College of Engineering, Architecture, and Technology – FY 2004 Research Abstracts

ARCHITECTURE

Discover Architecture 2003

The "Discover Architecture" academy will promote the importance of architecture to society, and illustrate potential career opportunities within the fields of architecture and architectural engineering. Over three years, 144 participants will be introduced to the challenges and rewards of these disciplines, and how mathematics and technology are applied in the problem-solving process and creation of architecture. Professional architects and engineers from both Oklahoma City and Tulsa have pledged their support of this academy, and along with the resources extended by OSU, this academy has the potential to become an ideal model of industry, government, and academia working together to promote a brighter future for our state.
Sponsors: Oklahoma State Regents for Higher Education, Cyntergy, Fritz Baily Architects, IserSchaefer Architects, Taylor Scott Architects, The Architects Collective, Wallace Engineering Allen Brown Architects, Frankfurt Short Bruza Architects Engineers Planners, LWPB Architects & Planners, Mass Architects, Studio Architects, TAP/The Architectural Partnership
PI: Suzanne D. Bilbeisi

Reaching Engineering and Architecture Career Heights 2003

Three summer academies will be held at OSU to introduce 90 high school women to career possibilities in technical fields of study. This multidisciplinary, inquiry-based program will introduce relevant issues in architecture, technology, and six engineering disciplines. Participants will solve open-ended design problems, interact with participating female engineers and architects from Oklahoma business and industry, and tour a major corporate research laboratory.
Sponsors: Oklahoma State Regents for Higher Education, OSU Foundation funded by Phillips Educational Initiative Grant, NASA Space Grant Consortium
PIs: Suzanne D. Bilbeisi
Division of Agricultural Sciences and Natural Resources: Danielle Bellmer

Issues of the Built Environment

The major goal of the course will be to introduce architecture students to a highly diverse learning experience while leveraging the networking technology to increase program reach at the same time reducing costs of travel. A secondary goal of the project is to expand faculty and technician experience and knowledge in the proper and effective use of H.323 videoconferencing in the classroom.
Sponsor: MIDnet
PI: Eric Connell

Artificial Sky to Test Daylighting Physical Models

The School of Architecture has a strong belief in the conservation of resources through sustainable design. That is why the school is seeking to integrate the engineering of daylighting systems into the curriculum of both architecture and architectural engineering programs. This NSF grant is being utilized to build a new laboratory, which is an Artificial

Sky Dome. The sky dome, which is a 100% controlled luminous environment, should simulate a variety of sky conditions, under which students will be able to test daylighting physical models. This laboratory will enable graduate and undergraduate students to explore new concepts of daylighting design, and consequently to help conserve energy in buildings. Utilization of daylight is one of the most cost-effective, energy-conserving strategies in the design and engineering of low-energy buildings. Integration between daylight and electric light in commercial buildings results in significant reductions in annual energy use and operating cost. This new laboratory is one-of-a-kind in the U.S. It will be open for the use of the building design community in Oklahoma and the country.
Sponsor: National Science Foundation
PI: Khaled A. Mansy

Designing a Professional Practice Curriculum for Cross-Cultural Mobility and Community Engagement
The purpose for this project in designing a professional practice curriculum for cross-cultural mobility and community engagement is three-fold: first, to enhance the potential for future professional mobility in architectural practice under NAFTA; second, to strategically re-deploy studio pedagogy to address shared momentum with emerging cross-border professional practice competencies in digital media, sustainable development, and cultural community contexts; and third, to define an innovative approach to language development and cultural literacy in professional practice education and continuing education.
Sponsor: University of Illinois-Chicago for the Department of Education
PI: Randy Seitsinger

COLLEGE OF ENGINEERING, ARCHITECTURE, AND TECHNOLOGY EXTENSION

Kangwon National University American Studies Short Program Summer 2004
Kangwon National University (KNU) and Oklahoma State University (OSU) have entered into an agreement under which the Office of Engineering Extension, within the OSU College of Engineering, Architecture, and Technology (CEAT), will conduct a 29-day summer program on the OSU-Stillwater campus for KNU electrical engineering undergraduate students. The summer program will emphasize exposure to English, American culture, and engineering in the classroom. Outside the classroom, additional activities allow KNU guests opportunities for English conversation interaction with English speaking OSU electrical engineering students and faculty, OSU international students, and retail businesses both in Stillwater and Oklahoma. It is planned that KNU students will be paired with conversation partners that will meet in the evenings and on weekends. Industry visits to American manufacturing/research companies that have electrical engineering departments, or have electrical or communication related products or services, are included.
Sponsor: Kangwon National University
PIs: George F. Collington, Jong-Moon Chung

CENTER FOR LOCAL GOVERNMENT TECHNOLOGY

County Government Personnel Education and Training Program
With the oversight provided by the Commission, it is proposed that the Center for Local

Government Technology and the Oklahoma Cooperative Extension Service will execute the County Government Personnel Education and Training Program by conducting training programs and providing technical assistance mandated by this legislation for County Assessors, County Clerks, County Commissioners, County Court Clerks, County Sheriffs, Country Treasurers and their deputies, and other county personnel.
Sponsor: Oklahoma State Auditor and Inspector
PIs: Michael L. Hughes
Division of Agricultural Sciences and Natural Resources: Ross O. Love

County Training Program
The County Training Program is a joint endeavor between CLGT and OCES. It provides education, training, and technical assistance to Oklahoma's elected county officers, their deputies and staffs, and state and local agencies. This program involves legislated and voluntary certification and training for the offices of County Assessor, County Clerk, County Treasurer, Court Clerk, County Sheriff, County Commissioners, and County Equalization Boards, and Purchasing Agents. Some of the units in the County Training Program are mandated by state law, while others are voluntarily imposed by county officer associations. Handbooks, course books, newsletters, and other training materials provide continuous training support on the job. The County Training Program itself is mandated by state law and administered by the Commission on County Personnel Education and Training. State-appropriated funds are contracted through the Office of the State Auditor and Inspector.
Sponsor: Oklahoma State Auditor and Inspector
PIs: Michael L. Hughes
Division of Agricultural Sciences and Natural Resources: Ross O. Love

Project Monitoring/Assessment Program for Oklahoma's Rural Transit Projects
The assessment program will utilize an interdisciplinary approach. The program will be a partnership between the individual transit projects, TPD, and CLGT. The primary objective of the program is to assure project compliance with applicable federal and state laws and administrative rules. The second objective will be to provide current information on the TPD website.
Sponsor: Oklahoma Department of Transportation
PI: Michael L. Hughes

Tribal Technical Assistance Program
Funded by the Federal Highway Association and the Bureau of Indian Affairs, this program provides for a resource center to furnish information, training, and technical assistance related to road and bridge construction, repair, and maintenance to more than 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. The TTAP center also maintains a mailing list, publishes a quarterly newsletter, keeps a library of technical literature and videotapes, and provides on-site assistance. The TTAP center at OSU is one of six TTAP centers across the U.S. and part of a network of 57 technical assistance centers.

Sponsors: Federal Highway Administration, Bureau of Indian Affairs
PIs: Jim Self, Michael L. Hughes

Rural Transportation Assistance Program
CLGT, in partnership with the Oklahoma Department of Transportation's Transit Planning Division, provides educational programs, software development, and technical assistance for Oklahoma's rural public transit systems. The program serves the Project Directors and their staffs at 22 rural public transit systems throughout Oklahoma. CLGT has developed computer programs to facilitate record keeping and data reporting and continually works to update these programs to meet changing reporting requirements and computer hardware/ software capabilities. On-site training is also offered to keep pace with hardware and software changes, computerization of new transit projects, and changing personnel. CLGT also presents workshops and statewide conferences on various transit subjects and helps coordinate the Bus Operators Rodeo each year. Recently, CLGT helped the Oklahoma Transit Association launch a statewide certification program for transit professionals. Oklahoma is one of the first states in the nation to introduce such a program.
Sponsor: Oklahoma Department of Transportation
PIs: Steven Singleton, Michael L. Hughes

Erosion Control on Rural Unimproved Roads in Stillwater Creek Watershed
This project is intended to assess sediment loss from unpaved rural roads in Payne County, demonstrate BMPs to reduce erosion and sediment yield, and educate county road crews, county commissioners, city road crews, and the general public about controlling erosion and sedimentation from unpaved roads.
Sponsor: Oklahoma Conservation Commission
PIs: Douglas A. Wright, Michael Hinkston
Division of Agricultural Sciences and Natural Resources: Michael D. Smolen, Don Turton

Local Technical Assistance Program (LTAP)
The major tasks of the LTAP Center are: 1) to conduct classes and conferences, 2) to provide technical assistance, 3) to serve as Oklahoma APWA Chapter Headquarters, 4) to publish a quarterly newsletter, and 5) to provide technology transfer material. The Center offers a County Roads Scholar Certification program, and is one of four original LTAP centers in the nation.
Sponsors: Oklahoma Department of Transportation, Federal Highways Administration
PIs: Douglas A. Wright, Michael L. Hughes

CHEMICAL ENGINEERING

Expanding Efforts in the Ultrapure Water Group to Address Resin Chemistry Issues – Phase 2
In Phase 1 of this project, the presence of several phenomena that affect the resins when exposed to aqueous ethanolamine at elevated temperature was established. Experimentation is still in progress to pinpoint more specific ETA/resin reactions. However, we have sufficient information to proceed with Phase 2. Two directions for Phase 2 are suggested: 1) define the impact of the hypothesized fouling mechanism on ion exchange resin performance, and 2) propose an alternative amine to ETA.
Sponsor: Electric Power Research Institute (EPRI)

PIs: Gary L. Foutch
College of Arts and Sciences: Alan Apblett

Gas Phase Corona Technology for Treatment of VOC Paint Booth Emissions
This research project has four phases. The first phase will utilize OSU's most recent plasma design, which is scalable by constructing many small reactors and packing them like straws in a can. This phase will focus on assessing the destruction efficiency of the VOCs contained in typical exhaust from a paint booth by the plasma reactor. The second phase of the project will size and construct/purchase the requested adsorption technology to concentrate the VOCs, and investigate the most effective manner (likely steam) to release these VOCs back into the air phase so they can be directed to the plasma reactor for destruction. Phase three of the project will involve the scale-up calculations and actual construction of a plasma reactor to handle the specified airflow rates. The fourth and final phase will involve testing the large-scale plasma reactor both with and without the pre-concentrator adsorber system to assess system performance, and develop detailed operational costs and maintenance costs.
Sponsor: Altech Services, Inc.
PIs: Gary L. Foutch, Arland H. Johannes
School of Civil and Environmental Engineering: John N. Veenstra

OSU Ultrapure Water Research Consortium
The overall objective of the UWC is to improve the fundamental understanding of ultrapure water processing. This objective is accomplished by developing detailed computer models that accurately predict ion exchange and membrane technology performance. The precise focus of the project is continuously refined through consultations with the sponsors at annual meetings, which has proven to be very successful in expanding dialog among students and industrial liaisons.
Sponsors: Dow Chemical Company, Intel, Pennsylvania Power and Light, Knoll's Atomic Power Laboratory, British Energy, Arizona Public Service, Virginia Power, Public Service Electric and Gas
PIs: Gary L. Foutch
College of Arts and Sciences: Allen Apblett

Research Related to the Production of Titanium Dioxide
This project will model the Kerr-McGee Titanium Dioxide production process using FLUENTTM, a commercial computational fluid dynamics program, and compare the results with plant data and current Kerr-McGee simulations performed with CFXTM. Initial efforts will focus on two- and three-dimensional fluid mechanics and heat transfer simulation, with the objective of defining nozzle geometry and operating conditions that will minimize or prevent material buildup on the reactor wall.
Sponsor: Kerr-McGee Chemical Corporation
PIs: Gary L. Foutch, Arland H. Johannes
School of Mechanical and Aerospace Engineering: Afshin J. Ghajar

Effective Stormwater and Sediment Control during Pipeline Construction Using a New Filter Fence
A need exists for replacing current ineffective silt fence technology with a workable, cost

effective alternative that is capable of trapping sediment for the duration of the construction project. Preliminary studies at OSU and other locations confirm the feasibility of this endeavor. The specific objectives of this research project are to: 1) modify the current silt fence technology to make it an effective stormwater and sediment control best management practice for pipeline (linear) construction, 2) test and optimize the technology under laboratory and field conditions, 3) develop and validate a computer model and graphic design aids for evaluating the performance of silt fence in the field and developing designs, and 4) develop mechanical techniques for installing the fence in a cost-effective manner.
Sponsor: University of Tulsa, Integrated Petroleum Environmental Consortium for Environmental Protection Agency
PI: Khaled A.M. Gasem

Integrated Petroleum Environmental Consortium Associate Director Allocation
The funds provided in this project are for Dr. K.A.M. Gasem's annual allocation as the OSU Associate Director of IPEC. The funds will be used to assist him in discharging his duties as described by the IPEC bylaws.
Sponsor: University of Tulsa, Integrated Petroleum Environmental Consortium for Environmental Protection Agency
PI: Khaled A.M. Gasem

Integrated Petroleum Environmental Consortium (IPEC) Research Administrative Services
Dr. Gasem has received the annual allocation as the OSU Associate Director of IPEC. These funds will be used to assist him in discharging his duties as described by the IPEC bylaws.
Sponsors: University of Tulsa, Integrated Petroleum Environmental Consortium
PI: Khaled Gasem

Experimental Batch Optimization
The purpose of this collaborative project is to develop new techniques for experimental optimization of batch recipes in real-time. Research software, developed at OSU, will be implemented at Eastern Carolina University (ECU) where it will receive *in-situ* spectroscopic measurements and process measurements from the laboratory batch reactor under development at ECU. The ultimate goal of the project will be to deliver a software program and demonstrate new techniques for experimental optimization of batch reactions.
Sponsor: University of Tennessee
PIs: Karen A. High, R. Russell Rhinehart

Measurement and Control Engineering Center
OSU created a Measurement and Control Engineering Center in affiliation with the National Science Foundation and the University of Tennessee, Knoxville (UTK). Twenty-five companies are contributing both financial support and program direction. The Center will bring industrial needs for improved control into the university for studies and evaluations by faculty and students. The Center was developed at UTK, where the research emphasis has been in measurement and analysis. The reputation of OSU faculty in applied control makes OSU attractive to all of them, and the establishment of an affiliate site in Stillwater will help broaden the industry support base. For industry considering joining the OSU

control center, becoming a partner with the MCEC is very attractive because it opens access to prior technology, other applied researchers, and an established, successful enterprise. Industrial Sponsorship is $35,000 per year. At semi-annual meetings, faculty presents progress to industry, industry provides direction for the next six months work, and industry selects projects for continued and new funding from the sponsorship pool.
Sponsors: National Science Foundation, Various Industrial Sponsors
PIs: Karen A. High, R. Russell Rhinehart

