Chowdhary
College of Arts & Sciences: A. Frazier, C. Crick

Advanced Surface Plasma Nitriding for Development of Corrosion Resistant and Accident Tolerant Fuel Cladding
Although various surface coating techniques have been proposed to increase oxidation and corrosion resistance of fuel cladding materials, the de-bonding of the coating layer with the original cladding matrix under exposure to coolants makes such approaches unsuitable for reactor applications. Furthermore, the feasibility of techniques for large scale processing on cladding tubes remains another technological bottleneck. This project aims to develop a hollow cathode plasma nitriding technique to solve the above issues. The project will impact both the development of advanced methods for manufacturing and the development of advanced reactor in-core structural materials.

Sponsor: Texas A&M Engineering Experiment Station for Department of Energy
PI/PD: Don A. Lucca

Radiation Tolerance and Mechanical Properties of Nanostructured Amorphous-Ceramic/Metal Composites
The goal is to use a radically non-traditional approach to design amorphous-ceramic/metal composites for service in extreme irradiation environments. Rather than try to prevent microstructure changes in polycrystalline aggregates, the team will evolve composite systems where one of the constituents is intentionally synthesized in a non-crystalline or "amorphous" state. The amorphous alloys will be used to develop advanced amorphous-ceramic/metal composites with greatly improved radiation tolerance above 300 dpa (displacements per atom), stability above 500 ºC, and improved mechanical performance combining the good properties of amorphous materials (high strength and elastic limit) with those of crystalline materials (high toughness, strain hardening).
Sponsor: The Board of Regents for the University of Nebraska for the University of Nebraska-Lincoln for DOE
PI/PD: Don A. Lucca

Fundamental Studies on Sintering of Amorphous Alloys, Composites and Coatings
This work investigates basic phenomena associated with spark plasma sintering (SPS) of Fe-based amorphous alloys. The theme of the work is that the unique mechanisms of SPS sintering, including Joule heating at the particle contacts under the simultaneous influence of pulsed direct current and uniaxial pressure, will help retain amorphous structure in the sintered compacts without undesirable crystallization. A plan is proposed to overcome the challenges associated with conventional solidification processing through innovative approaches: 1) SPS of bulk amorphous alloys, 2) SPS of in-situ (crystallization induced) and ex-situ (particulate reinforced and laminated) composites, and 3) SPS of amorphous composite coatings.
Sponsor: National Science Foundation
PI/PD: Sandip P. Harimkar

Robust Adaptive Autonomy in Contested Environments
Unmanned Aircraft (UA) have seen deployment and success in diverse battle arenas, however, the current heavily-supervised UA operation paradigm is not well matched with emerging needs of conflict. This work includes development of novel adaptive learning and decision-making algorithms that can provide robust mission performance in dynamically changing contested environments. The approach departs from the emerging theory of Bayesian Nonparametric modeling, leading to: 1) New scalable nonparametric predictive models and inference techniques for stochastic nonstationary processes with both long-term and abrupt changes; 2) Adaptive decision making algorithms that utilize these models for collaborative decision-making in uncertain, nonstationary, and contested environments.
Sponsor: Air Force Office of Scientific Research
PI/PDs: Girish Chowdhary

NRI: Collaborative Goal and Policy Learning from Human Operators of Construction Co-Robots

The overall goal of the research is to investigate and significantly advance the science of collaborative interaction between human operators and co-robots. The scientific inquiries will lead to the development of algorithms that can be used to train co-robots from skilled human operators to efficiently perform complex tasks in the face of real-world uncertainty, and to guide novice operators in performing such tasks. The primary targeted application is the construction and farming equipment industry that includes complex co-robots such as excavators, wheel loaders, tractors, forage harvesters where there is a significant need to understand and improve human-robot collaborative learning.

