CEAT Fiscal Year 2017 Active Awards

Architecture

eXploration Habitat (X-Hab) 2017 Academic Innovation Challenge: 1.6 Deep Space Mars Transit Habitat Layout and Development Studies

The goal is to develop fully autonomous habitation systems that enable human exploration of space; and develop, integrate, test and evaluate Habitation Systems that will be utilized as technology testbeds and to advance NASA's understanding of alternative mission architectures, requirements, and operations concepts' definition and validation.
Sponsor: National Space Grant Foundation for NASA
PI/PDs: Steve O'Hara
Mechanical and Aerospace Engineering: Jamey Jacob
College of Arts & Sciences: J. Cecil, Blayne Mayfield, Eric Chan-Tin

Deep Space Mars Transit Habitat Layout Studies

Following upon the previous X-Hab Academic Innovation Challenge, OSU will add to, modify and utilize previously developed components to test scenarios for a full deep space Mars transit and landing for the 2016 X-Hab Academic Innovation Challenge. The goals of the project include a short-term goal of an interdisciplinary senior design project to design, build and evaluate components for horizontally and vertically oriented habitats for deep space missions and a long-term goal to develop capabilities in education, research, and outreach in the field of space habitat design.
Sponsor: National Space Grant Foundation for NASA
PI/PDs: Steve O'Hara
Mechanical and Aerospace Engineering: Jamey Jacob

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: Douglas A. Wright

Oklahoma Public and Tribal Transportation Infrastructure Employee Occupational Safety and Health Training and Evaluation – Phase 1
This project will continue a program meant to reduce the frequency and severity of public sector highway worker incidents, including those in similar capacities with Tribal Nations. The goal will be to combine both research and implementation to identify areas of emphasis while delivering needed training in which data can be collected for these workers. The objective of the project will be to use a nationally accepted OSHA 10 Hour Construction Industry curriculum that has been modified to reflect issues faced by public sector highway workers to provide both training and evaluation for continued improvement and performance measurement.
Sponsor: Oklahoma Department of Transportation
PI/PD: Douglas A. Wright

Road Safety Assessment for Iowa Tribe and Sac and Fox Nation of Oklahoma
American Indian Tribes conduct road safety assessments as part of their transportation planning programs. The purpose is to assist with determining roadway deficiencies, maintenance issues and planning for future work that benefits transportation safety. Road Safety Assessments are evaluations of tribal roadways by independent, multi-disciplinary teams to identify specific safety recommendations. RSA teams identify safety risks using sources such as crash data, maintenance logs, interviews of roadway authorities, public testimony, and field observations. This project will assist the Iowa Tribe and Sac and Fox Nation in conducting a road safety assessment by supplementing existing staff with specialized technical expertise.
Sponsor: University of Oklahoma for the Southern Plains Transportation Center for the Oklahoma Department of Transportation
PI/PD: Karla Sisco

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: Douglas A. Wright, Michael Hinkston

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

County Computer Assistance Program
With oversight provided by the Oklahoma Tax Commission (OTC), the Association of County Assessors, and the 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, conducting training programs and technical assistance for County Assessors and County Treasurers. CLGT also provides coordination with the Oklahoma Tax Commission Ad Valorem Division (OTC) in fulfilling mutual responsibilities to support State CAMA and Assessment Administration (AA) software systems.
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

Chemical Engineering

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

High-Pressure/High-Temperature (HPHT) High-field NMR Diffusivity Measurements of Sandstone and Limestone Microplugs
The sponsor will procure two sandstone and two limestone microplugs of sufficient geometry to fit inside a commercially available high field nuclear magnetic resonance (NMR) tube. The microplugs will be cleaned, dried, and scanned by x-ray computed tomography (CT) for image porosity (φ) and pore size distribution (PSD). The OSU team will repeat the CT scans on the microplugs for calibration of calculated image φ and PSD against previous data, and acquire methane diffusion and relaxation rates under maximum and minimum field gradients at 2, 4, 6, 8, and 10kpsi methane pressure and corresponding subsurface temperature by high field NMR.
Sponsor: GE Global Research
PI/PDs: Prem Bikkina, Clint Aichele
Arts & Sciences: Jeffrey White

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

Computational Modeling of Tuberculosis Granuloma Activation
Matrix metalloproteinase 1 (MMP-1) dysregulation has been recently implicated in tuberculosis (TB) activation through experimental studies, but the mechanism is not well understood. Animal and human studies currently cannot probe the dynamics of activation, so a computational approach is proposed to fill this gap. The overall objective of the study is to predict TB cavity formation (a hallmark of activation) in response to the dynamics of MMP-1 dysregulation. Mathematical and computational tools will be developed and used to test the hypothesis that the dynamics of MMP-1 regulation play a key role in the transition from latent TB to active TB.
Sponsor: National Institutes of Health
PI/PD: Ashlee Ford Versypt

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

Using a Tissue-Engineered Vascular Model to Develop Mast Cells from Adult Stem Cells
The researchers have shown it is possible to grow mast cells from one type of adult stem cells in a 3D tissue-engineered model and that these cells are different than those generated from 2D cell culture systems. The researchers believe the tissue-engineered model can be used to develop mast cells from a variety of adult stem cell sources and that the cells are more functional than those developed in 2D cell culture systems. The project will lead to a better source of human mast cells and a model that can be used to study allergic diseases and test treatment strategies.
Sponsor: Oklahoma Center for Adult Stem Cell Research
PI/PD: Heather Fahlenkamp

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

Intelligent Sensor for Closed Loop Anesthesia Delivery (iSCAD) Propofol Testing
OSU will provide advice and carry out optical spectroscopy experiments to measure propofol in whole blood and serum.
Sponsor: Physical Optics Corporation
PI/PD: Sundararajan Madihally

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

Surface and Airborne Monitoring Technology for Detecting Geologic Leakage in a CO2-Enhanced Oil Recovery Pilot, Anadarko Basin, Texas

OSU, with the cooperation of the Southwest Regional Carbon Sequestration Partnership (SWP), will develop and implement new near-surface and airborne monitoring technologies. The research will focus on the design and deployment of a dense grid of shallow subsurface and surface sensors in combination with low-altitude airborne detection of CO2 and CH4. These technologies will be deployed in the Farnsworth Oil Unit in the Anadarko Basin of the northeastern Texas panhandle, where the SWP and Chaparral Energy, LLC, are conducting CO2-enhanced oil recovery experiments.