Travel Grant: AIChE Women's Initiative Committee Session for "Advancement and Retention of Female Chemical Engineers: Issues and Strategies"
The purpose of this proposal is to request travel funds for two speakers (Catherine Didion and Regina Murphy) to present at the Woman's Initiative Committee Session entitled "Advancement and Retention of Female Chemical Engineers: Issues and Strategies" at the Annual American Institute of Chemical Engineers (AIChE) meeting in Indianapolis. The biggest impact will be to the AIChE audience that rarely has the opportunity to attend sessions by the various speakers.
Sponsor: National Science Foundation
PI: Karen A. High

Prediction of Corrosion Rates and Sites for Gas and Oil Wells
This project was initiated to predict and mitigate the effects of corrosion in oil and natural gas wells. The economic viability of gas and oil production in the United States depends to a large extent on the life of wells in the highly corrosive environments typically found in the U.S. This is particularly important for wells in Oklahoma where the natural gas contains unusually large amounts of corrosive hydrogen sulfide and carbon dioxide. The models developed in this project are a combination of the thermodynamic, fluid mechanical, and corrosion mechanisms that are important in downhole systems.
Sponsors: Amoco Production Company, Chevron Research and Technology Company, Conoco, Oryx Energy Company, Phillips Petroleum Company
PIs: Martin S. High, D. Alan Tree, Jan Wagner

Biomass-based Energy Research
This project is one of the integrated activities by the Oklahoma/Mississippi Consortium (Oklahoma State University, University of Oklahoma, and Mississippi State University). These activities will be accomplished through five primary research projects: Feedstock Development, Biomass Gasification and Syngas Conditioning, Syngas Fermentation, Microbial Catalyst Development, and Economics. These projects will be working synergistically and are aligned to address the most important issues in the conversion of biomass to liquid fuel.
Sponsor: U.S. Department of Agriculture
PIs: Randy S. Lewis, A.J. Johannes
Division of Agricultural Sciences and Natural Resources: Ray L. Huhnke, Danielle Bellmer, Charles Taliaferro, Francis M. Epplin, Timothy J. Bowser

Conversion of Low-Cost Biomass to Ethanol
Conversion of underutilized low-cost biomass to liquid fuel and other useful products at a price competitive with fossil fuel derivatives is one of the prime objectives of renewable energy research. The primary mission of our project is to further develop the bioconversion

technology, which uses low-cost biomass for production of ethanol.
Sponsor: U.S. Department of Agriculture
PI: Randy S. Lewis

Novel Polymers Designed to Minimize Platelet Adhesion
A polymer has been modified with cysteine such that platelet deposition is significantly inhibited following exposure to plasma. The overall objective of this project is to optimize the modified polymer using cysteine modification to completely inhibit platelet deposition. This objective will be achieved following the completion of three specific aims: 1) measurement and modeling of transnitrosation and nitric oxide release, 2) optimize polymer modification to enhance nitric oxide release, and 3) application of optimized polymers to plasma and blood.
Sponsor: National Science Foundation
PI: Randy S. Lewis

Biodegradable Scaffolds for Tissue Regeneration
This project will focus on: 1) developing novel blends of biomaterials that can be tailored to required biomechanical properties, 2) optimizing macro- and micro-architecture of scaffolds, and 3) design and development of bioreactors. Project will be focused toward developing optimized scaffolds for applications such as heart valves and vascular grafts.
Sponsor: Oklahoma Center for the Advancement of Science and Technology (Applied Research)
PI: Sundararajan V. Madihally

Robotic Deposition of Dental Restorations
This project will support the efforts of the NIDCR Ceramics Team as a subcontractor and collaborator. This technology is on the cutting edge of freeform fabrication. Broad goals providing guidelines for the anticipated workload will be: 1) fabricate alumina and zirconia dental core structures using extrusion-based robotic deposition (EBRD), 2) fabricate porcelain veneer structures for (a) subsequent joining to cores and (b) direct printing onto cores, 3) investigate the feasibility of using EBRD to produce graded ceramic layer structures for optimal mechanical performance.
Sponsor: New York University for National Institutes of Health
PI: James E. Smay

Robotic Deposition of Tissue Engineering Scaffolds from Latex-Based Inks
Three-dimensional, mesoscale structures fabricated from colloidal building blocks are being investigated for tissue engineering scaffolds. The use of polymer colloids as the prime constituent in a direct write process allows for novel control over particle composition and surface chemistry; offering unique opportunities for tailoring scaffold properties. The scaffold mechanical integrity and porosity content are easily controlled through printing parameters and intrinsic polymer properties. In addition, the chemical environment for use of colloidal inks is aqueous and at neutral pH for biocompatibility. Our goal is to understand the processing characteristic of colloidal gel-based inks as well as to fabricate and characterize unique tissue engineering scaffolds.
Sponsor: Sciperio, Inc.
PI: James E. Smay

Oklahoma State University Geothermal Smart Bridge
This proposal describes a project aimed at research, development, and technology transfer associated with a bridge deck heating system to eliminate preferential icing. The proposed bridge deck heating system will have the following characteristics: 1) is hydronic (i.e., a heated fluid is circulated through tubes embedded in the bridge deck; 2) makes use of a ground source heat pump system, which recovers energy stored in the earth, and uses it to heat the fluid circulated through the bridge deck; 3) is automatic, integrates with the available intelligent transportation systems, and makes use of local and remote weather stations to forecast potential icing conditions; and 4) is expected to enhance both safety, by eliminating preferential icing conditions, and bridge deck life, by eliminating the application of salt on the bridge and reducing corrosion of the reinforcing steel.
Sponsor: Federal Highway Administration
PIs: James R. Whiteley
Division of Engineering Technology: Marvin D. Smith
School of Mechanical and Aerospace Engineering: Jeffrey D. Spitler, Daniel E. Fisher, Ronald
D. Delahoussaye
School of Civil and Environmental Engineering: M. Samir Ahmed
Biosystems and Agricultural Engineering: Ronald L. Elliott
Environmental Institute: Edward T. Knobbe

Development of Process Cause and Effect by Artificial Intelligence (AI)
Develop an algorithm that autonomously observes process data and develops linguistic cause-and-effect relationships in dynamic (time dependent), noisy, continuous processes when affected by natural events (not intentionally perturbed). Antecedents will include persistence and variable delays. Initially, genetic algorithms are proposed to develop neural-fuzzy rules. Quality of rules will be evaluated by goodness (likelihood of consequent happening), completeness (all events that could create an outcome are included in the antecedent), complexity (minimal variables and conjunctions in the antecedent), and sufficiency of data to evaluate rule. This multi-objective situation will be treated with Pareto Optimal techniques. The cause-and-effect relations might be expressed as, “If the flow rate decreased somewhat a short time past, and if a catalytic reactor was recently regenerated, then the product will be slightly yellow.” Or as, “If the cycle time for the carbon bed absorber is less than four hours, and product X is more than 10% of total production, then the recovered solvent will contain more than 50% water. If we know these cause-and-effect relationships, then we can use that knowledge to better manage our processes. The “intelligent system” could be used to discover process relationships faster than human experience would generate their operational expertise, and without human bias. Once discovered, these cause-and-effect rules could be used to warn operational staff of pending events so that they can take timely and directed corrective action. The rules could be used to automatically trigger control action. The rules could be used to guide process re-engineering that would eliminate the causes or the process mechanism that leads to the effect.
Sponsor: Measurement and Control Engineering Center
PIs: Gary G. Yen, R. Russell Rhinehart

CIVIL AND ENVIRONMENTAL ENGINEERING

Oklahoma State University Geothermal Smart Bridge
This proposal describes a project aimed at research, development, and technology transfer associated with a bridge deck heating system to eliminate preferential icing. The proposed bridge deck heating system will have the following characteristics: 1) is hydronic (i.e., a heated fluid is circulated through tubes embedded in the bridge deck; 2) makes use of a ground source heat pump system, which recovers energy stored in the earth, and uses it to heat the fluid circulated through the bridge deck; 3) is automatic, integrates with the available intelligent transportation systems, and makes use of local and remote weather stations to forecast potential icing conditions; and 4) is expected to enhance both safety, by eliminating preferential icing conditions, and bridge deck life, by eliminating the application of salt on the bridge and reducing corrosion of the reinforcing steel.
Sponsor: Federal Highway Administration
PIs: M. Samir Ahmed
Division of Engineering Technology: Marvin D. Smith
School of Mechanical and Aerospace Engineering: Jeffrey D. Spitler, Daniel E. Fisher, Ronald D. Delahoussaye
School of Chemical Engineering: J. Rob Whiteley
Biosystems and Agricultural Engineering: Ronald L. Elliott
Environmental Institute: Edward T. Knobbe

Determination of Dynamic Modulus Master Curves for Oklahoma HMA Mixtures
The objective of this research project would be to develop a procedure where ODOT could approach level 1 reliability for HMA master curves without performing detailed dynamic modulus testing for each mix in a pavement system. This would result in improved pavement performance by providing HMA master curves with near level 1 reliability while using level 2 or level 3 material characterization costs.
The improved reliability and reduced cost would be accomplished by evaluating ODOT HMA mixtures and determining which material and mix characteristics affect dynamic modulus and the resulting master curve. By evaluating the dynamic modulus of ODOT mixtures, the material and or mix characteristics that affect dynamic modulus, and the resulting master curve, would be identified. Based on the results of the analysis, the need for typical master curves based on asphalt binder grade and/or nominal aggregate size or from customized prediction equations based on Oklahoma mix properties would be determined.
Sponsor: Oklahoma Department of Transportation
PI: Stephen A. Cross

Evaluation of Cold, In-Place Recycling (CIR) for Rehabilitation of Transverse Cracking on US 412
The objective of this research project would be to evaluate the effectiveness of CIR with slurry crack injection to rehabilitate transverse cracked HMA pavements. If CIR is shown to be an effective rehabilitation procedure for transverse cracked HMA pavements, then a cost effective procedure for rehabilitation would be available to ODOT. The improved performance of CIR over conventional fabric interlayer and thin HMA overlays would result in significant cost savings to ODOT. The evaluation of the stiffness properties of CIR pavement using both non destructive techniques and laboratory techniques would allow the assignment of a reasonable AASHTO “a” coefficient to the CIR layer and/or CIR

rehabilitated pavement, resulting in improved reliability in HMA overlay thickness design.
Sponsor: Oklahoma Department of Transportation
PI: Stephen A. Cross

Evaluation of Test Methods for Determination of Aggregate Specific Gravity

The objectives of this study would be to evaluate the AggPlus^{tm} system and the SSD Detect system against the current AASHTO T-84 and T-85 methods. The procedures would be evaluated for accuracy, precision and ease of use. At the completion of the study a test method for determining the specific gravity and absorption of ODOT aggregates would be recommended.
Sponsor: Oklahoma Department of Transportation
PI: Stephen A. Cross

Guidelines for Using Prime and Tack Coats

The objective of the research project would be to develop a guide publication for the Central Federal Lands Highway Division (CFLHD) project development and field personnel that would provide decision-making guidance on how to use, when to keep, and when to eliminate prime and tack coats. Development of the guide publication would entail review of available literature and a review of CFLHD current construction specifications and construction procedures. Review of available literature would include searching the TRIS database, AASHTO, TRB, National Cooperative Highway Research Program publications, and manufacturer and supplier literature. A survey of state Department of Transportations in the CFLHD region would be performed to provide insight on current practice.
Sponsor: United States Department of Transportation – Federal Highway Administration Central Federal Lands Highway Division
PI: Stephen A. Cross

Durability of Cost Effective Timber Pile Repair Techniques to Moisture Cycling: Phase 2

A series of experimental tests are being performed to develop knowledge on how moisture cycling affects the structural performance of repaired timber piles. Repaired timber pile specimens are being subjected to accelerated moisture cycling tests in the laboratory. The pile repair technique consists of replacing the decayed core with aggregate injected with epoxy and providing material confinement with fiberglass reinforcement. Control specimens were compression tested before moisture cycling. The experimental specimens are being subjected to moisture cycling. The experimental specimens will be compression tested after being subjected to an increasing number of moisture cycles. A simple pressurized container was fabricated to quickly bring the moisture content in the specimens up to the fiber saturation point. The specimens are being quickly dried with the aid of low heat and air circulation.
Sponsor: University of Oklahoma for the Oklahoma Transportation Center for the Oklahoma Department of Transportation
PI: Robert N. Emerson

Partnerships for Advancing Technologies in Housing: Engineered Wood Frame Wall Panel System Integrating Prefabricated Truss Technology

An engineered wood frame wall panel system will be investigated that integrates

prefabricated metal plate connected truss technology with conventional wood frame wall construction. The wall panel system will be readily adaptable to current construction techniques and applications as well as future materials. The engineered wall panel system will be superior to conventional wood frame construction in the following ways: affordability, durability, environmental impact, and safety.
Sponsor: National Science Foundation
PI: Robert N. Emerson

Oklahoma Transportation Center (OTC)
This project sets forth a working relationship between the Oklahoma Department of Transportation (ODOT) and the Oklahoma Transportation Center (OTC). The goal of this proposed relationship is to bring the resources of the Oklahoma universities to bear on important transportation issues in the state and to do so in a cooperative and effective manner.
Sponsor: Oklahoma Department of Transportation
PI: Gorman Gilbert

Static and Fatigue Behavior of Threaded Drillstring Connectors
This project will evaluate the static behavior and fatigue performance of tubular threaded drillstring connections, which are being considered for use in Unocal's offshore deepwater projects. The experimental project scope will consist of 24 tests on three specimen sizes.
Sponsor: Unocal Corporation
PI: John P. Lloyd

Thor Connector Fatigue Testing
Oklahoma State University proposes a research program to evaluate the fatigue performance of the Thor Intervention riser.
Sponsor: Wyman-Gordon Limited
PI: John P. Lloyd

Use of Sensor Technology for Accurate Determinations of Groundwater Flow Parameters
This project will focus on the application of state-of-the-practice methods for the collection and subsequent analysis of groundwater velocity and direction data at select sites within the CG037 area at Tinker, AFB. Specifically, sensors developed and supplied by K-V Associates of Mashpee, Massachusetts will be secured through lease arrangement and applied to existing groundwater monitoring wells at Tinker AFB. The collected data were statistically analyzed to determine probability of occurrences for both directions of groundwater flow as well as velocity. This project was made necessary by the extreme local variation noted in these variables at Tinker AFB. Improvements in locating groundwater contaminant collection and remediation measures were sought.
Sponsor: Automated Sciences Group, Inc.
PI: William F. McTernan

Concrete Testing and Quality Control
This project is a research services agreement for graduate and undergraduate research assistants for concrete materials testing using the equipment and laboratory space of Strategic Solutions. The nature of the testing services includes batching concrete,

sampling fresh concrete, casting concrete specimens (beams, cubes, cylinders), testing fresh concrete (slump, unit weight, air content), testing hardened concrete (flexural, compressive, tensile, and pullout strength), and concrete maturity testing. Testing will be performed in accordance with the latest versions of the respective standards published by ASTM International.
Sponsor: Strategic Solutions for Oklahoma Center for the Advancement of Science and Technology (Applied Research)
PI: Garold D. Oberlender