Sponsor: National Science Foundation

PI/PDs: Girish Chowdhary

College of Arts & Sciences: Christopher Crick, Charles Abramson

NASA Oklahoma Space Grant 2015-2018

The NASA Oklahoma Space Grant Consortium includes numerous affiliates in the state including eight universities, two community colleges, two industrial affiliates, two informal science education affiliates, research center affiliate, and city government affiliate. The affiliates use NASA funding to develop programs for students to meet NASA goals. Some of the programs at OSU that receive this funding include Speedfest, Mission to Planet Earth, X-Hab, and OSU American Institute of Aeronautics and Astronautics High-Power Rocketry Team.

Sponsor: University of Oklahoma for NASA

PI/PD: Andy Arena

EnergyPlus Whole-Building Modeling and Simulation Software Development

EnergyPlus is a key part of DOE's building energy-efficiency strategy. In its ongoing program implementation and technical management efforts, the National Renewable Energy Laboratory (NREL) requires the assistance of OSU to provide technical support for new features development and for software defects resolutions.

Sponsor: Alliance for Sustainable Energy, LLC for National Renewable Energy Laboratory

PI/PDs: Dan Fisher, Jeff Spitler

Collaborative Research: Manufacturing of Complex Lenses for Thermal Imaging, Night Vision and Surveillance Systems

The objective is to test the hypothesis that when diamond milling brittle materials, the material response and character of the resulting surface and subsurface depends not only on the geometry of the tool-workpiece interaction, but also on the non-steady state nature of the process. Because of the effect on material response, some materials that are not practically diamond turnable can be machined by diamond milling. Research tasks include: 1) Design and construction of a simplified milling configuration, 2) Generation of machined specimens, 3) Surface and subsurface characterization. The outcome will identify conditions for more productive diamond milling of materials.

Sponsor: National Science Foundation

PI/PD: Don A. Lucca

Radiation Smart Structures with H-rich Nanostructured Multifunctional Materials
Through this NASA EPSCoR award, radiation smart structures and materials with H-rich nanostructured multifunctional materials will be developed and built for shielding astronauts from ionizing radiation during human missions beyond low-Earth orbit. The approach is interdisciplinary and involves research groups in Materials Science and Engineering at OSU Tulsa, the Dept. of Physics and Mechanical and Aerospace Engineering at OSU Stillwater. The research will find applications in a number of radiation based industries including medical physics and nuclear power generation in which high-strength, lightweight radiation shielding materials and appliances are needed.
Sponsor: University of Oklahoma for NASA EPSCoR
PI/PDs: Raman Singh
Materials Science and Engineering: Ranji Vaidyanathan
Physics: Eric Benton

Dynamic Data-Driven Motion Planning and Control for Pervasive Situational Awareness Application Systems
The goal is to leverage and contribute to Dynamic Data Driven Application System (DDDAS) framework to create algorithms that bring together on-demand sensing using UAVs and pervasive sensing using UGSs to support a data-driven application system that provides pervasive battlefield Situational Awareness (SA). Tasks to be performed by OSU include: 1) Perform research on value-of-information-based collaborative sensor allocation in adversarial environments, 2) Perform research on creating distributed algorithms to infer a dynamic model of the battlefield, and 3) Perform experiments to validate algorithms developed in this project.
Sponsor: Massachusetts Institute of Technology for Air Force Office of Scientific Research
PI/PD: Girish Chowdhary

NUE: Nanotechnology Education for Roll-to-Roll Manufacturing
Roll-to-Roll (R2R) manufacturing of flexible materials offers advantages over batch processing, including better yields, high speed automation, and potential to mass produce finished materials at lower costs. Since R2R manufacturing and the broader paradigm of additive manufacturing are seen as essential parts of advanced manufacturing, it is essential that these topics are introduced to undergraduate students. The goal is to educate undergraduate students in core nanotechnology topics for high precision R2R manufacturing. The investigators will develop curriculum material in nanotechnology and high precision R2R manufacturing in six undergraduate courses: Introduction to Engineering, Measurements, Manufacturing Processes, Mechatronics, Automatic Control, and Vibrations.
Sponsor: National Science Foundation
PI/PDs: Matthew Klopfstein, Xiaoliang Jin, Don A. Lucca, Prabhakar Pagilla