Sponsor: Department of Energy

PI/PDs: Peter Clark

Civil & Environmental Engineering: Tyler Ley

Mechanical & Aerospace Engineering: Jamey Jacob, Girish Chowdhary

College of Arts & Sciences: Jack Pashin, Nicholas Materer

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

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

Protecting Piers of Overhead Structures from Degradation
The Ohio Department of Transportation is interested in determining the best method of protecting both newly constructed and previously constructed bridge piers. The objective of the research is to conduct an in depth analysis of the Ohio Department of Transportation's current bridge pier maintenance/protection for overhead structures process and provide recommendations on how to improve safety, production and cost effectiveness.
Sponsor: University of Cincinnati for the Ohio Department of Transportation for the Federal Highway Administration
PI/PD: Norbert Delatte

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

High-Early Strength Concrete for Pavement Top Layer Application
The need to allow for landing the C-17 aircraft one hour after placement of the pavement top layer is achievable with the expertise of the team. OSU will make the following contributions to the project: 1) definition of material performance requirements that ensure compatibility with conventional pavement construction practices and also the pavement load-carrying requirements expressed by the U.S. Air Force; 2) development of the experimental program for evaluation of alternative materials in light of the identified performance requirements; 3) comparative performance and cost analysis of alternative materials to identify the most promising system for use in the targeted application.
Sponsor: Metna Co for United States Air Force
PI/PD: Norbert Delatte

Evaluation of Maintenance Procedures for Bridge Spalling on Parapet Walls
Ohio Department of Transportation removes unsound concrete (spalling) on parapet walls and deck edges from bridges by setting up traffic control zones followed by removing the spalling with pneumatic jack hammers, which leaves the area unprotected from deicing materials used during snow and ice. The research purpose is to determine if there is a better way to remove the spalling in lieu of pneumatic tools, the best method to seal/protect the newly exposed concrete surface to prevent further deterioration, and to conduct an analysis of the current process for repairing spalling on bridge parapets and deck edges and provide recommendations.
Sponsor: University of Cincinnati for the Ohio Department of Transportation for the Federal Highway Administration

PI/PD: Norbert Delatte

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

ECDP Project: Analysis of Transportation Infrastructure Risks to Climate Change
The team will use the Environmental Protection Agency's Stormwater Management Model, a continuous rainfall-runoff model that predicts runoff volumes and water quality from primarily urban watersheds, for the downtown Oklahoma City area to analyze the impacts of climate change on existing transportation and stormwater infrastructure from extreme flood events. This model will be used to re-create the hydrologic events of May 2015 and assess the impacts

of similarly-probable flood events (but of a different magnitude) in a future climate with today's infrastructure in place.
Sponsor: University of Oklahoma for the Southern Plains Transportation Center for Oklahoma Department of Transportation
PI/PD: David Lampert

2016 Summer Bridge Program Engineering and Design and Fabrication Project: Design and Build a Truss Bridge with Popsicle Sticks
The purpose is to support OSU faculty and students to develop and implement a transportation-related student project in the 2016 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 based on their choices. Among all the activities to be undertaken is a hands-on bridge design, building, and monitoring exercise and contest.
Sponsor: University of Oklahoma for the Southern Plains Transportation Center for Oklahoma Department of Transportation
PI/PDs: Xiaoming Yang, Greg Wilber
CEAT Student Services: Lance Millis

Mitigating Dry Shrinkage Pavement Cracking by Geocell
Objectives are to investigate the effectiveness of using geocell to mitigate the dry shrinkage cracking in expansive subgrade soils, and develop preliminary design and construction guidelines to use geocell to treat expansive subgrade soils for pavement construction and maintenance. The research investigates an innovative and potentially cost effective approach to mitigate dry shrinkage cracking problems in pavements. The idea is to use three-dimensional geosynthetic product (commonly known as geocell) to direct the soil shrinkage to form a network of smaller cracks instead of a large continuous crack. The smaller cracks are less likely to propagate through the asphalt concrete surface.
Sponsor: University of Oklahoma for the Southern Plains Transportation Center for US Department of Transportation
PI/PDs: Xioaming Yang, Rifat Bulut, Joshua Li

Assessing the Risk of Landslide on I-35 Near Davis, Oklahoma Using LiDAR
The main goal of this research is to investigate the use of Light Detection and Ranging (LiDAR) technology for slope monitoring and landslide/rockslide risk assessment on major highways in Oklahoma. This research will yield an innovative procedure for ODOT to use to monitor the slopes and assess the risk of landslide on the Oklahoma highways in the mountainous regions, thereby proactive actions can be taken to reduce the disruptions and dangers to the public traffic due to the disaster of landslide.
Sponsor: University of Oklahoma for the Southern Plains Transportation Center for US Department of Transportation
PI/PDs: Yongwei Shan, Joshua Li, Xioaming Yang

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

16S and NarK methodology development for Anammox
The first part of this project is to analyze the 16S rRNA genes for Anammox bacteria in a culture from the University of Arizona by PCR and clone library analysis. The second part of this project is to develop the methodology to analyze the NarK genes via a qPCR method though novel primer development. The final deliverable for this work is thus a 16S rRNA phylogenetic tree of the anammox culture, as well as a set of primers and optimized qPCR methology (thermocycling conditions and mastermix composition) for NarK gene analysis.
Sponsor: University of Arizona
PI/PD: Mark Krzmarzick

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 Standard Data Format for 2-Dimensional and 3-Dimensional Pavement Image Data that is Used to Determine Pavement Surface Condition and Profiles
This proposal addresses a critical need to nationally standardize pavement surface condition data analysis, reporting, sharing, and evaluation through establishing a standard 2D/3D pavement dataformat. The new standard will vastly facilitate data sharing and quality control to

satisfy the requirements in the pavement performance measures mandated by the Moving Ahead for Progress in the 21st Century Act (MAP-21).
Sponsor: Federal Highway Administration
PI/PDs: Kelvin Wang, Joshua Li, Cheng Chen

Development of Aggregate Characteristics-Based Preventive Maintenance Treatments Using 3D Laser Imaging and Aggregate Imaging Technology for Optimized Skid Resistance of Pavements
The objective 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

Assessing the Impact of Climate on Bridge Deck Deterioration

Task 1 - The objective is to identify: 1) factors affecting bridge deck conditions, 2) existing performance models for bridge decks, and 3) Oklahoma DOT's practices in monitoring and tracking bridge deck conditions and its decision process for maintenance.

Task 2 - The objective is to define climatological input variables. *Oklahoma Mesonet* will be the main source for climate data.