Evaluating the State of the State's Bridges: A Systematic Review of the Bridge Inspection System
This project, as envisioned, would assist the State Bridge Engineer and the Bridge Division to improve the bridge inspection system, and to develop tools that will allow more transparency in the interpretation of the data collected from bridge inspections. The project is a multi-phased approach that will build upon information collected in each of three phases of research. The three phases are envisioned as the following: 1) quantify the data from the existing and available bridge inspections, 2) inspect a statistically relevant sample of bridges to determine the condition of the bridges relative to the current inspection reports, and 3) help the State Bridge Engineer develop retrofit/repair/replacement strategies.
Sponsor: University of Oklahoma for the Oklahoma Transportation Center for Oklahoma Department of Transportation
PIs: Bruce W. Russell, Charles M. Bowen

Investigating the Admixture IPANEX for Use in Bridge Decks
This project extends the project originally awarded by OTC in FY 2003 under the same name. Its purpose is to investigate the admixture IPANEX for Use in Bridge Decks. The IPANEX project has been operated jointly with another project sponsored by OTC investigating the use of MMFX reinforcement in bridge decks. Both projects are demonstration projects where IPANEX has been used in the concrete bridge decks. IPANEX was added to the bridge deck concrete in two demonstration projects on I-35. One of the projects is located in Love County in southern Oklahoma. The other project is located in Kay County in northern Oklahoma. For each project, a pair of bridges was constructed with concrete containing IPANEX admixture on one bridge only. Its companion bridge did not contain the admixture. In the Kay County project, the north bound bridge contains both IPANEX and MMFX steel whereas the south bound bridge does not include IPANEX and uses epoxy coated reinforcement instead of MMFX steel. The task of this research project is to evaluate IPANEX admixture and its ability to enhance the mechanical and engineering properties of concrete, and to answer the question whether our bridge decks will be more durable through the use of the concrete admixture IPANEX.
Sponsor: University of Oklahoma for the Oklahoma Transportation Center for the Oklahoma Department of Transportation
PI: Bruce W. Russell

Investigation Admixture IPANEX for Use in Bridge Decks
This project outlines the work plan necessary to adequately assess the effects of IPANEX on hardened concrete properties. The research will also judge what important effects that the admixture may have on the fresh concrete properties and on concrete curing; all of

these factors affect the long-term performance of the concrete materials. The work plan necessarily includes sampling at the construction site, laboratory investigations, and analysis of the results and a synthesis of the information into a final research report.
Sponsor: Oklahoma Transportation Center for Oklahoma Department of Transportation
PI: Bruce W. Russell

Investigation of MMFX Reinforcement for Use in Bridge Decks
This project extends the project originally awarded by the Oklahoma Transportation Center (OTC) in FY 2003 under the same name. Its purpose is to investigate MMFX reinforcement for use in bridge decks. The MMFX project has been operated jointly with another project sponsored by OTC investigating the use of the admixture IPANEX in bridge decks. This project will sample the concrete from the bridge decks by extracting cores. The cores will be taken from the bridge decks in January and February of 2004. In addition to laboratory research, the project included a demonstration project located in Kay County in northern Oklahoma. Two companion bridges on I-35 were built crossing the Chikaskia River. The bridge for the southbound lanes was constructed with epoxy coated reinforcement and “regular” concrete. The bridge for the northbound lanes was constructed with MMFX steel and concrete containing IPANEX. The task of this research project is to evaluate MMFX reinforcement and its ability to enhance the durability of concrete bridge decks, and more specifically to answer the question MMFX reinforcement should be used in lieu of epoxy coated or “black” steel in our bridge decks.
Sponsor: University of Oklahoma for the Oklahoma Transportation Center for the Oklahoma Department of Transportation
PI: Bruce W. Russell

Investigation of Stainless Steel Clad Reinforcement for Bridge Decks
This project outlines the work plan necessary to adequately assess the efficacy of the stainless steel clad reinforcement, with the overall goal of examining the design issues, constructability, and the serviceability of the stainless steel clad reinforcement. The work plan necessarily includes work at the construction site, laboratory investigations, analyses of the results, and a synthesis of the information into a final research report.
Sponsor: Oklahoma Transportation Center for Oklahoma Department of Transportation
PI: Bruce W. Russell

Transfer, Development, and Splice Length for Strand/Reinforcement in High-Strength Concrete
The main objective of this study is to develop recommended revisions as appropriate to the AASHTO LRFD Bridge Design Specifications for normal weight concrete having compressive strengths up to 18 ksi, relating to: 1) transfer and development length of pre-stressing strand with diameters up to 0.62 inches; and 2) development and splice length in tension and compression of individual bars, bundled bars, and welded wire reinforcement and development length of standard hooks.
Sponsor: Purdue University for the National Academy of Sciences/National Cooperative Highway Research Program
PI: Bruce W. Russell

Development of a 511 Traveler Information Program Deployment Plan for Oklahoma
The Oklahoma Department of Transportation (ODOT) wishes to develop a deployment plan

for the “511 Travelers’ Assistance Program” outlined in 66 FR 141 (1999). The 511 Plan will include projects currently under development through the Intelligent Transportation System (ITS) program. The 511 Plan can also employ information infrastructure (fiber optic lines) currently owned by ODOT and the Oklahoma Turnpike Authority (OTA). The 511 deployment plan will be developed through a cooperative agreement between Oklahoma State University and the University of Oklahoma. Input will be sought from stakeholders, requirements of the 511 program will be determined, and a deployment plan produced that stresses affordability, ease of administration, and the needs of stakeholders.
Sponsor: Oklahoma Department of Transportation
PI: Dee Ann Sanders

Technology Transfer for the Domestic Petroleum Industry
This project will develop and conduct workshops for petroleum environmental regulators in Oklahoma and Arkansas and for Exploration & Production (E&P) inspectors with the Osage Agency of the Bureau of Indian Affairs. Prior to the workshops, extensive interviews with regulatory personnel and independent producers will be done to identify the most relevant environmental problems for which the E&P sector is seeking solutions.
Sponsor: University of Tulsa Integrated Petroleum Environmental Consortium
PIs: Dee A. Sanders
Engineering Extension: George F. Collington

Evaluation of Geocomposite Drainage Layer in Roadway Pavement Design
The proposed study consists of research of existing available data, geotechnical laboratory testing, compiling and analyzing the results, and developing a simple computer program for calculating the appropriate coefficients for directly considering the subgrade improvement benefits of the geocomposite in conventional pavement design methods. The geocomposite proposed for this study is a relatively new product produced by TENAX Corporation of Baltimore, Maryland. The product trade name is TENDRAIN™ and consists of a high-strength geonet core, covered on both sides with a nonwoven geotextile. The geocomposite has high tensile strength and a large water flow capacity under significant confining pressure. Large samples of the material, sufficient for the proposed laboratory testing program, have been provided by TENAX.
Sponsor: Tenax Corporation
PI: Donald R. Snethen

Quality Control Testing for Granular Materials
The proposed research program will be a combined effort between the Oklahoma State University (OSU) School of Civil and Environmental Engineering and the University of Oklahoma (OU) School of Civil Engineering and Environmental Science. Using Oklahoma Department of Transportation (ODOT) input, two samples of typical granular backfill and select borrow will be collected from approved material sources. Sufficient quantities of the typical granular materials will be obtained to run sieve analysis, Standard Proctor compaction, Maximum and Minimum Index Densities for relative density measurements, and direct shear tests to measure shear strength parameters. All tests will be conducted according to appropriate ASTM or AASHTO standard test methods. The test results will be used to correlate Proctor compaction-based acceptance criteria (i.e., percent compaction) with relative density values. The OU large-scale test facility will be used to prepare compacted test sections of the typical granular material samples in which four field test

methods will be run and the results compared. The field test methods selected for evaluation and comparison are: 1) nuclear moisture-density gauge (NMD), 2) Dynamic Cone Penetrometer (DCP), 3) PANDA Cone Penetration Test (PCP), and (4) GeoGauge Dynamic Stiffness device (GDS).
Sponsor: University of Oklahoma for the Oklahoma Transportation Center for the Oklahoma Department of Transportation
PI: Donald R. Snethen

Linear Scheduling Program Development
Linear Schedules are used for construction activities that span over long distances, such as fiber optic cables, pipelines, highways, and utility projects. This research involves computerizing the linear scheduling model as well as adding algorithms for critical path calculations, earned value analysis, and analysis of delay effects.
Sponsor: Willbros USA, Inc.
PI: G. Rock Spencer

Gas Phase Corona Technology for Treatment of VOC Paint Booth Emissions
This research project has four phases. The first phase will utilize OSU's most recent plasma design, which is scalable by constructing many small reactors and packing them like straws in a can. This phase will focus on assessing the destruction efficiency of the VOCs contained in typical exhaust from a paint booth by the plasma reactor. The second phase of the project will size and construct/purchase the requested adsorption technology to concentrate the VOCs, and investigate the most effective manner (likely steam) to release these VOCs back into the air phase so they can be directed to the plasma reactor for destruction. Phase three of the project will involve the scale-up calculations and actual construction of a plasma reactor to handle the specified airflow rates. The fourth and final phase will involve testing the large-scale plasma reactor both with and without the pre-concentrator adsorber system to assess system performance, and develop detailed operational costs and maintenance costs.
Sponsor: Altech Services, Inc.
PIs: John N. Veenstra,
School of Chemical Engineering: Arland H. Johannes, Gary L. Foutch

Gas Phase Corona Technology for Treatment of VOC Paint Booth Emissions (Phase II)
This continuation portion of the Gas Phase Corona Reactor technology (GPCR) is divided into two phases. Phase II deals with final scaling of the reactor to reach pilot scale size and the initial evaluation of costs. Phase III involves the actual construction of the pilot scale plasma unit, its installation on a paint booth at Tinker Air Force Base, and test runs of the pilot scale unit.
Sponsor: Tec-Masters, Inc.
PI: John N. Veenstra
School of Chemical Engineering: Arland H. Johannes, Gary L. Foutch
School of Industrial Engineering & Management: John W. Nazemetz

Industrial Water Treatment Plant Metals Treatment Process Optimization
This summer research project will investigate optimization of the metals treatment process at the IWTP. The focus of the project will be on the mixing units within the mixing basins,

with the major objective of being able to reduce the extent of short circuiting through the three basins, and thereby on improving the efficiency of the metals treatment process. The intent of the project is to investigate potential modifications to the metal treatment mixing process. Mixing process modification planned to be evaluated includes the following: different mixing/flocculation paddles, different size of paddles, placement of the mixing paddles inside the basins (i.e., not centered in basin), the use of baffles in the mixing basins, and varying the speed of the mixers.
Sponsor: Automated Sciences Group, Inc.
PI: John N. Veenstra

COLLEGE OF ENGINEERING, ARCHITECTURE, AND TECHNOLOGY EXTENSION

Kangwon National University American Studies Short Program Summer 2004

Kangwon National University (KNU) and Oklahoma State University (OSU) have entered into an agreement under which the Office of Engineering Extension, within the OSU College of Engineering, Architecture, and Technology (CEAT), will conduct a 29-day summer program on the OSU-Stillwater campus for KNU electrical engineering undergraduate students. The summer program will emphasize exposure to English, American culture, and engineering in the classroom. Outside the classroom, additional activities allow KNU guests opportunities for English conversation interaction with English speaking OSU electrical engineering students and faculty, OSU international students, and retail businesses both in Stillwater and Oklahoma. It is planned that KNU students will be paired with conversation partners that will meet in the evenings and on weekends. Industry visits to American manufacturing/research companies that have electrical engineering departments, or have electrical or communication related products or services, are included.
Sponsor: Kangwon National University
PIs: George F. Collington
School of Electrical and Computer Engineering: Jong-Moon Chung

EGLINE FIELD OFFICE

Joint Munitions Effectiveness Manual (JMEM) Program

OSU is currently working in its 38th year as the JMEM Production Contractor for the Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME). JTCG/ME is a Department of Defense (DoD) program sponsored by the Secretary of Defense's Director of Operational Test and Evaluation. We provide research, analysis, and computational support to three major joint service working groups within the JTCG/ME involved with the production and dissemination of classified conventional munitions effectiveness data. We also provide technical editing, graphics, composing, and document design/layout support to publish all JMEMs and JTCG/ME Special Reports according to military standards. The Oklahoma State University Engineering Research Field Office (OSUFO) is located on Eglin AFB, FL with a satellite office at Aberdeen Proving Ground, MD.

JTCG/ME provides nonnuclear munitions effectiveness information for DoD targeteers, weaponeers, and planners; operational commanders; weapon system designers; and logisticians. The information includes damage/kill probabilities for specific weapons and

targets; physical and functional characteristics of munitions and weapon systems; target vulnerability; obscuration impact on weapon effectiveness; and analytical techniques and procedures for assessing munitions effectiveness. This effort has resulted in a library of classified and unclassified JMEMs and standardized methodologies capable of rapidly generating effectiveness data over a wide range of delivery parameters for air-to-surface, surface-to-surface, antiair, and special forces weapons. The JTCG/ME is organized with three major working groups: JMEM/Air-to-Surface, JMEM/Surface-to-Surface (including Special Operations), and JMEM/Antiair, to cover the spectrum of weapon effects issues. In addition, a formally chartered Operational Users Working Group (OUWG) supports each JMEM working group. The JTCG/ME Program Office is the focal point for all JTCG/ME efforts. They coordinate the efforts of the working groups while the execution of those efforts is the responsibility of the working group chairmen. JMEM/Air-to-Surface is involved in the development of methodologies and analysis of data that assess the effectiveness of weapons launched from the air at targets on the ground. JMEM/Surface-to-Surface assesses weapons delivered from the ground at targets on the ground. JMEM/Antiair assesses weapons launched at air targets. The Joint Service Target Data Standardization Group to supports the other three working groups by assessing a target's loss of capability when impacted by a weapon's damage mechanisms. The OSUFO is organized into branches aligned with the JTCG/ME working groups. The OSUFO Vulnerability, Publications, and Graphics Branches are functionally organized to give maximum support across all working groups. OSUFO personnel coordinate on a daily basis with the working groups and the Program Office. They also work with other JTCG/ME contractors who are developing methodologies or working on target vulnerability studies to ensure their efforts will support JMEM production schedules and needs. The OSUFO performs development and weapons effectiveness analyses as well as supports the working groups in their efforts to obtain weapons data from the government program offices and the weapons contractors. The OSUFO's major responsibility is to produce JMEMs on time, based on working group schedules, with the capabilities and data required by the government.

The 56-employee effort is divided 63% for research/analytical support and 37% for technical publishing support. Research/analytical activity includes development, documentation, and maintenance of sophisticated computer programs designed to produce classified conventional weapons effectiveness data versus a broad spectrum of surface and airborne targets. Research activity also involves the collection and analysis of detailed weapon system characteristics data and target vulnerability data that provides inputs for weapons effectiveness programs.

The technical publishing function, working interactively and concurrently with OSUFO analysts, involves technical editing, illustrating, composing, and document design/layout required to produce high-quality documents to strict military standards. These documents include paper and electronic media products.

JMEMs were used in planning strikes in every conflict from the Vietnam War through Operation Iraqi Freedom. JMEM data are also widely used for training targeteers and weaponeers at service schools, conducting exercises, and supporting deployment contingency planning.