Left ventricular dyssynchrony in heart failure: investigation of altered hemodynamics and diagnostic accuracy of MRI using an in vitro phantom model
The central hypothesis of this study is that the diagnosis of left ventricular dyssynchrony (LVD) using magnetic resonance imaging (MRI) and treatment using cardiac resynchronization

therapy can be improved by: 1) quantifying the accuracy of MRI-based assessment of mechanical dyssynchrony maps and internal flow fraction by comparison to high-resolution benchmark datasets obtained on an MRI compatible left ventricle (LV) phantom, and 2) quantifying the mechanistic effects of septal-lateral wall motion delay on the energetics of LV function.
Sponsor: Oklahoma Center for the Advancement of Science & Technology
PI/PD: Arvind Santhanakrishnan

Protein-Nanoparticle Photoswitches for Subcellular Imaging
Super-resolution optical microscopy for subcellular imaging is in need of photoswitchable fluorophores with faster and more efficient switching and a higher number of photons emitted prior to photobleaching. The goal of the research is to develop a novel photoswitchable bioprobe for superresolution bioimaging. The photoswitch will be constructed from green fluorescent protein and silver nanoparticle (GFP-AgNP) conjugate. A potential application of the conjugate biomarkers is the intracellular imaging of cancer cells to reveal their therapeutic response to new drugs, which preferentially block cell movement and metastasis.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PDs: Kaan Kalkan
Division of Agricultural Sciences and Natural Resources: R. Miller

CAREER: Fundamental Studies on Ultrasonic Vibration Assisted Laser Surface Modification (UV-LSM) of Materials
This project investigates basic phenomena associated with *ultrasonic vibration-assisted laser surface modifications* (UV-LSM) and advances this knowledge for engineering surface microstructures and properties of advanced materials. The central theme of this CAREER proposal is that the attenuation of ultrasonic vibrations in the melt pool created during laser-material interactions will induce microscopic (interdendritic) and macroscopic (within melt pool) hydrodynamic flows in the melt influencing subsequent microstructure evolution (grain refinement, homogeneity, and defect-free surfaces). The effect of ultrasonic vibrations on rapid solidification behavior will be investigated during three laser surface engineering approaches: Laser surface melting, laser composite surfacing, and laser surface densification.
Sponsor: National Science Foundation
PI/PD: Sandip P. Harimkar

US-Germany Cooperative Research: M4 - High Resolution Surface Zone Analysis and Ion Beam Processing
In previous phases of this research, the research team utilized a range of high resolution surface techniques to quantify the mechanical and chemical nature of newly developed mold coatings for use in optical component production. The team found that ion irradiation is an effective means to convert hybrid sol-gel films to their final hardened state. The project focuses on the use of high resolution surface zone techniques to aid in the development of new advanced mold coatings based on ion irradiated sol-gel films, and to enable the near surface mechanical and chemical characterization of both mold surfaces and optical components.
Sponsor: Foundation Institute for Materials Science IWT - STB/TR4

PI/PD: Don A. Lucca

Web Transport Systems
The objectives of this research are: 1) to expand the range of static and dynamic models in WTS to include models for new elements identified by sponsors, 2) to refine the models for viscoelastic effects and web-roller slip effects, 3) to develop new models for the precise control of tension in each section in a multi-span web transport system, and 4) to develop guidelines for selection of the control algorithms which best meet the defined performance objectives for a given application.
Sponsor: Web Handling Research Center
PI/PDs: Keith Good, Karl Reid

Mechanical Behavior of a Web during Winding
The objective of this project is to develop algorithms for wound-on-tension for various types of winding in which nips are involved in the winding configuration, to study varying nip winding conditions and parameters so that the mechanics of nip winding can be quantified and incorporated into winding and defect models, and to study and develop models for nip related defects.
Sponsor: Web Handling Center
PI/PD: Keith Good

Web Wrinkling - Prediction and Failure Analysis
Web quality degradation can occur if wrinkling takes place across the rollers or inside (or upon) wound rolls. This research is concerned with determining how wrinkles form as a function of web line and web material parameters.
Sponsor: Web Handling Center
PI/PD: Keith Good