Task 3 - The objective is to integrate climate data with the National Bridge Inventory for enhanced data analyses.

Task 4 - The objective is to present research findings and promote the research to pursue additional funding from other sources.

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

PI/PDs: Yongwei Shan, Phil Lewis, Joshua Li

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

Prep-ME Software Implementation and Enhancement

The objective of this Phase III project is to assist participating state DOTs with the full implementation of Prep-ME software for traffic data collection and Pavement ME Design and to deliver new generation of Prep-ME software with enhanced and customized features for each individual state. Phase III tasks include: 1) Provide on-site and webinar training for participating states, 2) Develop portable version of Prep-ME for field data collection and WIM calibration, 3) Enhance existing traffic module in Prep-ME, 4) Provide technical support to meet state needs.

Sponsor: Louisiana Department of Transportation and Development, Louisiana Transportation Research Center
PI/PDs: Joshua Li, Kelvin C.P. Wang

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

Shrinkage Induced Deformation in Steel Bridges Made Composite with Concrete Deck Slabs – Phase 2
The Phase 2 and 3 goals are to further investigate the phenomena of concrete shrinkage and other volume changes, and to assess their effects on deflections in steel bridges made composite with concrete decks. Tasks include: 1) Construct a full-sized bridge prototype that mirrors construction in ODOT bridges and a test setup for evaluating typical forming systems, 3) Make recommendations to improve forming and bracing systems supporting fresh concrete, 4) Perform temperature loading on the bridge deck, 5) Perform repeated load testing on the prototype bridges. 6) Perform testing including measurements for compressive strength, tensile strength, elastic modulus and shrinkage.
Sponsor: Oklahoma Department of Transportation for the Federal Highway Administration
PI/PDs: Bruce Russell, Tyler Ley

One Voice for Sewer Infrastructure
One-Voice is an initiative to develop and publically present empirical data that accurately demonstrates the condition and trends for underground sewer infrastructure across the U.S. The project will provide the National Association of Sewer Service Companies (NASSCO) with information on which to base a decision of whether to proceed with the One Voice initiative. The deliverable will be a report that establishes costs of developing and sustaining this initiative compared to industry-wide and NASSCO specific benefits. The outcome will be a determination of the efficacy of the *One-Voice* database and the feasibility of expanding the prototype on a national level.
Sponsor: NASSCO, Inc.
PI/PDs: Phil Lewis, Yongwei Shan

Evaluation of Ec3000 as Stabilizer to Reduce Risk on Design-Build Pavement Projects in Texas Constructed over Expansive Soils

As a subcontractor, OSU's scope of work for the project involves: 1) Suction measurements (including osmotic suction) using different concentrations of Ec3000 in different soil types, 2) Determination of the soil-water characteristic curve (SWCC) for the selected soil types, 3) Perform moisture diffusion tests to establish diffusion coefficients for the soils, 4) Measuring soil index properties, 5) Field testing and monitoring, 6) Assisting in developing and conducting other laboratory tests and field tests as needed for the successful completion of the project.
Sponsor: Texas A&M Transportation Institute for Environmental Soil Stabilization, LLC
PI/PD: Rifat Bulut

Development of an Asphalt Pavement Test Facility at the OSU Unmanned Aerial Vehicle Facility

The objective is to assist in the construction of the UAV runway to develop a pavement that can be used as a test facility for evaluation of pavement materials including, but not limited to, plant-mixed warm and hot mix asphalt pavements, high RAP and RAS mixes, asphalt surface treatments, pavement preservation treatments, 100% RAP cold mixes and aggregate bases with surface treatments. At the completion of the construction, ODOT will have a facility available to them through OSU to test and evaluate surface treatments, surface mixes, including high RAP and RAS mixtures, and pavement preservation treatments for various applications.
Sponsor: Oklahoma Department of Transportation for the Federal Highway Administration
PI/PDs: Stephen Cross, Joshua Li, Kelvin Wang

The Use of Resistivity Testing for Quality Control of Concrete Mixtures

The objective of this project is to investigate the potential of resistivity testing in assessing the performance of typical concrete mixtures used in bridge and pavement infrastructure in Oklahoma. The sensitivity and reliability of the method with Oklahoma materials will be investigated in order to formulate new guidelines and specifications that would allow ODOT to produce high quality concrete. These specifications could be used to approve and accept concrete mixtures. This means that strength would no longer be the only value that is used to accept a concrete mixture and instead a measurement of permeability could be included.
Sponsor: Oklahoma Department of Transportation for the Federal Highway Administration
PI/PDs: Julie Hartell, Tyler Ley

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

Monitoring Extreme Loading and Climate Impact on Infrastructure
To address climate impact and traffic overload on concrete infrastructure, evaluation and monitoring guidelines will be developed using sensing technologies such as acoustic emission monitoring capable of qualifying and quantifying material damage and locating zones in distress. Climatological profiles will be created for critical infrastructure regions of Oklahoma using climatological data from *Oklahoma Mesonet*. The effects of exposure combinations on concrete properties will be continuously monitored and analyzed using AE and ultrasonic techniques. Signature wave parameters that may be characteristic of temperature change, moisture change or microstructural changes will be determined and implemented towards the creation of new monitoring guidelines.
Sponsor: University of Oklahoma for the Southern Plains Transportation Center for Oklahoma Department of Transportation
PI/PDs: Julie Hartell, Phil Lewis, Tyler Ley, Yongwei Shan

Safety Evaluation of Pavement Surface Characteristics with 1mm 3D Laser Imaging Technology
Accurate and timely information on pavement surface characteristics are critical for evaluating the performance, condition, safety, and serviceability of pavements of streets, roadways, and airfields. Even though high-speed technologies to gather information on pavement macro-texture, friction, and profiles are mature, separate instrumentation is needed for each of these data collections. Further, surveys of longitudinal and transverse profiles and macro-texture can only be conducted on a limited small area on a pavement lane, or line-of-sight. This research focuses on the application of 1 mm 3D imaging with full-lane coverage at highway data collection speed for various safety evaluations.
Sponsor: University of Oklahoma for the Southern Plains Transportation Center for the US Department of Transportation
PI/PD: Kelvin Wang