Sponsor: U.S. Air Force

PIs: Dean Karl N. Reid, Arthur J. Rosenbaum

ELECTRICAL AND COMPUTER ENGINEERING

Field Penetration Studies – Statistics and Bounding

The long term goal of this project is to develop analysis tools to generate a boundary for and a statistical characterization of the fields inside non-ideal (lossy), electrically large cavities, as is found in a typical transport. An additional goal is to determine the coupling of the fields that exist in the complex environment to electrically small avionics boxes.
Sponsor: Old Dominion University Research Foundation for NASA
PI: Charles F. Bunting

Vitalizing Electromagnetic Concepts to Enhance Relevancy: VECTOR

The Department of Electrical Engineering will develop and implement a two course sequence in electromagnetics based on proven teaching methods: VECTOR (Vitalizing Electromagnetic Concepts To Obtain Relevancy). Project goals are to make EM relevant to students, utilize modern engineering tools and techniques to teach fundamental concepts; pipeline students into the electromagnetics-photonics curriculum, and evaluate VECTOR as a test-bed for future development of exemplary curricular materials.
Sponsor: National Science Foundation
PIs: Charles F. Bunting, James C. West, R. Alan Cheville

CAREER: Multidimensional THz Imaging and Collaborative Research Oriented Education

This research program will use optoelectronically-generated pulses for imaging and characterization in the far infrared (FIR) spectral region. This research will be integrated into curriculum development designed to address fundamental shortcomings in providing research opportunities for undergraduate students.
Sponsor: National Science Foundation
PI: R. Alan Cheville

CAREER: Multidimensional THz Imaging and Collaborative Research-Oriented Education REU Supplement

The goal of this supplement program is to incorporate two undergraduate students into the NSF CAREER funded research program in the Ultrafast Terahertz Optoelectronic Laboratory (UTOL), which makes use of optoelectronically generated pulses for imaging and characterization in the far infrared spectral region. Specific and focused projects are available for these students, which are suitable for undergraduate involvement.
Sponsor: National Science Foundation
PI: R. Alan Cheville

Hands-On Undergraduate Laboratory in Photonics Using Case Studies and Other Non-Traditional Methodologies

Project goals are to develop a photonics curriculum expanding existing courses with a relevant laboratory based on an “industrial model.” This curriculum will implement pedagogy based on modern learning theory, adapt the case study methodology to link lectures with laboratories, create materials and develop local faculty expertise in the case study methodology, and create and implement assessment instruments to measure the effectiveness of this methodology.

Sponsor: National Science Foundation
PIs: R. Alan Cheville,
College of Education: Kay S. Bull

Nanoshell-Based Infrared and Terahertz Adaptive Materials and Devices
The Ultrafast Terahertz Optoelectronics Laboratories (UTOL) at Oklahoma State University will characterize the biomimetic materials developed at Rice University and University of Houston. Characterization will be performed via terahertz time domain spectroscopy. The UTOL will measure sample transmission, reflection, and the angle dependent far field scattering signature of biomimetic structures. In addition, the class 1000 cleanroom facility currently being constructed in the UTOL will be available for incorporating the biomimetic materials developed at Rice University and University of Houston into devices and structured surface coatings.
Sponsor: Rice University for U.S. Army Research Office
PIs: R. Alan Cheville, Daniel R. Grischkowsky

Relevancy Enhancement Achieved by Laboratories and Lecture Integrated for Engineering Education (REAL LIFE) Adoption of a Relevant Undergraduate Curriculum
The School of Electrical and Computer Engineering –in conjunction with the OSU College of Education, the OSU library, and the School of Industrial Engineering and Management - will increase retention of engineering students at OSU by implementing a model based on successful engineering curriculum reform efforts. The curriculum model is named REAL LIFE (Relevancy Enhancement Achieved by Laboratories and Lecture Integrated for Engineering Education) and is designed to enhance relevancy. REAL LIFE integrates three proven teaching methods: problem based learning, team learning, and case studies. This model has been implemented and tested at Oklahoma State University through a National Science Foundation “Course, Curriculum, and Laboratory Improvement” award with great success.
Sponsor: National Science Foundation
PIs: R. Alan Cheville, Charles F. Bunting, Carl D. Latino, Keith A. Teague
School of Industrial Engineering and Management: Camille F. DeYong
College of Education: Richard J. Bryant
Edmond Low Library: Elizabeth A. Reiten

Terahertz Spectroscopy of Complex Matter
This research project is a collaborative experimental-theoretical effort to investigate the electronic properties of complex matter in the terahertz frequency region from 25 GHz to beyond 5 THz. The goal of this project is to make fundamental contributions to the understanding of complex matter through development and adaptation of THz time domain spectroscopy techniques.
Sponsor: Department of Energy
PIs: R. Alan Cheville, Daniel R. Grischkowsky

THz Impulse Scale-Ranging, THz Imaging, and Ultra-Sensitive THz Time-Domain Spectroscopy
OSU proposes to apply the techniques of THz optoelectronics developed at OSU to three areas of DoD relevance: 1) THz impulse scale ranging will be used to address fundamental

questions in electromagnetic scattering including target detection in clutter and millimeter wave imaging. 2) In conjunction with fundamental investigations on ranging, the study will develop materials/surfaces with specific dielectric properties in the millimeter and submm spectral region. These will include low visibility materials and dielectrics whose response at THz frequencies mimics that at GHz for use in table top ranging studies. 3) The PIs propose to apply the THz time-domain spectroscopy (THz-TDS) technique that they have pioneered to previously intractable experimental problems in trace molecular detection. The newly developed technique of Waveguide THz-TDS enables characterization of materials at nanogram quantities.
Sponsor: United States Army Research Office
PIs: R. Alan Cheville, Daniel R. Grischkowsky

USASMDC Terahertz Time Domain Spectroscopy: A Novel Approach for Finding Cracks in Composite Materials
OSU will partner with Nomadics, Inc. to develop and test THz Time Domain Spectroscopy capabilities to find cracks in composite materials. OSU's primary goals will be to: 1) modify existing or build new THz TDS setup in order to examine samples of composite material specimens similar to those used in missiles, 2) develop suitable protocols for damaging composite materials, 3) characterize composite material specimens looking for indications of damage, and 4) analyze data to determine best methods for flaw detection and evaluation.
Sponsor: Nomadics, Inc. for U.S. Army Space and Missile Defense Command
PI: R. Alan Cheville

Advanced Broadband Digital Cable-TV Set-Top System and Networking Research
Oklahoma State University will participate in building advanced developer's supplemental tools for Digital Cable-TV Set-Top boxes and Digital Cable-TV networking devices that assists the functionality of scanning and surveying platform capabilities in terms of available resources, and also monitor usage of application layer threads by direct API calls or head-end based operations such that the deployed application operates within the discovered allowable boundaries. The project also includes advanced research on network security and information assurance (IA) analysis and optimization.
Sponsor: LaLucha, LLC
PI: Jong-Moon Chung

American Studies Short Program between Kangwon National University of the Republic of Korea and Oklahoma State University
Oklahoma State University will provide undergraduate students from Kangwon National University (Republic of Korea) with first hand exposure to American language both in and outside the classroom. Kangwon National University (KNU) and Oklahoma State University (OSU) hereby enter into an agreement under which the Office of Engineering Extension, within the OSU College of Engineering, Architecture, and Technology (CEAT), will conduct a 29-day summer program on the OSU-Stillwater campus for KNU electrical engineering undergraduate students. The summer program will emphasize exposure to English language in English language classes, English in electrical engineering classes, industry and research lab visits, as well as exposure to American culture.
Sponsor: Kangwon National University
PIs: Jong-Moon Chung

Engineering Extension: George F. Collington

Center of Excellence in Information Technology & Telecommunications (COEITT) Domain Leader
Dr. Jong-Moon Chung will be representing Oklahoma State University (OSU), serving as Domain Leader for the Center of Excellence in Information Technology & Telecommunications (COEITT) over the next year period. The essential functions of a COEITT Domain Leader are to work with the Executive Director (ED) and the Associate Directors of Collaborative Research (ADCRs) of the COEITT in the establishment and implementation of the strategy for collaborative research in targeted application and topical area (known as a "domain") in information technology and telecommunications among Oklahoma's research universities, private sector, and state agencies. The COEITT Domain Leader responsibilities and duties are listed as follows: 1) Serve as the team leader for one's respective university to recruit and generate interest among other faculty for research in their domain. 2) Work with peer leaders from the other research universities in their domain to: a) Provide specific recommendations to COEITT ED and ADCRs on funded programs to be targeted based on existing research interests and expertise at their respective institution. b) Identify infrastructure and personnel needs in order to be competitive at a national level with the federal funding agencies; this will require an understanding of the funding agencies' strategies, priorities, and recently funded projects. c) Develop demonstration projects that can be used to explain relevance of research to the general public, institutional leadership, and funding decision makers such as members of Congressional delegation, state legislators, and their staff members. d) Lead and be involved in the development and submission of proposals within their respective domain, resulting in submission of at least one significant research proposal. Significant is defined as project funding of $250,000 or more with team members collaborating in the research from at least two of the three research universities.
Sponsor: OSU Foundation for the Center of Excellence in Information Technology and Telecommunications, OSU-Tulsa
PI: Jong-Moon Chung

Feasibility Study of the RFID MMM Systems
The objective of this project is to conduct a thorough investigation on the system requirements involved in developing the Radio Frequency IDentification (RFID) based Micro-Memory Module (MMM) devices and the downhole and surface reader/writer terminals. It will also be to fully understand and quantify: 1) communication channel characteristics in LWD environments; and 2) physical constraints of Telemetry Systems in LWD environments. Downhole Reader/Writer, Surface Reader/Writer, and Contactless RF Memory Module system designs will be developed.
Sponsor: Halliburton Energy Services
PIs: Jong-Moon Chung, Charles F. Bunting, Chriswell G. Hutchens

Hybrid Wireless and Wired Networking Systems
OSU and Sciperio, Inc. are collaborating to develop novel wireless communication and networking devices. The OSU-Sciperio team is working to advance the antenna design, power management, and miniaturization of the system applying the mesoscopic integrated conformal electronics (MICE) technology developed by Sciperio through funding from the Defense Advanced Research Projects Agency (DARPA) of the Department of Defense

(DoD). The core components of the research and development include the baseband and RF hardware and its control firmware as well as the networking and interface systems.
Sponsor: Oklahoma Center for the Advancement of Science and Technology (Applied Research)
PI: Jong-Moon Chung

IA Technologies for Mobile Users
Oklahoma State University will work in collaboration with Shadowband Systems, Inc. for a Phase-I Small Business Innovative Research (SBIR) Program for the U.S. Department of Defense (DoD). This Air Force project objective is to design and develop networking systems that can provide the highest level of end-to-end security between mobile and non-mobile voice and data wireless networks while making the communication more adaptive, robust, and reliable. The developed systems include next generation reliable data communication technologies and also state-of-the-art protection, detection, and response technologies collaborating at multiple network layers of the networking system. This project has been awarded a Phase-2 from 2004 to 2006 to complete the research and development of these advanced information assurance systems.
Sponsor: Shadowband Systems, Inc. for U.S. Air Force
PI: Jong-Moon Chung

Kangwon National University American Studies Short Program Summer 2004
Kangwon National University (KNU) and Oklahoma State University (OSU) have entered into an agreement under which the Office of Engineering Extension, within the OSU College of Engineering, Architecture, and Technology (CEAT), will conduct a 29-day summer program on the OSU-Stillwater campus for KNU electrical engineering undergraduate students. The summer program will emphasize exposure to English, American culture, and engineering in the classroom. Outside the classroom, additional activities allow KNU guests opportunities for English conversation interaction with English speaking OSU electrical engineering students and faculty, OSU international students, and retail businesses both in Stillwater and Oklahoma. It is planned that KNU students will be paired with conversation partners that will meet in the evenings and on weekends. Industry visits to American manufacturing/research companies that have electrical engineering departments, or have electrical or communication related products or services are included.
Sponsor: Kangwon National University
PI(s): Jong-Moon Chung, George F. Collington

Network Anomaly Detection Using a Self-Similar Traffic Model
Oklahoma State University is conducting research for the National Science Foundation (NSF) for a project focused on developing novel algorithms to execute precision network anomaly detection using the statistical variables variation as a detection metric of the self-similar traffic model. The research objective is to develop novel next generation intrusion detection system (IDS) algorithms that will become important tools for the future network security and information assurance. This project is in collaboration with Shadowband Systems, Inc.
Sponsor: Shadowband Systems, Inc. for National Science Foundation
PI: Jong-Moon Chung

Telecommunications Virtual Laboratory Development
The objective of this project is to develop a telecommunication education infrastructure through a virtual telecommunications laboratory course that is a key part of OSU's Master of Science in Telecommunications Management (MSTM) program. These lab modules will be developed and tested at OSU-Stillwater and OSU-Tulsa and in cooperation with Ponca City's Broadband Initiative and the Oklahoma Municipal League's (OML) Telecommunications Project.
Sponsor: United States Department of Education
PIs: Jong-Moon Chung, George M. Scheets, Jr.
College of Business Administration: Ramesh Sharda, Mark Weiser, Nick Romano

Advanced Retinal Imaging for Non-Invasive Disease Study
The goal of this project is to facilitate and promote non-invasive evaluation of diabetic retinopathy by applying advanced retinal imaging and machine learning approaches. The National Eye Institute reports that existing treatments for diabetic retinopathy, a common sight-threatening complication of diabetes, have proved 95 percent effective in maintaining vision. Nonetheless, 40,000 Americans continue to go blind each year from this disease. This continuing loss of sight from diabetic retinopathy is primarily a result of the failure to have regular eye evaluations that can identify those at risk for vision loss even though their disease remains asymptomatic. For this reason, essentially all professional and patient organizations recommend qualified annual retinal evaluations for patients with diabetes. The novel technology of digital retinal imaging, using a stereoscopic fundus camera, is able to instantly image the retina at high levels of resolution. Skilled non-physician experts grade the images for the presence and severity of a variety of characteristics based on standard protocols. Patients diagnosed with sight-threatening retinopathy are referred to eye specialists as early as possible. To efficiently scale these systems, a few key software tools are needed. In this project, we have three specific aims: 1) assess and control the retinal imaging quality; 2) promote disease detection, staging, and monitoring by novel 2-D/3-D image annotation methods; and 3) invoke a hierarchical grading process to optimize the involvement of graders of different levels of skill. Standardized, efficient, and reliable retinal image grading is the overall goal.
Sponsor: Oklahoma Center for the Advancement of Science and Technology (Applied Research)
PIs: Guoliang Fan, Gary G. Yen

CAREER: Advanced Statistical Modeling Approaches for Structured Video Representation and Research-Oriented Multidisciplinary Education
The career development plan consists of two integral parts: the research and educational plans. The research plan aims at developing structured video representation to enhance interpretability and manipulability of visual data. This research program will be integrated into the educational plan to build a research-oriented multidisciplinary educational environment for both undergraduate and graduate students. Specific plans for improving retention of minority and women students are addressed in the educational program.
Sponsor: National Science Foundation
PI: Guoliang Fan