New Product Development Center

Design and Fabrication of a Cricket Farming System
NPDC will provide design engineering, fabrication and testing services for the proposed cricket farming system. NPDC will test various materials and parts to determine materials appropriate for cricket husbandry; test materials to determine what the crickets can and can't crawl on; test vibration and acceleration needed to vibrate/shake crickets for harvesting purposes; evaluate conveyor belt materials and design; and evaluate various parts and components for their intended purpose. NPDC will design an improved cricket cage system that employs an innovative matrix media and watering, feeding, and automated harvesting design. The prototype will be tested through 1-2 cricket growth cycles.
Sponsor: All Things Bugs, LLC for DARPA
PI/PD: Robert Taylor

Investigation of an Absorption/Reflection Based Chlorine Sensor
The proposed product is a non-invasive, non-destructive, long life sensor that measures active or "free" chlorine content in water or aqueous solutions using photometric quantitative analysis techniques. The end uses for this product are water monitoring and treatment industries.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PDs: Robert Taylor
Electrical and Computer Engineering: Keith Teague

Design of an Airplane Transporting System
The goal of this project is to complete the full research, conceptualization and design for a 90 degree curve that is bounded on each end with a 15 meter straight section of the underground airplane conveyance system presented to Oklahoma State University by Airplane Transport Systems. The design process will be completed in 18 months with all documentation necessary to fabricate and install the system for testing with an aircraft.
Sponsor: ATC World Wide, LLC
PI/PDs: Robert Taylor
Civil and Environmental Engineering: Julie Hartell, Mohamed Soliman
Electrical and Computer Engineering: Nishantha Ekneligoda
Mechanical and Aerospace Engineering: James Kidd

Establishing a Working Prototype Development Program
OSU's New Product Development Center (NPDC) assists Oklahoma's industry, inventors, and entrepreneurs with their product and process development, technology commercialization, and technical needs. NPDC clients often lack the resources to develop working prototypes. With this Economic Development Administration grant, NPDC will launch a working prototype development center at the OSU Institute of Technology, allowing NPDC clients to have all the necessary resources for a successful path from concept to commercialization.
Sponsor: U.S. Department of Commerce Economic Development Administration
PI/PDs: Robert Taylor

Oklahoma Small Business Development Center Network 2018
OSU's Small Business and Technology Development Center (SBTDC) was created through a partnership with the Oklahoma Small Business Development Center and with matching funds from the Oklahoma Center for the Advancement of Science and Technology. SBTDC provides business services such as business planning, financial analysis, marketing research, lending assistance, government contracting and manufacturing assistance to new or established businesses. SBTDC advisors work with business owners to determine the type of service needed. Free business counseling, low cost training, workshops and web-based tools are provided based on needs. The SBTDC works with the Small Business Development Center network across the state.
Sponsor: Southeastern Oklahoma State University for U.S. Small Business Administration
PI/PD: Robert Taylor

Oklahoma Inventors Assistance Service
The Inventors' Assistance Service (IAS) provides information, education, and assistance to Oklahoma inventors navigating the process of transitioning an idea into a product. The IAS offers workshops; maintains a website, a resource database, and a roster of contacts; offers informational materials; and offers general assistance to persons navigating the invention process. The IAS operates the Selected Inventions Program to organize inventor efforts to successfully bring an invention to the point where the process transitions to licensing, manufacturing, or recruitment of capital.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PDs: Robert Taylor, Jessica Stewart

Professional Development

Highway Construction Materials Technician Training & Certification Program
The College of Engineering, Architecture, and Technology (CEAT) at OSU is partnering with the Oklahoma Department of Transportation for the administration, management and delivery of the Training and Certification Program (HCMTP) for the Oklahoma Highway Construction Materials Technician Certification Board. This program serves ODOT, the Oklahoma Turnpike Authority, and the transportation construction industry. OSU CEAT assumes responsibility for all aspects of HCMTP training and certification including program training, certification, program administration, record keeping, and equipment upkeep and maintenance.
Sponsor: Oklahoma Department of Transportation
PI/PDs: Clayton Moorman
Civil Engineering: Stephen A. Cross