Development of Mixture Designs for Pumpable Concrete for Extreme Weather
Recent research has aimed to improve optimized graded concrete specifications for slip formed paving concrete. Preliminary estimates found that cost savings of over $4 million and energy to power over 400 homes could be saved each year that the specification is used in Oklahoma. Oklahoma DOT was so excited about this work that they decided to provide additional funding to extend these findings to structural concrete. Funding from this grant will be used to extend the current research to a larger number of materials and to also focus on the performance of these materials in extreme environments.
Sponsor: University of Oklahoma for the Southern Plains Transportation Center for the US Department of Transportation
PI/PDs: Tyler Ley

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

Development and Implementation of a Mechanistic and Empirical Pavement Design Guide (MEPDG) for Rigid Pavements: Phase 3
The Mechanistic-Empirical Pavement Design Guide (MEPDG) is the new pavement design guide released by the American Association of State Highway and Transportation Officials (AASHTO). AASHTO suggests that each state highway agency validate and, if necessary, calibrate the MEPDG design models based on local conditions. The objective of the research is to validate and calibrate the MEPDG for the design of typical Oklahoma rigid pavements. The secondary objectives of the research are: 1) to continue to monitor the field performance of the instrumented road section on I-44 and 2) to investigate the slab/base friction property of typical Oklahoma rigid pavement structures.
Sponsor: Oklahoma Department of Transportation for the Federal Highway Administration
PI/PD: Xiaoming Yang, Tyler Ley

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

SusChEM: Collaborative Research: A Multi-Scale Environmental and Kinetics Study on the Pyrolysis of Sustainable Biomass Feedstock
This collaborative study between Tennessee Technological University and OSU looks at the kinetics and socio-economic broader impacts of biomass pyrolysis. The investigators will introduce a Multiple Variable Control Volume Reactor to independently control the particle-related and homogenous-related transport phenomena and associated reactions, making it possible to independently observe the two processes. In a serious of experiments, model compounds and whole biomass will be studied in an effort to understand the extent to which pyrolysis occurs within condensed phase intermediates and the homogeneous gas phase. The PIs will also introduce a new multi-scale modeling platform based on kinetic cellular automaton.
Sponsor: National Science Foundation
PI/PD: Tyler Ley

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

Surface and Airborne Monitoring Technology for Detecting Geologic Leakage in a CO2-Enhanced Oil Recovery Pilot, Anadarko Basin, Texas

OSU, with the cooperation of the Southwest Regional Carbon Sequestration Partnership (SWP), will develop and implement new near-surface and airborne monitoring technologies. The research will focus on the design and deployment of a dense grid of shallow subsurface and surface sensors in combination with low-altitude airborne detection of CO2 and CH4. These technologies will be deployed in the Farnsworth Oil Unit in the Anadarko Basin of the northeastern Texas panhandle, where the SWP and Chaparral Energy, LLC, are conducting CO2-enhanced oil recovery experiments.

Sponsor: Department of Energy

PI/PDs: Tyler Ley

Chemical Engineering: Peter Clark

MAE: Jamey Jacob, Girish Chowdhary

College of Arts & Sciences: Jack Pashin, Nicholas Materer

Collaborative Research: Coupling System Chemistry and Time-Dependent Deformation of Cementitious Materials through Evolving Thermodynamic States

The primary objective of this project is to develop a fundamental thermodynamic model framework that links evolving system chemistry and mechanics of cementitious materials, and to implement the model through a computational method that predicts the fully coupled evolution of microstructure and viscoelastic/viscoplastic properties of the materials. Any stress induced changes to the material microstructure – and resulting time-dependent deformation – will be predicted by the model. In synergy with the fundamental modeling, novel experiments utilizing time-stepping micro-computed tomography of stressed specimens will be performed to verify and quantify the interconnection between chemistry and mechanics through phase dissolution in cementitious materials.

Sponsor: National Science Foundation

PI/PD: Tyler Ley

Mechanisms of Hydration and Setting of Ordinary Portland Cement in Simple and Complex Systems

For this project OSU will be responsible for completing laboratory scale micro X-ray computed tomography (mCT), focused beam X-ray Fluorescence (mXRF), and focused beam X-ray diffraction (mXRD) on Portland cement and combinations of Portland cement with mineral and chemical admixtures. In addition, several tests will be completed with these same techniques at synchrotrons facilities. The experiments will focus on investigating the change in the hydration of different clinker phases in different soak solutions that simulate the pore solution chemistry of hydrating Portland cement.

Sponsor: Trustees of Princeton University for the Federal Highway Administration

PI/PDs: Tyler Ley

Mechanical and Aerospace Engineering: Jay Hanan

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

Safety Culture of the US Transit Industry
The objective of the work is to assist the FTA's Office of Transit Safety and Security in assessing and enhancing the existing safety culture of transit agencies. The anticipated results include presentations in technical conferences and a survey of the safety culture of transit agencies.
Sponsor: University of Oklahoma for the Federal Transit Administration
PI/PD: M. Samir Ahmed

Electrical and Computer Engineering

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

VEF U.S. Faculty Scholar Grant
The Vietnam Education Foundation, an independent U.S. Federal Government agency, has awarded this U.S. Faculty Scholar Grant to conduct a teaching program in Vietnam. Dr. Teague will teach a senior level electrical engineering course, Digital Signal Processing, offered by a combination of face-to-face and video teleconference between Oklahoma State University and Thai Nguyen University of Technology.
Sponsor: Vietnam Education Foundation
PI/PD: Keith Teague

Privacy Issues in Smart Grid Data Sharing
Security methods such as encryption cannot solve privacy issues. To protect end users' privacy, identifiable information is removed from consumption traces. However, the data may still be quasi-identifiable. Recently, several privacy enhancing techniques have been proposed by adding hardware components such as rechargeable batteries or renewable energy sources (leading to higher cost), or adding artificial disturbance such as quantization noise (leading to reduced data utility). The investigator will comprehensively analyze the pros and cons of these techniques by quantifying data utility, privacy, cost efficiency and energy efficiency, and propose a solution that reaches the optimal tradeoff among these performance measures.
Sponsor: OSU Foundation for National Energy Solutions Institute – Smart Energy Source Association (NESI-SES)
PI/PD: Qi Cheng

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

Rational Design of Thermoelectric Materials and Material Processing Approaches Based on Microwave Processing of Silicides
Dr. Krasinski will work on the construction of the pulsed high voltage power supply for the pulsed magnetron. He will design the electronic circuit and work on building the pulsed microwave source. He will also perform the experiments investigating the effect of the E and H field in the decrystallization process. The work at OSU will occur in direct coordination with NCSU where the ultimate materials systems will be devised.
Sponsor: North Carolina State University for the National Science Foundation
PI/PD: Jerzy Krasinski