Toward an Integrated Web-GIS Decision Support System for Evaluating USDA's Conservation Reserve Program (CRP)
This project aims to develop a prototype of an integrated Web-GIS Decision Support System (DSS) for USDA Conservation Reserve Program (CRP) (i.e., CRP-DSS). CRP is a voluntary program to provide incentives for farmers and ranchers to strengthen environmental stewardship of their lands, and gives producers additional resources to reduce topsoil erosion, increase wildlife habitat, and improve air and water quality on these lands. The objective of this project is to develop accurate and timely decision-support aids and research tools to help USDA manage, plan, and monitor the CRP program. The study area in this project is Texas County, OK, where the CRP enrollment ranks first in Oklahoma. Particularly, advanced remote sensing, GIS, and networking technologies have been involved in this project to develop the CRP-DSS.
Sponsor: Oklahoma NASA EPSCoR
PIs: Guoliang Fan
College of Arts and Sciences: Mahesh Rao, Johnson Thomas

24/7 Remote Monitoring of Work Zones and Intelligent Decision Support System for the Safety of Motorists and Highway Construction Workers
In this research, the goal is to design, implement, deploy, and evaluate the effectiveness of a monitoring system that will be built using off-the-shelf technology with an intelligent decision support system to provide dynamic and proactive information related to work zone traffic conditions to reduce accidents.
Sponsor: Oklahoma Transportation Center for Oklahoma Department of Transportation
PI: Rafael Fierro

Adaptation and Learning at All Levels in Intelligent Robot Teams for Reconnaissance, Surveillance, and Battlefield Assessment
OSU will provide the software tools and develop the methodology that will enable a team of mobile robots to navigate within dynamic environments and adapt to new tasks, while providing performance guarantees. We believe that recent stability results in *hybrid systems* can be applied to a class of autonomous systems, specifically, a group of autonomous vehicles engaged in reconnaissance, surveillance and battlefield assessment.
Sponsor: University of Oklahoma for United States Army
PI: Rafael Fierro

CAREER: Coordination of Dynamic Networks – A Hybrid System Approach
A dynamic network consists of spatially distributed dynamic nodes (e.g., autonomous vehicles or mobile sensors), which are coordinated by a common set of goals and possible dynamic interaction between the nodes. There are many applications where a dynamic network may be more suitable than a single vehicle, especially where a distributed system of sensors is advantageous. This research effort will be structured along the following thrusts: 1) a framework that integrates the physical, computational, and communication network, 2) novel optimization-based control methods for dynamic cooperative networks will be developed, implemented, and tested on actual hardware, 3) Model Predictive Control of Dynamic Networks will be derived to solve formation control problems, and 4) Goal Directed Sensor Networks.
Sponsor: National Science Foundation

PI: Rafael Fierro

Hierarchical Hybrid Control of Multi-Vehicle Systems
The goal of model predictive control (MPC) is to compute an optimal control signal within a finite horizon taking into account system constraints. Our goal is to merge the strengths of MPC and hybrid control theory into a unified framework that allows stability and performance guarantees to be made on real world systems. The proposed research is an important step towards the next generation of hybrid control theory that is needed to design robust multi-vehicle systems. MPC theory will guide hybrid control to coordinate robot teams by maximizing an appropriate global performance index. Theoretical results will be implemented on actual vehicles engaged in a wide range of tasks from team manipulation, to search and rescue, to cooperative exploration and target acquisition.
Sponsor: National Science Foundation
PI: Rafael Fierro

Software Enabled Control for UAV Formation Flight
Advances in information technologies and networked control systems are enabling an increasing interest in multi-vehicle systems equipped with embedded processors and sensors, and communications capabilities. The technology incorporated into unmanned aerial vehicle (UAV) fleets to allow their use in applications such as intelligence gathering, surveillance, reconnaissance, and communication will be one of the core competencies of the future unmanned vehicle systems. In this project, we will design a hardware-in-the-loop (HIL) simulation platform where novel software-enabled control strategies for UAV formation flight can be tested. Then, these algorithms would be implemented on actual UAVs at NASA Langley Research Center.
Sponsor: University of Oklahoma for Oklahoma State Regents for Higher Education
PI: Rafael Fierro

THz Interconnect
This project will investigate direct optoelectronic generation and detection of THz pulses within the waveguide or at the input and output faces of the waveguide. The ultimate goal is to devise an efficient coupling structure between a high performance chip and the waveguide. We also propose to apply the physical principles of standard waveguide connectors, coupling and multiplexing structures to develop similar components for our unique planar metal waveguides. The goal is to develop a compatible series of waveguide components for an interconnect system.
Sponsor: Rennselaer Polytechnic Institute for Semiconductor Research Corporation
PI: Daniel R. Grischkowsky

Unique Applications of THz Time-Domain Spectroscopy and Waveguide THz-TDS
This project continues our focus on applying the THz time-domain spectroscopy (THz-TDS) technique that we have pioneered and our technique of waveguide THz-TDS to previously intractable experimental problems that cannot be solved by other methods. In addition, we have begun new efforts in linear and nonlinear THz coherent transients, and the experimental study of the propagation of a THz pulse consisting of a coherent superposition of whispering gallery modes of a silicon cylinder.
Sponsor: National Science Foundation
PI: Daniel R. Grischkowsky

A 8Kx8 MRAM and LTC 1625 Feasibility Study for High Temperature SOI/SOS Implementation
The primary task of this project is to develop and implement an 8Kx8 MRAM prototype for operation at high temperatures up to 230° C. There are two different types of foundries involved in MRAM (Magnetoresistive Random Access Memory) development. The first foundry does the SOI/SOS. The second foundry does the magnetoresistive processing for MRAM memory array, which functions as data storage. This project will proceed in two phases. Phase I will involve refining MRAM performance specification, circuit development of the SOI/SOS core, and experimental verification of the write sense. Phase II will follow the Phase I core development phase with the development of the 8Kx8 MRAM.
Sponsor: Halliburton Energy Services
PI: Chriswell G. Hutchens

A 14-bit Ksps Analog-to-Digital Converter and Digital Cell Library for High Temperature Applications
The objective of this project is comprised of two parts: 1) to complete the design and fabrication of an ADC (14-bit@2 Ksps consuming 50mW@180 C), and 2) to develop a digital cell library for VHDL synthesis. The complete ADC design includes both the AFE and the digital back end (DBE) on the same chip for monolithic integration but with provisions to dice the AFE and DBE separately. Digital cell library development consists of developing and characterizing over 80 logic and I/O cells with the purpose of automating digital layout. This includes cell simulation, electrical and physical characterization, and finally, compilation into a cell library that can be used for VHDL code synthesis.
Sponsor: Halliburton Energy Services
PI: Chriswell G. Hutchens

Assignment Agreement with the U.S. Navy
The purpose of this assignment is to provide SPAWAR Systems Center-San Diego Integrated Circuits Research and Development Branch the temporary services of a research scientist and expert in the area of mixed signal circuits to assist in the process characterization of UTSOI Wafer technology and development of mixed signal UTSOI Wafer technology circuit building blocks.
Sponsor: SPAWAR Systems Center
PI: Chriswell G. Hutchens

Investigate the RF and Analog Scaling Limits of DSM CMOS and Support of FLEX Base RF-Analog
OSU is collaborating with SPAWAR, San Diego to develop and/or advise the effort in the development of analog device models for: matching, s-parameter models, BSIM4 SOI modeling, noise characterization (including gate currents), and gate leakage for two or more differing device processes. This will cover test cell design and layout, measurement, and fitting of data as required. With regard to device and passive modeling, it is expected that OSU will assist in the design and layout the test cells for noise modeling, SPAWAR, San Diego will extract the data and models, will be developed jointly through interaction.
Sponsor: Space and Naval Warface Systems Center, San Diego (SSCSD)
PI: Chris G. Hutchens

Investigate the RF and Analog Scaling Limits of Nanometer CMOS
This project will develop or lead the effort in determining the analog and RF limits of Silicon deep submicon (DSM) CMOS. DSM is defined in this context to be 50 to 25 nm gate length devices. This study entails determining the effects or scaling limits for analog CMOS circuits including: the efficient use if power, using the "sea of digital" gates to enhance analog accuracies, and determining the feasibility of using DMS CMOS to support 10 to 100 GHz Navy communications. This requires development of DSM analog, s-parameter models, BSIM4 SOI modeling, noise characterization (including gate currents), and gate leakage for two or more differing devices. The objective of each model study or development task is summarized as follows: 1) BSIM4 SOI modeling task, to develop a model for: parasitics, bandwidth, noise, matching and self gain, and to extent possible, incorporating the results of all modeling studies where feasible. 2) The matching study results in accurate matching models for VT, Beta, and gate leakage as a function of device area. 3) S-parameter modeling task will determine: fT, fmax, and device parasitics. 4) Noise modeling of 1/f, thermal noise for channel and gate currents, and gate resistance. 5) Feasibility of 1 V Communications systems including both the RF front end and the ADC backend. Tasks 1 through 5 entail the design, layout, fabrication, and test of devices and subcells by OSU Mixed Signal VLSI group.
Sponsor: Space and Naval Warfare Systems Center San Diego (SSCSD)
PI: Chriswell G. Hutchens

Quartz Resonator-Based Pressure Measurement System for Downhole High Temperature Applications
OSU will continue developing high temperature circuits in SOS/CMOS. This includes memory cells, ADC building blocks, level shifters, and a high temperature digital cell library. Our research has demonstrated the functionality of logic gates and low-level analog building blocks (i.e., cascodes) and OTAs at temperatures in excess of 200C. Finally, we will develop a high temperature screening protocol for SOS/CMOS using a high temperature chuck and probe station.
Sponsor: Halliburton Energy Services
PI: Chriswell G. Hutchens

High-Functional Epitaxial Semiconductor Photonic Materials and Devices for UV-mid IR Applications
The underlying theme of this project is to use state-of-the-art epitaxial MOCVE and MBE growth techniques to improve the quality of technologically important semiconductor multi-layered thin films and to investigate their properties toward developing highly functional photonics devices.
Sponsor: Office of Naval Research, Oklahoma State Regents for Higher Education
PI: Jerzy S. Krasinski

Innovative Nanotechnology in Wide Gap Photonic and Electronic Materials and Devices
This program will combine basic research and device development for wide-gap materials, such as GaN, ZnO, and related materials. The most important task for the development of semiconductor material and devices critical to Department of Defense such as blue light emitting diodes (LEDs) and blue laser diodes (LDs), is development of *p*-doping procedures

for GaN and ZnO materials.
Sponsor: Office of Naval Research
PIs: Jerzy S. Krasinski
College of Arts and Sciences: J.J. Song
Center for Laser and Photonics Research: Gil H. Park

Aging Weapon System Support – Task 4.1
The goals for this task are to: 1) complete value engineering and creation of schematics for each part number 2A2 circuit card assembly. This consists of approximately five part numbers. 2) Create test software and testing procedures for each different part number circuit card assembly. 3) And, create suggested redesign of 2A2 circuit card assembly as a replacement card that can be utilized for either configuration original card design.
Sponsor: Sverdrup Technologies
PI: Carl D. Latino

Engineering Energy Laboratory
In addition to involvement in energy research, the Engineering Energy Laboratory organized and conducted the annual Frontiers of Power Conference and the Energy Information Dissemination Program for the sponsoring utilities. Specific research modeling and analysis of renewable energy sources and systems, utility impacts of distributed generation, and development of knowledge-based tools for the design of Integrated Renewable Energy Systems (IRES) were involved.
Sponsors: Oklahoma Gas and Electric Company, Public Service Company of Oklahoma, Empire District Electric Company
PI: Rama Ramakumar

IGERT: Advanced Graduate Training in Photonics Research
The goal of the IGERT program is to provide a program to expose students to a multidisciplinary research environment by training them in a broad range of photonics disciplines. This will narrow the gap between traditional graduate school and real job settings in academia, industry, and government laboratories engaged in problem-oriented, multifaceted tasks.
Sponsor: National Science Foundation
PIs: Michael A. Soderstrand
College of Arts and Sciences: John W. Mintmire, Nicholas A. Kotov

FNBDT: Investigation of Enabling Technologies for Secure Multimedia on Your Desktop
This project concerns aspects of the Secure Multimedia on Your Desktop (SMYD) proof-of-concept project and the Future Narrow Band Digital Terminal (FNBDT). The general goal of this project is the development, enabling, and demonstration of certain types of multimedia communications over packet networks, including mixed or dissimilar networks. The primary focus involves development of technologies associated with MELP and FNBDT.
Sponsor: Maryland Procurement Office
PI: Keith A. Teague

Spatial/Temporal DSP Research and Implementation on an Embedded Multi-Processor System

This research proposes to address three projects: 1) direction finding interpolation optimization, 2) VSIPL (Vector Signal Image Processing Library) and MPI (Message Passing Interface) and algorithm benchmarking on a Mercury embedded multi-processor system, and 3) adaptive filter-based M-FSK modulation classification and single-channel IC (interference cancellation).
Sponsor: Raytheon Company
PIs: Keith A. Teague, George M. Scheets

Numerical Studies of Low Grazing Angle Microwave Scattering from Breaking Water Waves
OSU proposes to investigate the low-grazing angle (LGA) microwave scattering from water waves that are breaking with differing energy using computational electromagnetic techniques. The goal of the project is to enhance the understanding of scattering under realistic breaking-wave conditions, allowing the development and implementation of efficient electromagnetic models to predict the signatures of breaking waves in the open sea.
Sponsor: Office of Naval Research
PI: James C. West

Beyond Falcon Star (F-16 Life Extension)
To support the Beyond Falcon STAR program to extend F-16 fleet service life to 8,000 flight hours, this research will develop, implement, and validate methods of estimating structural severity values (SSI and USI) for each individual flight under various mission types, weapons loads, and flight configurations. Estimation functions will be constructed whose inputs involve mission types, weapons loads, and flight configurations (a combination of continuous, discrete, and categorical input variables), and whose outputs are best estimates of SSI and USI values with statistical confidence intervals. A graphical user interface will be developed to facilitate the tracking of SSI and USI values from individual ACSN level to the total force level.
Sponsor: Tec-Masters, Inc.
PI: Gary G. Yen

Part Failure Knowledge Capture and Reuse in Maintenance Forecasting
This research project involves two aspects of work devoted to develop tools needed to enhance the failure mode knowledge capture on the shop floor and to equip mechanics with defense logistics mission capability demand forecasting. The first goal is to develop an automated middleware of capturing part failure data on the shop floor, initially targeted at Constant Speed Drive (CSD). The maintenance information acquired will then be exploited to conduct the Failure Mode and Effect Analysis (FMEA) of specific LRUs (such as CSD) and will be extendedly used for demand forecasting and part obsolescence analysis. Additional effort will be invested to consolidate the databases providing a unified view of maintenance/repair activities based upon a multi-agent distributed network framework. The system to be developed will be designed to be compatible with the Tinker AFB shop floor portal designed by Electronic Data Systems.
Sponsor: Automated Sciences Group, Inc.
PI: Gary G. Yen