OSU as an Authorized OSHA Training Institute Education Center
OTI Education Centers are a national network of non-profit organizations authorized by OSHA to deliver occupational safety and health training to private and public sector workers, supervisors, and employers on behalf of OSHA. The OTI Education Centers Program supports OSHA's training and education mission through a variety of safety and health programs.
OTI Education Center courses include OSHA standards and Outreach Training Program trainer and update courses. The OTI Education Centers offer more than 50 courses on various safety and health topics including recordkeeping, machine guarding, confined space, electrical standards, ergonomics, safety and health management, and fall protection.
Sponsor: United States Department of Labor – Occupational Safety and Health Administration
PI/PDs: Clayton Moorman

Tribal Technical Training Center

Southern Plains Tribal Technical Assistance Program (TTAP) Center

Funded by the FTA and in cooperation with the Bureau of Indian Affairs, this program provides a resource center to furnish information, training, and technical assistance related to road and bridge construction, repair, and maintenance to over 49 tribal governments in a four-state area. The TTAP mission is to meet the educational needs of tribal governments related to roads, bridges, public transit, transportation systems, inter-governmental coordination, and economic development. An important part of the mission is to provide training sessions, classes, and workshops geared to specific tribal needs. OSU's TTAP center is one of seven TTAP centers across the U.S.
Sponsor: United States Department of Transportation - Federal Highway Administration
PI/PD: Karla Sisco

STIC Incentive: Accelerating Innovation Deployment in Oklahoma
The purpose of this project is to promote innovation to Tribes, locals, and internal staff of ODOT and FHWA through education, information sharing, and media. Through this work, TTC will elevate the state's profile to the wider transportation community (elected officials, the traveling public, and nationwide) by sharing Oklahoma's progress and successes.
Sponsor: Oklahoma Department of Transportation for the United States Federal Highway Administration
PI/PD: Karla Sisco

Division of Engineering Technology (TECH)

RAPID/Collaborative Research: Households Immediate Response During a Night Time Earthquake
The purpose of this RAPID proposal is to examine households' earthquake risk perceptions and their night time immediate response following the 2018 Eastern Taiwan Earthquake, a magnitude 6.1 earthquake which stuck Taiwan at 11:50 p.m. on February 6, 2018.
Sponsor: National Science Foundation
PI/PDs: Tristan Wu

Flame Mitigation
The main objective of this project is to check if a jet fire occurs when portable gas containers (PGCs) are tilted while being exposed to an external ignition source with and without a specifically designed Flame Mitigation Device installed. Three different sizes of PGCs (1.25 gal, 2.5 gal and 5 gal) are subject to the experiments.
Sponsor: Midwest Can Company
PI/PDs: Haejun Park, Qingsheng Wang

Industrial Assessment Center Program
The mission of the IAC is to assess energy, waste, and productivity practices with the purpose of enhancing the management of the same within the clients enterprise and to share best practices with other IACs, while educating and training the next generation of energy, waste,

and productivity professionals. The IAC will continue to serve clients throughout Oklahoma, Arkansas, Kansas, and north and northwest Texas, including the Texas Panhandle. The latest technology will be employed to perform assessments that focus on energy, waste, and productivity issues in the clients' facilities.
Sponsor: Department of Energy
PI/PDs: Hitesh Vora
Industrial Engineering & Management: William Kolarik, Terry Collins

Measuring Benefits of Horizontal Directional Drilling Compared to Open-cut Using a Real-time Wireless Smart Sensor
The objectives of the project are to measure, analyze, and quantify the benefits of horizontal directional drilling over open-cut procedures based on workers and equipment safety, productivity and airborne emission using a real-time wireless smart sensor and traffic control analyses. The outcome is expected to be empirical evidence of the benefits of horizontal directional drilling over open-cut procedures in terms of improved productivity, minimizing airborne emissions, workers and equipment safety, better traffic control management, and being a more economical solution.
Sponsor: University of Oklahoma for Southern Plains Transportation Center for US Department of Transportation
PI/PD: Jonghoon Kim