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

Development of High Efficiency Nanostructured Thermoelectric Generators for Industrial Waste Heat Recovery
Over the past six years, the investigators have developed advanced nanostructured thermoelectric materials at lab scale that can work efficiently for applications from room temperature to 1100 C. The purpose of this OCAST accelerated research program is to scale up the method of synthesis of such efficient material structures and package them to form thermoelectric generators that can be employed at different locations appropriate for industrial applications. OSU will lead the material research and innovation. Marlow Industries will lead the packaging of the thermoelectric modules, and Amethyst Research Inc. will lead the hydrogenation optimization and commercialization steps.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PD: Jerzy Krasinski

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

Measuring the Shielding Effectiveness of Surrogate Samples
Reverberation Chambers are used to measure the Shielding Effectiveness (SE) of different materials because it exposes the material to a uniform and isotropic field from multiple angles of incidence. In this project, the SE of surrogate samples will be measured using the nested reverberation chamber measurement approach. The SE measurement is based on the comparison of the electromagnetic power without the sample on the secondary chamber wall to the electromagnetic power when the sample is present on the wall of the secondary chamber. The received power will be measured over the frequency range of 700 MHz to 8 GHz.
Sponsor: Applied Research Associates, Inc.
PI/PDs: Vignesh Rajamani, Chuck Bunting

SHB: Type I (EXP): Context-aware Ubiquitous Human Health Monitoring
The project objective is to develop a ubiquitous human health monitoring system that collects not only vital signs, but also daily activities and environmental context of a human subject in an everyday life setting. From these collected data, higher level knowledge such as anomalies will be extracted to assist in health evaluation, medical diagnosis/prognosis or healthcare delivery. Such a system is called a Smart Health Monitoring (SmartMon) System, which will help realize ubiquitous health monitoring and healthcare delivery. The major research tasks focus on the development and evaluation of the proposed hardware platform and theoretical framework of the SmartMon system.
Sponsor: National Science Foundation
PI/PDs: Weihua Sheng, Qi Cheng

Collaborative Research: Manipulating Terahertz Waves Using Three-Dimensional Metamaterials
THz waves have proven challenging to control due to a paucity of electromagnetic materials with an effective response at THz frequencies. This “THz gap” results in a great impediment for the development of functional THz optical components and systems. In view of these challenges, the objective is to develop a synergetic approach that incorporates Transformation Optics (TO) theory, the tunable metamaterials design under effective media approximation, the scalable 3D fabrication technologies, and the experimental validation to explore a range of novel Terahertz optical components: 1) TO-enabled aberration free THz imaging lens, and 2) an integrated THz lab-on-chip sensing platform.
Sponsor: National Science Foundation
PI/PDs: Weili Zhang, John O’Hara

Collaborative Research: CI-ADDO-NEW: An Open Memory Array Compiler Framework to Support Devices, Circuits and Systems Research
The objective is to enable memory and computer system research by creating an open-source memory compiler infrastructure called Open-RAM, to be used by architects and system designers, circuits/device researchers, and CAD researchers. No current memory compilers allow researchers to experiment from the system to device level using real, synthesized memories. The PI intends to: generate single and multi-port RAM arrays and register files; provide detailed specification for portability and extensibility to future processes; perform automated timing, power, and yield characterization; be interoperable with common academic and commercial tool flows; verify correctness of memories, methodology, and characterization in two prototype chips.
Sponsor: National Science Foundation
PI/PD: James E. Stine

RF Physical Layer Authentication via Watermarking
The purpose of this project is to test the viability of several physical layer authentication schemes in both simulated and real-world scenarios in order to inform further development of those methods that may be of interest to the U.S. Navy. This project will perform testing of the impact of these schemes on both watermark aware & non-watermark aware receivers. A WACR should be able to reliably process a physical layer authentication signal. Ideally the performance of a standard non-WACR receiver should not be degraded by that same signal and the presence of the authentication signal should remain unknown.
Sponsor: Exelis, Inc. for Department of Defense Naval Research Laboratory
PI/PDs: George Scheets, Keith Teague

Synthetic Aperture Radar Processing for Change Detection
The work addresses the processing of synthetic aperture radar imagery to detect changes of a land environment over time. The work is associated with coherent imaging radar systems developed by Sandia National Laboratories. The researcher will investigate automated methods to apply accurate phase-error autofocus functions to all pixels in radar images. The researcher will also investigate image-registration algorithms used in determining the coherent change between images.
Sponsor: Sandia National Laboratories for U.S. Department of Energy
PI/PD: James West

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: Caroline Reed

Development of a Handbook: Making the Culture Shift Handbook
IFSTA/OSU Fire Protection Publications is partnering with the National Volunteer Fire Council on the development and production of a handbook and accompanying curriculum targeted to volunteer fire department officers. The handbook and curriculum are part of a comprehensive project, *Making the Cultural Shift*, which promotes making a cultural shift to a more safety-minded organization. Topics include: leading by example, training, setting and enforcing policies and procedures, and providing incentives. The issue of culture and the role it plays in health and safety practices is addressed, as well as the unique attributes of the volunteer fire service related to cultural change.
Sponsor: National Volunteer Fire Council, Inc. for the United States Department of Homeland Security - FEMA
PI/PD: Nancy J. Trench

Fire Service Training

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

Assistance to Firefighter Grant - State Fire Training Academy
Fire Service Training provides training that enables Oklahoma Emergency Responders to safely meet recognized standards of professional competence. This grant provided funding for 30 Self Contained Breathing Apparatus (SCBA) with spare cylinders, 10 complete sets of turnout gear, and two fit test machines. The new SCBAs will be used for Fire Academy students during their basic training. The turnout gear will be for fire instructors at the state fire training academies that instruct live fire training. The fit test machines allow FST to provide fit testing of face-pieces and respirators for volunteer firefighters at department meetings or regional fire schools.
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

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: Caroline Reed
Fire Protection Publications: Nancy Trench

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

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 project is expected to overcome these limitations and lead to a rich body of knowledge regarding connectivity problems, and, in particular, to markedly faster approaches for solving vertex-centric connectivity problems. In addition, the work will likely generalize existing results about edge-centric connectivity and will have consequences for hop-constrained and survivable network design problems.
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