Charge Transport Dynamics of Dye-Sensitized TiO2 Nanorods

TiO_2 nanoparticle based dye-sensitized solar cells (DSSCs) show very promising applications in photovoltaic devices for electricity generation. The porous networks made of TiO_2 nanocrystallites enhance the light harvesting surface area by a factor of about 1000 times compared to a flat surface. An overall solar-to-electric energy conversion efficiency of 10% has been obtained using photoelectrochemical techniques. However, the interparticle charge transport mechanism and the high electron-hole recombination rate of TiO_2 nanoparticles limit the further increase of solar-to-electric energy conversion efficiencies. This project will utilize crystalline TiO_2 nanorods instead of nanoparticles as the base material of solar cells. There are two advantages compared to nanoparticles: 1) periodically structured TiO_2 nanorods such as with various lateral geometrical shapes and 2D, 3D photonic crystal structures processed by Electron-beam evaporation will trap solar light more efficiently than sintered TiO_2 nanoparticles; and 2) low carrier recombination rate enables more efficient current generation. As a result, a total 15% solar-to-electric energy conversion efficiency is expected from TiO_2 nanorod-based DSSCs.
Sponsor: Oklahoma EPSCoR for Oklahoma State Regents for Higher Education
PI: Weili Zhang

ELECTRONICS RESEARCH AND DEVELOPMENT LABORATORY

Engineering and Launch Support Services for the AIT-2 Program
This project is in support of a National effort in Missile Defense. ERDL's task for this project is to modify, test, and deliver two flight-quality encoders similar to those used on ALTAIR and to design, build, test, and deliver six flight-quality deviation adjusters. In addition ERDL provides ground station telemetry equipment and support as well as launch support.
Sponsor: Space Vector Corporation
PI: Thomas G. Bertenshaw

FIRE PROTECTION PUBLICATIONS

Traffic Incident Management Systems (TIMS) Technical Research
The objective of this project is to partner with the International Fire Service Training Association (IFSTA). The project involves research and development of effective technical guidance for fire and emergency services in Traffic Incident Management System (TIMS) for enhanced compliance with United States Department of Transportation (DOT) Manual of Uniform Traffic Control Devices (MUTCD) and soon to be released National Fire Service Incident Management System (IMS) Consortium Model Procedures Guide for Highway Incidents.
Sponsor: Federal Emergency Management Agency
PIs: Nancy J. Trench, Michael A. Wieder

U.S. Fire Administration Fire Prevention and Safety
OSU proposes to specifically address issues identified in the *Beyond Solutions 2000 Report*, targeting fire safety issues for young children, older adults, and people with disabilities. The three projects in the proposal are: Project A - A National Review of Fire Safety Information for People with Disabilities; Project B - Translating Fall and Fire

Prevention Materials for Older Adults; and Project C - Fire Safety Messages for Young Children Three to Five Years Old
Sponsor: Federal Emergency Management Agency
PIs: Nancy J. Trench
Division of Engineering Technology: Tom J. Woodford

FIRE SERVICE TRAINING

Emergency Response to Terrorism Training Program

Fire Service Training proposes to deliver the following training program 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 first responders in Oklahoma to manage the consequences of terrorist acts. These first responders include fire and other emergency responders such as ambulance services, local civil emergency management personnel, LEPC members, and law enforcement.
Sponsor: Federal Emergency Management Agency
PI: Ralph A. Brown

Hazardous Material Emergency Preparedness (HMEP) Grant FY04

The University shall provide class notices/requests to all rural, town and city fire departments, police departments, Local Emergency Planning Committees, Emergency Medical Service organizations, and Police/Sheriff/OHP departments and shall deliver the following courses: HazMat Awareness, HazMat Awareness Train-the-Trainer, HazMat Operations, NFA Chemistry of Hazardous Materials, and Incident Management Systems (IMS).
Sponsor: Oklahoma Department of Civil Emergency Management
PI: Ralph A. Brown

Oklahoma Response to Terrorism Conference

The 2003 Conference on Oklahoma Response to Terrorism was held in order to bring together responders from all disciplines for information sharing. This conference was held in Tulsa, Oklahoma on September 24–26, 2003 and was administered in cooperation with Fire Service Training, Oklahoma State University (OSU) and the Oklahoma Office of Homeland Security. Approximately 400 participants were in attendance from fire service, emergency medical, law enforcement, fixed facility medical, emergency management, public works, 911 Centers, and others who will be on the front line of response to a major terrorist event, if another one were to occur.
Sponsor: Oklahoma State Department of Health
PI: Ralph A. Brown

State Fire Training Systems Support Grant

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.
Sponsor: Federal Emergency Management Agency
PI: Ralph A. Brown

INDUSTRIAL ENGINEERING AND MANAGEMENT

Problem Parts – Task 4.2
Through the Problem Parts for Aging Aircraft Weapon Systems program, the Air Force and other military services are extending the life of weapons systems well beyond their originally intended lifecycle. This project, under OSU's Aging Systems Sustainment and Enabling Technologies (ASSET) program (formerly known as the Computer-Assisted Technology Transfer or CATT program), seeks to support the military's goals for readiness by expanding the supply base of small- and mid-sized manufacturing companies that can provide parts no longer procurable from original equipment manufacturers (OEMs) by the Department of Defense (DoD). By expanding the manufacturing base of potential suppliers and utilizing their excess capacity—often using reverse engineering and other sustainment engineering initiatives—to provision parts that meet government specifications. Solutions for these non-procurable parts will result in extended service life of aging weapons systems, enhance our military's capabilities, and reduce procurement intervals and costs.
Sponsor: Sverdrup Technologies
PI: Michael Carolina

Bank of Oklahoma Assistance and Assessment
The goal of this project is to provide assistance as the Bank of Oklahoma Financial Operations and Technology Division continues maturing in its quality journey. To accomplish this, OSU will help drive the Baldrige core values into the organization and make them a way of life.
Sponsor: Bank of Oklahoma
PI: Camille F. DeYong

Relevancy Enhancement Achieved by Laboratories and Lecture Integrated for Engineering Education (REAL LIFE) Adoption of a Relevant Undergraduate Curriculum
The School of Electrical and Computer Engineering–in conjunction with the OSU College of Education, the OSU Library, and the School of Industrial Engineering and Management–will increase retention of engineering students at OSU by implementing a model based on successful engineering curriculum reform efforts. The curriculum model is named REAL LIFE (Relevancy Enhancement Achieved by Laboratories and Lecture Integrated for Engineering Education) and is designed to enhance relevancy. REAL LIFE integrates three proven teaching methods: 1) problem based learning, 2) team learning, and 3) case studies. This model has been implemented and tested at Oklahoma State University through a National Science Foundation Course, Curriculum, and Laboratory Improvement award with great success.
Sponsor: National Science Foundation
PIs: Camille F. DeYong
School of Electrical and Computer Engineering: R. Alan Cheville, Charles F. Bunting, Carl D. Latino, Keith A. Teague
College of Education: Richard J. Bryant
Edmon Low Library: Elizabeth A. Reiten

CELDi (Collaborative Research: Center for Engineering Logistics and Distribution)
A new Industry/University Cooperative Research Center (I/UCRC), called the Center for Engineering Logistics and Distribution (CELDi), has been formed. The vision for the center

is to provide integrated solutions to logistics problems, through modeling, analysis, and intelligent-systems technologies.
Sponsor: National Science Foundation
PI: Ricki G. Ingalls

Fleet and Chemical Optimization for Oilfield Enhancement Services, Phase I
This project will create a model that will determine an optimal configuration of production enhancement equipment and chemical systems at camps for a given set of potential jobs. This optimization will show Halliburton how to more efficiently use existing equipment and chemical systems and determine the effectiveness of new equipment and chemical systems. This project will use information gathered under the *Fleet Optimization for Oilfield Production Enhancement Services* project as a part of the research effort in this project. The *Fleet and Chemical Optimization for Oilfield Production Enhancement Services – Phase 1* project expands the model to much more complex operational parameters
Sponsor: Halliburton Energy Services
PI: Ricki G. Ingalls

Fleet Optimization for Oilfield Production Enhancement Services
The goal of this project is to create a model that will determine an optimal configuration of production enhancement equipment at camps for a given set of potential jobs. We believe that this optimization will show Halliburton how to more efficiently use existing equipment and determine the effectiveness of new equipment.
Sponsor: Halliburton Energy Services
PI: Ricki G. Ingalls

Freight Movement Model Development for Oklahoma Phase II
In the first year, the research consisted of two main activities. The first developed a math model for a regional (i.e., primarily North America) model. The regional model will be able to determine the amount of freight traffic that is flowing into, out of, and through the state of Oklahoma. The second activity in the first year detailed a survey of databases to determine exactly which databases will feed the regional model.
The second year of the project consisted of two main activities. The first was the verification of the math model created in the first year. The second activity was the development of the software system that will be used to run the regional freight movement model. In the third year, the research team has reviewed the pertinent literature in the area and determined the advantages and disadvantages of existing freight movement models. The results of this research project will be a prototype software system that will run the Freight Movement Model for the State of Oklahoma. This software system will be deployable to state employees and members of the Oklahoma Transportation Center for their use.
Sponsor: University of Oklahoma for the Oklahoma Transportation Center for Oklahoma Department of Transportation
PIs: Ricki G. Ingalls, Manjunath Kamath

Industrial Assessment Center (IAC)
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 client's 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 in special cases, 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 client's facilities. In addition, the IAC will partner with the Oklahoma Applications Engineers, power companies, and local business and professional associations to better service clients and to gain higher visibility for the IAC Program.
Sponsor: U.S. Department of Energy
PIs: William J. Kolarik, Wayne C. Turner

Oklahoma Forest Industries Technology Program
In order to support the Oklahoma Forestry Industries Technology Program, W. Kolarik and W. Turner (Industrial Engineering and Management) will provide the following services. First, they will work with one selected Oklahoma manufacturer that manufactures products with forest products-related SIC codes. Selection will be made in consultation with the Oklahoma Forestry Industries Technology Program Principals. Second, they will develip an industrial assessment for this client, where the assessment will cover energy usage and productivity issues relevant to the client's operations. The assessment will include an energy usage profile, a production process overview, one day of on-site work to understand the client's operations, creative work to develop recommendations for the client, recommendation work-ups, which will include technical and economic projections and estimated payback periods, and reporting work. Reporting work will be both formal and informal and include the client and the Oklahoma Forestry Industries Technology Program Principals and others designated by the Principals.
Sponsor: Oklahoma Center for the Advancement of Science and Technology (Applied Research)
PIs: William J. Kolarik, Wayne C. Turner

Design, Implementation, and Documentation of Manufacturing Process
The objective of this proposal is to offer the services of an Industrial Engineering graduate student towards solving manufacturing systems oriented projects to B S & B Safety Systems LLC. These projects include: 1) assisting in supporting the existing wireless system product line in terms of inventory and quality control analysis, 2) assisting in the development and creation of manufacturing support for new wireless product, and 3) providing documentation support for existing and new processes in engineering and manufacturing functional areas.
Sponsor: B S & B Safety Systems, L.L.C.
PI: John W. Nazemetz

Project Collaboration (Phase II)
Phase II work will support development of a systematic approach to the project identification/response/management process. The focus of this development effort will be the definition and implementation of a collaborative information collection and dissemination environment that is available over the web and is capable of providing real-time status information to project managers. The environment would provide for the coordination of the four major components of the CASI/OC-ALC interface in support of the project identification/response/management process.

Sponsor: Altech Services, Inc.
PIs: John W. Nazemetz, Paul E. Rossler
College of Business Administration: Nickolas Romano

Project Collaboration (Phase III)
The Project Collaboration III Project will build upon the work, findings, and lessons learned during previous phases and provide support to the Oklahoma City Air Logistics Center (OC-ALC) as it continues to develop an applied research program within revised OC-ALC and CASI organizational structures and with a new contractor. The project will build upon previous experiences and be comprised of two major thrusts: adopting the processes to the new OC-ALC and CASI organizational structures, and providing an integrated web service for project management, document editing, and document storage. OSU and TU will cooperate in the research.
Sponsor: Tec-Masters, Inc.
PI: John W. Nazemetz

Process Improvement Methodology Development
The Oklahoma City Air Logistics Center (OC-ALC) is a large and complex organization and is currently undergoing a major reorganization. This reorganization will impact many processes within the Center. Processes will need to be redesigned to accommodate the changed organizational structure and responsibilities and represent a significant opportunity to improve operations/processes and reduce cost. The OC-ALC is envisioning a review of current progressive methods/processes used in commercial organizations and has solicited university-led studies of the current commercial processes/practices in three representative areas: the industrial base, the general administrative base, and the accounting base.
Sponsor: Altech Services, Inc.
PIs: John W. Nazemetz, Paul E. Rossler
College of Business Administration: Nickolas Romano

Robotic Lifting Devices
The research proposed here involves a systematic study to identify improved methods of the methods and devices needed for the movement and manipulation of large surface components at the Oklahoma City Air Logistics Center (OC-ALC). The Oklahoma City Air Logistics Center (OC-ALC) Depot maintenance activities require the transport and positioning of large aircraft components (sheet metal parts, gearboxes, etc.). During repair, many manual repetitive movements may be required and the workers often manipulate these large surfaces manually resulting in increased risk of injury, lost productivity, increased costs, increased worker fatigue, greater worker turnover, damage to parts, and poor workforce morale. One example of potential improvement is the lifting and transportation of stabilizers for the KC-135.
Sponsor: Tec-Masters, Inc.
PIs: John W. Nazemetz, Paul E. Rossler

A Facility Systems Evaluation for Oklahoma Indian Health Services
The intent and objective of this project is to evaluate the building envelope and all building systems contained therein. This is being done to provide information necessary to develop projects required to increase system efficiency and controllability, reduce operating and maintenance costs, replace/upgrade defective equipment or equipment that is at or near

the end of its useful service life, and improve/upgrade the building and systems to meet the latest edition of all applicable codes and standards.
Sponsor: USPHS Indian Health Service
PI: Wayne C. Turner

CAREER: Effects of Inter-Group Cooperation, Competition, and Conflict on Agile Manufacturing

This research program is examining the effects of inter-group cooperation, competition, and conflict on the agility of manufacturing companies in the United States. It includes a significant educational component – providing research opportunities for undergraduate students, particularly women and under-represented minorities.
Sponsor: National Science Foundation
PI: Charlene A. Yauch

INVENTORS ASSISTANCE SERVICE

Oklahoma Inventors Assistance Service Program

The Inventors Assistance Service (IAS) office has been established on the campus of Oklahoma State University for the purpose of providing information, education, and assistance to Oklahoma inventors navigating the process of transitioning an idea into a product. The IAS has built and continues to maintain cooperative relationships with other state and national agencies of similar purpose. 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. The IAS seeks to expand its service into that of a resource whose success with inventor assistance, education, and networking is well known throughout Oklahoma. Functions such as Selected Inventions (Phase I and Phase II) educational clinics, semi-annual workshops, presentations at conferences and workshops, Office on the Road, the Speaker Program as well as our day-to-day operations of providing independent inventors with education, information, and referrals will continue without interruption.
Sponsor: Oklahoma Center for the Advancement of Science and Technology (Applied Research)
PI: Thomas G. Bertenshaw

MECHANICAL AND AEROSPACE ENGINEERING

CFD-Based Multidisciplinary Analysis of Flight Vehicle Simulation and Control, Phase II

The first objective for this project is to enhance capabilities in Finite Element-Based Structural, Aeroelasticity, and Aeroservoelasticity with Applications to STARS. Phase II it is proposed to enhance STARS FE capabilities through: 1) STARS-NASTRAN-IDEAS comparisons; (2) PATRAN -to- STARS preprocessor GUIs; and 3) PATRAN/NASTRAN to STRAS data conversion. The second objective is the Multidisciplinary Optimization Toolbox for STARS. Objective three will be validations and enhancements in Capabilities in Finite Element-Based CFD with Applications to STARS. This objective will also focus

on specific validation and enhancements to FEA analysis using STARS. Efforts will focus largely upon the recently developed STARS CFD code, which implements a viscous solver.
Sponsor: Advanced Engineering Solutions for NASA
PI: Andrew S. Arena

GSRP – Experimental Investigation of Air Flow within Partially Blocked Cavities with Emphasis on Forces on the Blocking Object
The aim of this project is to: 1) provide a simple configuration for use in comparing CFD predictions, and 2) investigate fundamental flow physics with a focus on developing low order models suitable for dynamic modeling use.
Sponsor: Glenn Research Center for NASA Dryden Flight Research Center
PI: Andrew S. Arena

Oklahoma Space Grant Consortium
This project is supported by the Oklahoma Space Grant Consortium (OSGC), which has its headquarters at the University of Oklahoma. 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 OSGC consisting of the University of Oklahoma, Langston University, Cameron University, and Oklahoma State University. Since then, more than $100,000 in fellowships has been awarded at these universities to promote the goals of the National Space Grant College and Fellowship Program.
Sponsors: University of Oklahoma, NASA
PI: Andrew S. Arena, Jr.