Fire Modeling of Apartment Fire
Oklahoma State University will recreate the fire that occurred in Overland Park, Kansas using a fire simulation software program. The simulation will be based on the materials and design of the building as existed at the time of the fire. Comparisons will also be made to the use of other building materials. Key variables of interest include the temperatures, heat fluxes, and fire spread. The final report will consist of a copy of the simulation results (in a visual format) as well as a document providing the technical justification of the values used in the simulation.
Sponsor: City of Overland Park, Kansas Fire Department
PI/PD: Bryan Hoskins

Understanding the Significance of Standards in Fire Protection and Related Fields
The project involves creating seven 30-minute videos as a learning resource to be integrated into existing undergraduate, graduate, and professional development courses to educate students about the role of standards in the field of fire protection. The objective of the videos is to help students understand the standard development process and the applications of codes and standards. The standards to be addressed are product standards, installation and maintenance standards, and model codes.
Sponsor: National Fire Protection Association Research Foundation
PI/PDs: Bryan Hoskins, Virginia Charter

Evaluation of the Responsiveness of Occupants to Fire Alarms in Buildings: Phase I
The overall goal of this project is to develop a guidance for best practices on emergency notification of occupants in buildings. This initial Phase I effort will focus on gathering

information from the available materials on the effectiveness of fire alarm signals, voice alarms and mobile technology on notifying the building occupants in the event of an emergency and develop a research plan in support of achieving the overall goal.
Sponsor: National Fire Protection Association Research Foundation
PI/PD: Bryan Hoskins

Smart City Potential, Assessment & Planning: Decision Support Framework for Smart Communities
Project deliverables include: 1) community land use forecast, 2) smart community mapping database, 3) smart buildings mapping database, 4) built environment framework plan, 5) evaluate existing buildings within created framework, 6) draft municipal code and comprehensive plan.
Sponsor: OSU Foundation for National Energy Solutions Institute – Smart Energy Source Association (NESI-SES)
PI/PD: Lantz Holtzhower

Flammability Standards for Building Insulation Materials – Phase II
The purpose of Phase II is to evaluate if non-flame retarded foam insulation can be used in foundation and under slab/subgrade applications. Small scale fire testing shall be conducted to compare the use of non-flame retarded insulation to flame retarded insulation in foundation and under slab/subgrade applications. A technical report will be prepared on the results of the fire testing. The OSU team will then use the input of the Task Force to draft code-change language (as appropriate) along with storage recommendations, and commentary to address the Phase I working group concerns.
Sponsor: California Department of Forestry and Fire Protection (CAL FIRE)
PI/PDs: Rob Agnew, Jarrett Metheny, Virginia Charter, Qingsheng Wang, Haejun Park

Evaluation of LPG Pool Fire Heat Flux
The main goal of the project is to conduct a technical literature review to collect quantitative data on the following from publications/research papers: 1) amount of radiant heat emitted by various sized LPG pool fires at various distances; 2) determine the heat flux values that will cause LPG storage tanks to fail. Compile these knowledge gaps in a report. The final report from this research will provide quantitative information on LPG fire hazards to the NFPA 58 and 59 Technical Committee, which may be used in revisions to the standards.
Sponsor: National Fire Protection Association Research Foundation
PI/PD: Qingsheng Wang

Collaborative Research: Study of Flammability, Mechanism and Heat/Mass Transfer Associated with Burning of Flame Retardant Polymer Nanocomposites
The objective is to understand the mechanism and to quantify the synergistic fire retardant effect of the nanofillers that form a physical barrier and the nanofillers that cause catalytic charring of the burning polymer. This will be achieved by studying the kinetics and the mass and heat transfer processes involved in the pyrolysis of the polymer with and without the

nanofillers. The work is transformational because it will for the first time quantify the synergistic fire retardant effect of nanofillers in polymer nanocomposites.
Sponsor: National Science Foundation
PI/PD: Qingsheng Wang