Data Driven Optimization on Power Grid Investment Operation and Resilience
In this project, the investigator will derive data-driven risk-averse stochastic optimization models with efficient decomposition algorithms for transmission expansion and power generation scheduling problems under high penetration of renewable energy and the disruptions of extreme events, so as to maintain a reliable and resilient power system. More specifically, the investigator will work on the following two tasks during the project period: 1) Data-Driven Stochastic Transmission Expansion Planning, 2) Data-driven Risk-Averse OPF under Uncertain Renewable Energy Output and Extreme Events.
Sponsor: Uchicago Argoone, LLC as Operator of Argonne National Laboratory for the U.S. Department of Energy
PI/PD: Chaoyue Zhao

Designing Databases for a Hazardous Material Movement Model in Oklahoma (Phase 1)
The objective of this effort is to develop a database containing information regarding the amount of HazMat transported in the state of Oklahoma. The project will provide a database structure which may be utilized in subsequent phases (phases conducted after Oct 2016) to identify the HazMat distribution and movement via major highways and Metropolitan Statistical Areas (MSAs) in Oklahoma.
Sponsor: Oklahoma Emergency Management for the USDOT-Pipeline and Hazardous Materials and Safety Administration
PI/PDs: Arash Pourhabib, Manjunath Kamath, Chaoyue Zhao
Biosystems and Agricultural Engineering: R. Scott Frazier

Privacy Issues in Smart Grid Data Sharing
For many energy applications, there are events that happen infrequently, but their occurrence causes a significant cost. For example, tornados or severe weather conditions can disrupt a power plant from functioning. If such events can be predicted in advance, measures can be undertaken that mitigate their negative impacts. System Informatics provides an opportunity to integrate empirical information in data with domain knowledge for an enhanced understanding of energy systems. The objective is to devise models based on information in forms of spatio-

temporal data and physical laws that govern spatio-temporal systems which contain energy systems.
Sponsor: OSU Foundation for National Energy Solutions Institute – Smart Energy Source Association (NESI-SES)
PI/PD: Arash Pourhabib

EAGER/Cybermanufacturing: CYMAN: A CYber MANufacturing and Entepreneurship Initiative to Foster Global Manufacturing
The project will create a community of engineers (manufacturing, software/information based) who will exchange ideas, identify new cyber/physical product needs, and develop app prototypes that lead to collaborative manufacturing of physical products. A community of interdisciplinary engineering students will be established who will interact through a Cyber-Manufacturing Test Bed. The test bed and community formation will pursue three sets of activities: 1) Develop a Cyber-Manufacturing Test Bed and related Curriculum 2) plan and implement on-line cyber communities for project-based learning and app development and 3) introduce curriculum modules and refine them in identified courses through app extensions and group projects.
Sponsor: National Science Foundation
PI/PDs: Joe Cecil
Arts & Sciences: Blayne Mayfield

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

EAGER: US IGNITE: A Gigabit Network and Cyber-Physical Framework for Advanced Manufacturing
In this US Ignite (EAGER) project, the goal is to demonstrate an ultrafast high gigabit application in the area of Advanced Manufacturing. The manufacturing domain is micro/meso devices assembly, which involves the manipulation and assembly of intricate micron and millimeter sized objects. Overall, the objective is to develop and demonstrate an Advanced Manufacturing application through the creation of a Collaborative Meso/Micro Assembly Test Bed (COMAT) whose engineering life cycle is accomplished in an agile manner using ultra fast high gigabit

networks which support collaboration among distributed tools and resources for design analysis, assembly planning, simulation and finally assembly.
Sponsor: National Science Foundation
PI/PD: J. Cecil

REU SITE: Research Experiences in Information Centric Engineering (ICE)
The goal of this REU Site initiative is to provide meaningful research experiences to a new generation of engineers and scientists in emerging process domains with an Information Centric Engineering emphasis. Useful research experiences provided to undergraduate students will encourage them towards graduate programs and research careers in these leading edge research areas. The resources of the Center for Information Centric Engineering at OSU will be used by the REU students to conduct research in manufacturing (micro devices assembly) and biomedical (virtual surgical environments) domains.
Sponsor: National Science Foundation
PI/PD: J. Cecil

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

Collaborative Research: US IGNITE: EAGER: Exploring Ultrafast Networks for Training Surgeons Using Virtual Reality Based Environments
The goal is to develop and demonstrate new virtual reality based applications for training medical residents and doctors in microsurgical techniques using the Global Environment for Network Innovations infrastructure and capabilities. Surgical training is usually limited to face-to-face situations where the expert surgeon and trainees are in the same room performing intricate procedures. Since experts in microsurgical techniques are not available in most parts of the country, such training is not readily available to many medical students. The virtual reality based surgical training application will address this challenge by eliminating the need for experts and trainees to be co-located.
Sponsor: National Science Foundation
PI/PD: J.A. Cecil

Motorcycle Crash Causation Study
The following are the objectives of this study: 1) Determine the main human, vehicular, environmental and roadway factors that contribute to motorcycle crashes and impact crash avoidance; 2) Identify the types of motorcycle crashes; 3) Assess the effectiveness of existing countermeasures including protective gear and rider training/education; 4) Identify additional feasible countermeasures/interventions that can reduce motorcycle crashes and crash injuries; and 5) Estimate the risk factors for motorcycle crash involvement.
Sponsors: United States Department of Transportation - Federal Highway Administration, American Motorcyclist Association
PI/PD: John Nazemetz

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 focus on IOFs and small and medium-sized manufacturers located within Oklahoma, Kansas, western Missouri, western Arkansas, eastern New Mexico, and beyond, as coordinated by our field managers. 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

Materials Science and Engineering

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

Advanced Materials Development for Aerospace Thermal Management Applications
Dr. Govindaraju at OSU and Jeffrey Didion at NASA Goddard Space Flight Center (GSFC) will collaborate to develop thermal interface materials for high heat flux density thermal

management solutions for spacecraft applications. An undergraduate and graduate student intern will be supported under the research. As part of this Research Initiation Grant, some of the preliminary experiments on developing thermal interface materials will be conducted by a student intern at the NASA GSFC.
Sponsor: University of Oklahoma for NASA (EPSCoR)
PI/PDs: Nirmal Govindaraju, Raj N. Singh

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

Testing Support for SiC-SiC Composites for Thermal Conductivity and Mechanical Properties
OSU's Next Generation Materials Laboratory in the School of Materials Science and Engineering will perform the following testing for Physical Optics Corporation (POC): 1) Thermal conductivity testing according to C1461 using a Laser Flash Netzsch LFA 457 equipment and specific heat measurements using a combined DSC-DTA-TGA equipment. Three tests will be conducted on 10 mm diameter composite specimens provided by POC. 2) Flexural testing of ceramic composites at room temperature using C1341-13 for either 3-point or 4-point bend testing. Five tests will be conducted on flexural specimens provided by POC. A report will be provided summarizing the test results.
Sponsor: Physical Optics Corporation for Department of Energy
PI/PD: Ranji Vaidyanathan