NASA Space Grant Fellowship
NASA established the National Space Grant College and Fellowship Program to expand the agency's research base by providing grants and fellowships to institutions involved in fields related to space. The purpose of the program is to increase understanding, assessment, development, and utilization of space resources by promoting a strong educational base, responsive research and training activities, and broad and prompt dissemination of knowledge and techniques. The program is designed to support interdisciplinary and multidisciplinary space research programs within the university community and provide a means to integrate NASA-related activities of training, research, and public service. Finally, the program supports a network of Oklahoma colleges and universities—The Oklahoma Space Grant Consortium—to promote the program's goals and objectives. In addition to OSU, member institutions include the University of Oklahoma (lead institution and fiscal agent), Langston University, and Cameron University. Each year, fellowships are given to students engaged in NASA-related research and education projects.
Sponsor: NASA National Space Grant College, Fellowship Program
PI: Andrew S. Arena, Jr.

Distribution Dynamics of Active Flow Control
Active flow control is an important area of research for NASA and particularly for NASA Langley Research Center. The first objective for the research is to develop an improved

model of piezoelectric actuator synthetic jet performance that correctly predicts performance trends with air density. The second objective is the development of a one-dimensional fluid-acoustic analysis scheme for the prediction of pulsed-jet active flow control distribution system performance.
Sponsor: Oklahoma NASA EPSCoR
PI: Frank W. Chambers

Mercury Marine R&D Intern Program
This project involves a number of research and development activities at Mercury Marine that focus upon improvements to the performance and reliability of existing products and the design of new products. This program enhances the capabilities and motivation of student interns, expands the research and development programs at Mercury Marine, promotes synergy between OSU faculty and students and Mercruiser, and ultimately benefits the economy of the State of Oklahoma.
Sponsors: Oklahoma Center for the Advancement of Science and Technology (Applied Research), Mercury Marine
PI: Frank W. Chambers

Mercury MerCruiser Engineering R&D Intern Program
The project will involve a number of research and development activities at Mercury MerCruiser that focus upon improvements to the performance and reliability of existing products, the design and testing of new products, and improvements in production operations. This program will enhance the capabilities and motivation of the student interns, expand the research and development programs at Mercury MerCruiser, promote synergy between OSU faculty and students and MerCruiser, and ultimately benefit the economy of the State of Oklahoma through improvements in the technical human resource base and the competitiveness of Mercury MerCruiser. The research objectives are as follows: 1) develop an engine exhaust system that exceeds all federal regulations for exhaust and noise emissions, 2) research new methods to seamlessly integrate the powertrain into the boat assembly process, 3) further develop and expand an adaptive "SmartCraft" electronic control and data system that enables all of the various operating systems of a vessel to operate from one integrated system, 4) utilize research to optimize the overall powertrain reliability and durability, 5) develop an engine that exceeds customers' expectations relative to noise, vibration, and harshness, 6) incorporate proven research techniques to identify means to improve the robustness of the design for the fuel and electrical systems, and 7) develop new production systems that are more efficient, that are safer for the production workers, that are more accommodating to environmental constraints, that improve quality, and that facilitate ISO certification.
Sponsor: Oklahoma Center for the Advancement of Science and Technology (Applied Research)
PI: Frank W. Chambers

BAe 146 Fire Fighting Tanker Modifications
Oklahoma State University (OSU) will assist in the preliminary design of the 3,000-gallon slurry tank proposed for the BAe146-100 Fire Fighting Tanker Modifications in J2 Engineering Report J2S03-0056. OSU will perform initial fluid dynamic analyses to: recommend slurry tank size, recommend slurry chute size, recommend fuselage hole size,

and determine approximate fluid flow rate of slurry from tank at full discharge.
Sponsor: J2 Engineering, Inc.
PI: Eric A. Falk

High Cycle Fatigue Damage Accumulation in Aircraft Engines by Probabilistic Microplastic Energy Dissipation
Oklahoma State University will perform unsteady aerodynamic testing, facilitating fatigue-life confidence interval development and model validation for non-synchronous, arbitrary, blade-resonance excitation. Results from these tests will be incorporated with simultaneous analytical efforts at Oklahoma Christian University (OCU). It is expected that OCU will resolve preliminary model development issues and conduct bench experiments to produce material stress-strain and fatigue data required for model parameter selection and validation.
Sponsor: Universal Technology Corporation for U.S. Air Force
PI: Eric A. Falk

High Cycle Fatigue Damage Accumulation in Aircraft Engines by Probabilistic Microplastic Energy Dissipation – Phase II
Oklahoma State University will perform unsteady aerodynamic testing, facilitating fatigue-life confidence interval development and model validation for non-synchronous, arbitrary, blade-resonance excitation. Results from these tests will be incorporated with simultaneous analytical efforts at Oklahoma Christian University (OCU). It is expected that OCU will resolve preliminary model development issues and conduct bench experiments to produce material stress-strain and fatigue data required for model parameter selection and validation. Overall, the combined investigation will establish the feasibility of predicting blade HCF using energy-based fatigue damage accumulation concepts. Moreover, the practicality of employing blade-resonance event counting as a metric for evaluating fatigue damage, rather than endurance limits or forcing cycles, will also be assessed.
Sponsor: Universal Technology Corporation for U.S. Air Force
PI: Eric A. Falk

Influence of Blade-Row Interactions on Stage Spanwise Efficiency
This project will analyze experimental results from the Stage Matching Investigation (SMI) compressor rig located in the Air Force Research Laboratory (AFRL) at Wright-Patterson AFB. Particular attention will be paid to observed isentropic efficiency differences in the outer 15% blade-span region of the SMI, where these differences have previously been found to depend on the axial spacing between blade-rows. In addition to the experimental analysis, computational fluid dynamics (CFD) will be applied to the SMI geometry and operating conditions in order to study effects of the computational mesh and blade-tip clearance modeling on CFD model accuracy with respect to observed experimental phenomena.
Sponsor: Universal Technology Corporation for U.S. Air Force
PI: Eric A. Falk

Integration of Low Energy Technologies for Optimal Building and Space Condition Design
This project, building on DOE's new EnergyPlus platform, will first implement, test, and

experimentally validate a number of low energy system and zone extension models in EnergyPlus. Envelope and system models will be experimentally validated using existing data sets and an experimental test facility at Oklahoma State University. In addition, an extensive program of software use testing will verify the robustness of the new models and their ability to perform in the context of a wide range of system configurations.
Sponsor: Department of Energy
PIs: Daniel E. Fisher, Jeffrey D. Spitler

Lighting Heat Gain Distribution in Buildings
The objective of this research is to experimentally determine the thermal characteristics of light fixtures for cooling load calculation procedures. The experiments are performed in a well instrumented and controlled test room and include estimates of radiant and convective heat transfer to the room and to the ceiling plenum.
Sponsor: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
PI: Daniel E. Fisher

Optimal A/C Cycles for 21st Century Refrigerants
The primary objective of this research is to develop innovative unitary air conditioning equipment that uses advanced and natural refrigerants. In order to do this, it will be necessary to develop refrigeration cycles that incorporate new types of components and processes.
Sponsors: Oklahoma Center for the Advancement of Science and Technology (Applied Research), York International Corporation Unitary Products Group
PIs: Daniel E. Fisher, Jeffrey D. Spitler, Simon J. Rees

Research Related to the Production of Titanium Dioxide
This project proposes modeling the Kerr-McGee Titanium Dioxide production process using FLUENTTM, a commercial computational fluid dynamics program, and comparing the results with plant data and current Kerr-McGee simulations performed with CFXTM. Initial efforts will focus on two- and three-dimensional fluid mechanics and heat transfer simulation, with the objective of defining nozzle geometry and operating conditions that will minimize or prevent material buildup on the reactor wall.
Sponsor: Kerr-McGee Chemical Corporation
PIs: A.J. Ghajar
School of Chemical Engineering: Gary L. Foutch, Arland H. Johannes

Thermal Management of Microchannels
The quest for smaller, faster, and cheaper electronics has surpassed the current air cooled technologies ability to dissipate the heat generated. Advanced devices such as high electron mobility transistors (HEMT), used in radio frequency communications and radar, require high reliability, which equates to lower device temperatures. Reliability is directly related to the operational temperature of electronic equipment. Forced convection, direct contact, liquid cooling will be investigated using microchannels integrally etched into the device substrate. Recent experimentation indicates there is a deviation from classical theory of heat transfer and pressure drop due to scaling effects to the microchannel regime. This research will characterize the relationships of dimensionless numbers based on parameterized values on the microscale for pressure drop and heat transfer.

Sponsor: Sandia National Laboratories for US Department of Energy
PI: Afshin J. Ghajar

Mechanics 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. A further objective is 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. The project also aims to study and develop models for nip related defects.
Sponsor: Web Handling Research Center
PI: 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 Research Center
PIs: Keith Good, John J. Shelton

A Center for Product and Process Development and Commercialization for Small U.S. Manufacturers
This project proposes a partnership known as the New Product Development Center (NPDC) that helps to solve two problems occurring in Oklahoma and in many other areas of the nation: 1) rural areas in need of a new means to revitalize their economies, and 2) higher education institutions in need of changes to allow students more involvement in solving real world problems. The approach to revitalizing the rural economy will be through growth of rural manufacturing and will result from using university research and development capabilities to help develop highly competitive new products for small rural manufacturers. The approach to allowing students more involvement in solving real world problems will be through involving undergraduate and graduate engineering, science, and business students in development of these new products for small rural manufacturers. In the process, the students will assist in the complete cycle of product concept evaluation, product prototype development, and product commercialization, and thus increase their exposure to realistic real world problems. The partnership builds on existing capabilities at Oklahoma State University, regional universities, small manufacturers, and state economic development organizations. The unique features of the project are the partnership itself and the heavy involvement of students in the product development process. This project should create a method that could be successfully disbursed to other states across the country.
Sponsor: National Science Foundation
PI: L.L. Hoberock
Biosystems and Agricultural Engineering: Bill J. Barfield
Division of Agricultural Sciences and Natural Resources: Sam Curl

Enhancing the Oklahoma Alliance for Manufacturing Excellence with Applications Engineers in Rural Areas
The Oklahoma Alliance for Manufacturing satisfies a critical need for engineering technology transfer assistance by placing engineers from Oklahoma State University in rural Oklahoma areas. Through this program, a link is provided between these application

engineers and the engineering resources that exist at OSU in the College of Engineering, Architecture, and Technology and the Division of Agricultural Sciences and Natural Resources.
Sponsor: Oklahoma Alliance for Manufacturing Excellence, Inc.
PIs: L.L. Hoberock
Biosystems and Agricultural Engineering: Ronald L. Elliott

New Product Development Center for Small Rural Manufacturers (NPDC)
Oklahoma State University has established a New Product Development Center to assist the state's small rural manufacturers in developing new products and processes, thus increasing their sustainability and profitability. The NPDC will bring the research and development capabilities of OSU to Oklahoma's small rural manufacturers. It will help create high-paying jobs and reduce the "brain drain" from these areas.
Sponsors: Oklahoma Water Resources Board, Oklahoma Department of Commerce
PIs: L. L. Hoberock,
Biosystems and Agricultural Engineering: Bill J. Barfield

Fundamental and Technological Aspects of Finishing Balls of Advanced Ceramics, Glasses, and Silicon Using Magnetic Field Assisted Polishing
The ultimate goal of the proposed work is to generalize the principles of polishing to other ceramic ball materials as well as various types of glasses and semiconductor metals, such as silicon. The specific goals are: 1) to extend the knowledge base to investigate the polishing capability of other materials of technological importance, 2) to extend the methodology and technological principles developed for magnetic float polishing equipment to other ceramics, glasses, and semiconductor materials, such as silicon, and 3) to increase the knowledge base for polishing ceramic materials.
Sponsor: National Science Foundation
PIs: Ranga Komanduri, Zhen B. Hou

Modeling of High Speed Machining of Difficult-to-Machine Materials
This grant provides funding for the development of an analytical model and experimental verification of high-speed machining (HSM) of different work materials. In specific, thermal modeling of shear localization in HSM will be conducted using different difficult-to-machine materials, such as titanium alloys, nickel-based super alloys, and hardened steels.
Sponsor: National Science Foundation
PIs: Ranga Komanduri, Zhen B. Hou

Modeling of the Ultra-Precision Machining Process Using New Combined Molecular Dynamics/Monte Carlo (MD/MC) Simulation
In this project, an innovative approach to the simulations of nanometric cutting at conventional cutting speeds is addressed. The following three aspects of simulation of machining at atomic level have a significant impact on the nature of simulation and our understanding of the process. They are: 1) simulations of machining at conventional cutting speeds never before attempted due to long processing times involved with conventional MD simulations; (2) simulations of machining of semiconductor materials, such as silicon, germanium with a diamond tool. Also, included under this category are the simulations of machining of iron with a diamond tool to investigate the chemical nature of wear and simulations of machining of bcc and hcp materials (in addition to fcc metals currently being

modeled), using the Modified Embedded Atom Method (MEAM); and (3) use of parallel processing in a distributed computing environment (or Beowulf cluster) to significantly reduce the computational time per run so that large size work pieces (up to one million atoms) can be considered.
Sponsor: National Science Foundation
PIs: Ranga Komanduri
College of Arts and Sciences: Lionel Raff