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

Nanodiamond for biological imaging applications
The goal is to develop nanodiamond powders as replacements for conventional fluorescent agents used in biological imaging applications. The nanodiamond powders will be optically, thermally, and chemically stable and will be tailored to emit light efficiently at four distinct optical emission wavelengths used in biological imaging applications. It is expected that the nanodiamond powders will be resistant to photobleaching, will be non-toxic and biocompatible. The nanodiamond material will significantly reduce the complexity involved in sample preparation and acquisition of images for biological applications. COARE Biotechnology Inc. has expressed interest in commercialization of the product upon demonstration of proof-of-concept.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PDs: Nirmal Govindaraju, Raj N. Singh

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

All-Composite Storage Tanks for Absorbed Natural Gas
The Next Generation Materials Laboratory at OSU, in collaboration with CleanNG LLC, will develop and manufacture low-pressure, liner-less, all-composite adsorbed natural gas tanks (Magmacel AD™). The natural gas will be stored at low-pressures using a high-surface area carbon material for adsorption of the gaseous fuel, thus enhancing the safety of the fuel tanks. Several different activated carbon materials including their combinations will be evaluated. OSU will assist CleanNG to produce the prototypes, test and characterize the fuel storage capacity of the adsorbent and improve the mechanical properties of the composites through nano-additives based on natural ingredients.
Sponsors: Oklahoma Center for the Advancement for Science and Technology, Clean NG LLC
PI/PDs: 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

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 BoldQuest 16.2
OSU will provide modified group 1 commercial off the shelf UAS and operators consistent with real world non-state actor tactics, techniques and procedures. Platforms will be sufficient in numbers to provide continuous support against friendly forces utilizing both a combination of rotary wing and fixed wing craft. Platforms will be modified with full motion video downlinks and FCC/FAA approved ADS-B receiving system, integrated with a technology demonstration of ADS-B command and control of small UAS within a complex and dynamic airspace scenario.
Sponsor: ASRC Federal Holding Company for United States Army.
PI/PDs: Jamey Jacob
OSURF: Gary Ambrose

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

Low Cost OTS Cruise Missile
This project will demonstrate the capability of a guided missile using hobby high-powered rockets and commercial off-the-shelf autopilots. These systems, which can be acquired for less than $1,000 in parts, can easily deliver several pounds of payload to targets miles away with high accuracy. This will significantly change the landscape of battle for US forces.
Sponsor: Defense Advanced Research Projects Agency
PI/PD: Jamey Jacob

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

eXploration Habitat (X-Hab) 2017 Academic Innovation Challenge: 1.6 Deep Space Mars Transit Habitat Layout and Development Studies
The goal is to develop fully autonomous habitation systems that enable human exploration of space; and develop, integrate, test and evaluate Habitation Systems that will be utilized as technology testbeds and to advance NASA's understanding of alternative mission architectures, requirements, and operations concepts' definition and validation.
Sponsor: National Space Grant Foundation for NASA
PI/PDs: Jamey Jacob
Architecture: Steve O'Hara
College of Arts & Sciences: J. Cecil, Blayne Mayfield, Eric Chan-Tin

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

Desert Chance III Training and Flight Support

As a subcontractor, OSU will provide labor for this effort in the categories of: junior technician and mid level analyst.

Sponsor: Chamber Corporation for U.S. Navy

PI/PD: Jamey Jacob

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 from Jan 4-25, 2017 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

AFRL C-UAS Team Tinker
OSU Unmanned Research Systems Institute (USRI) will provide AFRL Team Tinker with a demonstration of Counter UAS (C-UAS) capabilities. The technology demonstration will occur at Nevada test on or about 1 – 5 December 2016 and will encompass OSU-USRI operating a UAS platform in support of AFRL C-UAS Commander's Challenge Team Tinker's uniquely designed and integrated C-UAS detection and negation system. In support of this C-UAS technology demonstration, OSU-USRI will develop unique integrated platform(s) to assist Team Tinker in the execution of a family of systems that uniquely detect and defeat commercial off-the-shelf Group One UAS.
Sponsor: Modern Technology Solution, Inc. (MTSI) for Air Force Research Laboratory
PI/PD: Jamey Jacob

Geothermal Vision Study
A DOE Geothermal Technologies Office vision study taskforce focuses on thermal applications of low temperature geothermal energy, particularly, geothermal heat pump (GHP) and direct use. This project will review and evaluate the current status of GHP applications in the U.S., including the installed base and geographical distribution, barriers preventing wider market penetration, cost and performance of the state-of-the art technologies, and technologies under development that target the barriers. This project will also investigate the maximum technical potential of thermal applications in the U.S. based on robust data, modeling, and analysis of available geothermal resources and potential demands for thermal applications.
Sponsor: UT-Battelle, LLC for Oak Ridge National Laboratory
PI/PD: J.D. Spitler

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/PDs: Jamey Jacob, Girish Chowdhary

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

Double-pulsed digital holographic diagnostics for aerated liquid jets in supersonic crossflow
Aerated-liquid injector is of interest to the Air Force due to its capability of generating finely atomized sprays for scramjet engines applications. Measuring the spray structure in the near-field of the fuel injector in supersonic flow is essential to optimize performance of the combustor section of scramjet engine. Digital holographic microscopy is effective for probing aerated liquid jets injected in subsonic crossflow. Still missing is information regarding fuel injection in supersonic crossflow. Digital holographic microscopy will be used to investigate aerated-liquid jets injected in supersonic crossflow and provide benchmark data for droplet sizes and velocities in the near-injector region.
Sponsor: Taitech, Inc. for United States Air Force
PI/PD: Khaled Sallam

Versatile Experimental Autonomy Research Aircraft Technology (VEARAT)
The following tasks will be performed by OSU: Task 1 – System and Subsystem Requirements Definition – OSU shall contribute to defining requirements for an advanced modular autopilot;

Task 2 – BASSET UAV Modification Design – OSU shall provide recommendations for integration of advanced modular autopilot; Task 3 – Modular GNC hardware/software development – OSU shall take the lead role in developing the autopilot with the help of NextGen; Task 4 – Communication systems integration and interfacing – OSU shall assist NextGen in selection and integration of communication systems; Task 5 – Detailed Autonomy Subsystems/ Algorithms Interface Documentation for the Testbed Users – OSU shall prepare the autopilot interface documentation.
Sponsor: NextGen Aeronautics, Inc. for NASA
PI/PD: Girish Chowdhary

UAS for Infrastructure Inspection
This project will develop capabilities for use in power and utility line inspections by unmanned aircraft systems (UAS) to provide a viable unmanned inspection tool for routine inspection and damage detection. Small unmanned aircraft systems (SUAS) will be developed with advanced autonomous navigation capability, power management and data management collection and storage, and intuitive operational interfaces including intelligent utility tracking using lightweight sensors.
Sponsor: OSU Foundation for National Energy Solutions Institute – Smart Energy Source Association (NESI-SES)
PI/PD: Jamey Jacob

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

Deep Space Mars Transit Habitat Layout Studies
Following upon the previous X-Hab Academic Innovation Challenge, OSU will add to, modify and utilize previously developed components to test scenarios for a full deep space Mars transit and landing for the 2016 X-Hab Academic Innovation Challenge. The goals of the project include a short-term goal of an interdisciplinary senior design project to design, build and evaluate components for horizontally and vertically oriented habitats for deep space missions and a long-term goal to develop capabilities in education, research, and outreach in the field of space habitat design.
Sponsor: National Space Grant Foundation for NASA
PI/PDs: Jamey Jacob
Architectural Engineering: Steve O'Hara

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/PD: Dan Fisher

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

Acoustic Measurements of SUAS for DHS RAPS
OSU will provide staff services and subject matter experts in support of the Department of Homeland Security Robotic Aircraft for Public Safety (RAPS). OSU staff will assist UML by performing acoustic measurements of small UAS that will participate in the RAPS program and providing corresponding technical reports.
Sponsor: University Multispectral Laboratories for Department of Homeland Security
PI/PD: Jamey Jacob

Surface and Airborne Monitoring Technology for Detecting Geologic Leakage in a CO2-Enhanced Oil Recovery Pilot, Anadarko Basin, Texas
OSU, with the cooperation of the Southwest Regional Carbon Sequestration Partnership (SWP), will develop and implement new near-surface and airborne monitoring technologies. The research will focus on the design and deployment of a dense grid of shallow subsurface and surface sensors in combination with low-altitude airborne detection of CO2 and CH4. These technologies will be deployed in the Farnsworth Oil Unit in the Anadarko Basin of the northeastern Texas panhandle, where the SWP and Chaparral Energy, LLC, are conducting CO2-enhanced oil recovery experiments.
Sponsor: Department of Energy
PI/PDs: Jamey Jacob, Girish Chowdhary
Chemical Engineering: Peter Clark
Civil Engineering: Tyler Ley
College of Arts & Sciences: Jack Pashin, Nicholas Materer

SNM: Roll-to-Roll Atomic/Molecular Layer Deposition
The goal is to investigate and develop atomic/molecular layer deposition (ALD/MLD) processes for continuous production and to develop a roll-to-roll machine for ALD/MLD process which will enable thin-film growth on a flexible, moving substrate. The Colorado team will study the ALD/MLD processes which will be compatible for R2R manufacturing and the OSU team will design and develop a R2R machine for this process to conduct the experimentation in the project. The OSU team will build two R2R machines, one for experimentation at OSU and the other for experimentation at Colorado.
Sponsor: University of Colorado at Boulder for National Science Foundation
PI/PD: Prabhakar R. Pagilla

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

Collaborative Research: Ion Irradiation-Induced Nanocrystallization of Metallic Glasses and Its Effects on Their Mechanical Properties
Metallic glasses have superior hardness and high resistance to wear and corrosion, however they are generally brittle due to the absence of internal obstacles to arrest shear band

propagation. The objective of the work is to develop an understanding of the mechanisms responsible for nanocrystal phase formation when metallic glasses are subjected to ion irradiation, and to quantify the resulting effects on the materials' mechanical behavior.
Sponsor: National Science Foundation
PI/PD: Don A. Lucca

Oklahoma Space Grant Consortium
Congress authorized the National Space Grant College and Fellowship Program to develop and/or enhance university research infrastructure to support basic and applied NASA-related research and technology development. In 1991, NASA awarded the State of Oklahoma a grant for the Oklahoma Space Grant Consortium. Since that time, fellowships have been awarded at the participating universities to promote the goals of the National Space Grant College and Fellowship Program.
Sponsor: University of Oklahoma for NASA
PI/PD: Andrew S. Arena, Jr.

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

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

Oklahoma Small Business Development Center Network 2017
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: Dana Fisher

Manufacturing Improvement Program for the Oil and Gas Industry Supply Chain and Marketing Cluster
Comprehensive improvement in manufacturing requires a review of a manufacturer's facilities, equipment, processes, product line, people, finances, markets and customers. The goal is to increase the innovation capacity and improve profitability of small- to medium-sized manufacturers in the oil and gas industry cluster. This will result in job creation in 44 low-income Oklahoma counties. Objectives are to help manufacturers 1) access current competency, 2) develop plans to reduce energy use and improve manufacturing processes, 3) innovate product lines, 4) train a diverse workforce, 5) manage financial consequences and outcomes, and 6) identify and meet the needs of customers and markets.
Sponsors: Department of Energy
PI/PDs: 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

Oklahoma Inventors Assistance Service (Tulsa Office Startup)
This award establishes an Inventors Assistance Service/New Product Development Center office at the Helmerich Research Center in Tulsa, including hiring or transferring necessary staff, installation and setup of instrumentation, remodeling and preparation of laboratory space as needed, and setup and connection to communications/computer systems as required for operation of the office. The office will provide assistance to inventors and small- and medium-sized manufacturers who want to develop new products and/or processes or who need help with invention and innovation processes, including patent applications, evaluation of competing technologies, market research, prototyping, and interactions leading to additional development and financing resources.
Sponsor: Oklahoma Center for the Advancement of Science and Technology
PI/PD: Robert Taylor

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 and Environmental Engineering: Stephen A. Cross

Division of Engineering Technology (TECH)

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

Fire testing for portable gas containers

The objective of the project is to determine if a jet fire occurs when portable gas containers are tilted while being exposed to an external ignition source with and without a specifically designed nozzle. Three different sizes of portable gas containers will be included in the experiments.

Sponsor: No-Spill, Inc.
PI/PDs: Haejun Park, Qingsheng Wang

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