Multiscale Modeling and Simulation of Material Processing
The proposed work will address some critical issues involved in multiscale, multiphenomena material modeling—theory and simulation. The primary goal is to develop scaling laws for multiscale simulations, using such material testing techniques as tension and indentation, from atomistic to continuum, via mesoplasticity to enable the design engineer to use these scaling laws as a CAD tool for various materials design and processing applications. The following specific problems will be addressed in this proposal: 1) material response at nanolevel using MD and MD/MC simulations and experimental verification of the results using microtensile testing, nanoindentation, and scratching; 2) scaling laws from nanolevel (atomistic), via mesoplastic (micro or dislocation) level, to continuum (macro) level of polycrystalline ductile as well as brittle materials; 3) integration of a novel simulation method, namely, material point method (MPM) with MD simulation to cover a wide range of scales from continuum to nanolevel, via mesoplastic level, or vice versa in nanometric tensile testing and indentation; 4) experimental verification using *in situ* tensile testing inside a SEM and nanoindentation. A Digital atomic force microscope (AFM) and an MTS Nano Indenter XP system will be used for experimental verification on single and polycrystalline silicon (and other materials) over a range of included angles of the indenter in the case of nanoindentation and loading rates in the case of nanotension experiments; 5) application of MD and MD/MC simulations of nanoindentation and nanotension using potentials developed from *ab initio* calculations using Gaussian 98 software and neural networks (NN) as well as other potentials, such as the modified embedded-atom method (MEAM) for a wide range of fcc, bcc, hcp, and covalent materials; 6) application of massive parallel processing of MD and MD/MC simulations as well as MD/MPM simulations in a distributed computing environment; and finally, 7) effort will be made to link the outcome of the MD-MPM simulations and the scaling laws to Computer Aided Design (CAD) so that the design engineer can utilize this tool for various materials design and processing applications.
Sponsor: Air Force Office of Scientific Research
PIs: Ranga Komanduri, Samit Roy, Hongbing Lu

Science and Engineering Research Center for Durable Miniaturized Systems
The goal of this program is to establish an infrastructure for a distributed Center of Excellence for “Durable Miniaturized Systems” in the mid-west. Various important areas were proposed, including understanding the effect of fabrication processes, system handling, particulate matter on the surface, friction and wear, encapsulation, and aging. Dr. Komanduri will work with personnel from the Environmental Institute and the College of Arts and Sciences on some of these issues.
Sponsor: University of Arkansas
PIs: Ranga Komanduri
Environmental Institute: Edward T. Knobbe

College of Arts and Sciences: Nicholas F. Materer

U.S.-India Cooperative Research: Magnetic Field Assisted Finishing Process
This project is on a U.S.-India cooperative research project under special NSF-DST (Department of Science and Technology, India) Science and Technology Program for Scientists and Engineers. This project deals only with the collaborative aspect of research between the U. S. and the Indian researchers. The primary focus of research is on the finishing of advanced materials by magnetic field assisted polishing. By taking advantage of the combined knowledge-base on magnetic float polishing and magnetic abrasive finishing, the PIs intend to apply it to the new technology of magnetorheological abrasive flow finishing of advanced materials.
Sponsor: National Science Foundation
PI: Ranga Komanduri

WORKSHOP: Unsolved Problems and Research Needs in Thermal Analysis of Material Removal Processes; Stillwater, OK, October 23-25, 2003
The focus of the workshop will be thermal aspects of various material removal processes, such as metal cutting, grinding, and polishing. Various experimental, analytical, and numerical techniques will be critically reviewed and research needs and opportunities will be identified.
Sponsor: National Science Foundation
PI: Ranga Komanduri

Development of a Low Maintenance ph Probe for Application to Water and Waste Water Industries
Waste water often includes contaminants such as oils, dirt, algae, and dissolved minerals and these substances tend to foul the pores in the conventional permeable glass-bulb type pH probes. The objective of this project will be to develop a means of measuring pH that will overcome the fouling problem. This might be accomplished by developing probes that are self-cleaning or, through the use of new technologies and developing non-contact probes. Non-contact measurements have been discussed in commercial literature but may not necessarily be adaptable to these applications. Various companies offer several different types of self-cleaning probes, which might be adapted to waste water monitoring.
Sponsor: New Product Development Center for the Oklahoma Department of Commerce
PI: Richard L. Lowery

Accelerated Material Property Testing of ETR35 Used in Grommet Assembly
An accelerated life testing approach, based on time-temperature superposition, will be conducted to evaluate the long-term behavior of a silicone rubber. The short term, accelerated tests at one strain level will be conducted. Multiple compressive relaxation or creep tests will be conducted at elevated temperatures for a period of four decades of time in logarithmic scale.
Sponsor: Medtronic, Inc.
PI: Hongbing Lu

Acquisition of a High Speed Digital Camera for Advanced Materials, Processing, and Dynamic Events Research.
The Cordin Model 550 High Speed Digital Camera System will be acquired. The camera

can acquire 62 color frames with a spatial resolution of 10001000 pixels at a frame rate up to four million frames per second. The need for such equipment is felt to support primarily the research activities by the five Co-Principals. However, it will be made available for use by other researchers at the university on as-need basis. The features of the Cordin 550 digital camera such as portability and convenience in setting up enables this versatile piece of equipment to be readily used by all researchers on the OSU-Stillwater campus.
Sponsor: National Science Foundation
PIs: Hongbing Lu, Eric A. Falk, J. Keith Good, Ranga Komanduri, Peter M. Moretti

CAREER: Measurements of Local Viscoelastic Properties by Nanoindentation
The proposed research will develop and validate a method to determine linearly and nonlinearly viscoelastic properties of time-dependent materials using nanoindentation technology.
Sponsor: National Science Foundation
PI: Hongbing Lu

Characterization and Modeling of Local Viscoelastic, Fracture, and Delamination Behavior of Nanostructured Polymeric Films and Coatings
Nano-structured polymeric films and coatings, made of polymer matrix embedded by such nanoparticles as carbon nanotubes, graphite fibers, and nanoclay particles, have potential for such applications as films used in Ultra-light Unmanned Aerial Vehicles (UAV) and protective coatings to prevent fuel leaking in composite cryogenic fuel tanks. Conventional tensile or shear tests appropriate for bulk specimens may not be necessarily applicable for the characterization of the local properties of films and coatings filled with carbon nanotubes, nanoparticles, or nanofibers, which are all referred as "nanoparticles" in the sequel. This project will develop methods using nanoindentation to characterize the local viscoelastic, fracture, and delamination behavior, as well as develop methods to model the local non-uniform properties based on the nano- or micro-structures of the nanocomposites. While the work proposed in the project is primarily for nanocomposite coatings and films, some methods proposed herein are expected to be applicable to bulk nanocomposites.
Sponsor: NASA Langley Research Center
PI: Hongbing Lu

Characterization of Material Mechanical Properties and Failure Modes/Criteria, Including Long-Term Behaviors of a Custom Polymer Coating and Substrate Alloyed Wire/Coil
Conductive wires with a polymer sleeve are made by coating layers of thin polymer films on a metal alloy conductor. The coated wires are then wound to form a coil that will be used in a pacemaker lead. As previous testing and FEA modeling predict, the coating and coil winding processes and the coating and substrate material properties significantly influence the structural integrity of the coating.
To determine the structural integrity and durability of the coated wires, it is necessary to determine the mechanical properties of the coatings and the coiled alloy wire substrate. Two major areas of testing and FEA modeling analysis are being conducted. They are: 1) measurement of the mechanical properties of the coating and the substrate alloy wire before and after the coil winding process; and 2) accelerated material mechanical property measurement to determine the long-term behavior of the coating on straight wire and coil over a ten-year period of service.

Sponsor: Medtronic, Inc.
PI: Hongbing Lu

Fundamental Investigation of Web Slitting Processes
The long-range goals are to develop fundamental understanding of the slitting process; to develop criteria for producing straight and clean slit edges in slitting; to develop models to identify right slitting methods for different web materials; and to reduce or eliminate slitting problems that include slivers at the slit edges, burr edge formation, debris generation, and delamitation of laminated webs and coated webs.
Sponsor: 3M
PI: Hongbing Lu

Viscoelastic and Hygroscopic Effects on the Formation of Baggy Lanes in Webs
The objective of this project is to develop methodologies to wind viscoelastic webs to produce rolls that have dimension stability to minimize the formation of baggy lanes. Research will be focused on the understanding of baggy lane formation in viscoelastic webs with non-uniform width direction thickness profile.
Sponsor: Web Handling Research Center
PI: Hongbing Lu

Creation of Epitaxy-Ready ZnO Substrates
This project seeks to develop a commercially successful process for the production of ultra-high quality ZnO substrates to be used in the manufacture of short wavelength LEDs and lasers. The crystalline defects and surface stoichiometry produced as a result of mechanical polishing, chemomechanical polishing, and reactive ion etching will be studied with the use of high energy ion backscattering, ion channeling, and low and room temperature photoluminescence to determine and optimize the effects of the processing conditions on the surface perfection and subsequent epitaxial film growth.
Sponsors: Oklahoma Center for the Advancement of Science and Technology (Applied Research), Eagle-Picher Technologies, LLC
PI: Don A. Lucca

GOALI: Creation of Crystalline Surfaces for Short Wavelength Light Emitters
This project seeks to advance our capability for the manufacture of epitaxial films for use in short wavelength light emitters by contributing to a basic understanding of the generation of crystalline defects in both substrates and epitaxial films that result from processing. OSU will quantify the nature and extent of the defects and damage created by chemomechanical polishing, pre-growth substrate surface preparation, and epitaxial growth with the use of backscattering spectrometry and scanning electrical properties microscopy.
Sponsor: National Science Foundation
PI: Don A. Lucca

U.S.-Germany Cooperative Research: High Resolution Surface Zone Analysis in the Transregional Center on Process Chains for the Replication of the Complex Optical Components
This project is an extensive collaborative effort between Oklahoma State University, Universität Bremen, and RWTH Aachen. The United States-Germany Transregional Collaborative Research Center involves sixteen technical projects centered on the

development of processes for the manufacture of complex, high quality optical components for next generation applications in information technology and telecommunications; health care and the life sciences; national defense; sensing; lighting; and energy conversion. There are technical projects in the areas of design, hard coatings, replication techniques, and measurement science and technology. The research focus of this sub-project, “High Resolution Surface Zone Analysis,” is on developing an understanding of the dependence of the near surface mechanical state on the processing conditions used to create sol-gel derived and magnetron sputtered hard coatings for molds, and for ceramic mold surfaces created by ultraprecision grinding and polishing.
Sponsor: National Science Foundation
PI: Don A. Lucca

U.S.-Germany Cooperative Research: Process Chains for the Replication of Complex Optical Components: High Resolution Surface Zone Analysis
This project seeks to advance the capability for the manufacture of complex, high quality optics for next generation applications. The overall aim of the Transregional Cooperative Research Center is to lay the scientific foundations for the deterministic and economical production of optical elements with complex geometry.
Sponsor: National Science Foundation
PI: Don A. Lucca

GOALI: Nonlinear Control of Advanced Hard Disk Drives
The proposed work will explore and develop nonlinear control system design strategies that will allow the development of cost effective advanced hard disk drives that will exceed densities of 100,000 tracks per inch. The objective is to achieve positioning accuracy to within five percent of track width and fast seeks in the presence of thermal effects, shock, and vibrations that are common in PC, workstation, and hard disk array applications.
Sponsors: National Science Foundation, Seagate Technology, LLC
PI: Eduardo A. Misawa

Non-Linear Guidance and Tracking Algorithm Development
This project is to focus on research on guiding and tracking algorithms, which are robust to nonlinear direction finding (DF). The ultimate goal will be to develop novel guidance algorithms for unmanned airborne vehicles (UAV) that drive the line-of-sight (LOS) and LOS rate to desired values in the presence of uncertainties and nonlinearities in low-cost and dual-use sensors.
Sponsors: Raytheon Company
PIs: Eduardo A. Misawa, Prabhakar R. Pagilla

REU/RET GOALI: Nonlinear Control of Advanced Hard Disk Drives
Research experience for one high school teacher (RET) and two undergraduate students (REU) has provided the OSU team the opportunity to work with science and math teachers at the high school level. This program also aids in preparation and recruiting of students into the graduate program in Dynamic Systems and Control and future research careers.
Sponsor: National Science Foundation
PI: Eduardo A. Misawa

Out-of-Plane Dynamics of a Flat Web

The objectives of this project are: 1) to develop analytical models of dynamic air/web interaction, 2) to develop experimental techniques for web dynamics, and 3) to develop guidelines for improving runnability.
Sponsor: Web Handling Research Center
PI: Peter M. Moretti

Adaptive Control of Web Guides
The specific objectives of this research include: a systematic study of adaptive methods that are suitable for web guides; formulation of stable and structured adaptive controller for web guides by exploiting the inherent structural properties of the guide mechanisms and the lateral dynamic behavior of webs; development of high performance adaptive controllers for web guides that can be tailored to address the practical issues in the web handling industry; and extensive experimentation to validate and incorporate the proposed adaptive algorithms.
Sponsor: Oklahoma Center for the Advancement of Science and Technology (Applied Research)
PI: Prabhakar R. Pagilla

CAREER: Robust Controllers for Large-Scale Interconnected Systems: Applications to Web Handling Systems
The research plan consists of rigorous evaluation of existing lateral and longitudinal dynamic models of a web. Further goals are to develop accurate models for lateral and longitudinal dynamics, design robust decentralized controllers for the models, conduct experiments on ALCOA's finishing process line, generalize the results, and integrate the research activities into current curriculum and develop innovative curricula.
Sponsor: National Science Foundation
PI: Prabhakar R. Pagilla

Dynamics of Motor, Controller, and Mechanical Drive for Tension Control
The objectives of this research are: 1) determination of the state of knowledge of motor/ controller dynamics from literature and by consultation with experts in the sponsoring companies; 2) development of experimental methods for determination of the motor/ controller dynamics for undocumented systems; 3) analysis of resonances caused by flexible drive components, as well as the effects of backlash and saturation; and 4) furnishing the results of the projects to the WTS programmer(s) for improvement of simulation of process lines.
Sponsor: Web Handling Research Center
PIs: Prabhakar R. Pagilla, John J. Shelton

The Role of Active Dancers in Tension Control of Webs
With the need for increased performance and productivity in the web processing industry, accurate modeling and effective controller design for web handling systems is essential for increasing the web processing speed and the quality of the processed web. Accurate tension control has always been a key element of web handling systems. An important objective of the tension control system is to maintain tension within the desired limits under a wide range of dynamic conditions such as speed changes, variations in roll sizes, and web property. Tension variations affect printing quality and tend to cause web breakage and wrinkles. A dancer mechanism is typically used as a feedback element in a majority of

tension control systems. The tension controller is driven by the variations in the position of the dancer mechanism as opposed to the variations in actual tension from the desired tension. The requirement to maintain the desired tension within a narrow range from the unwinding zone to the first printing unit places a demand for better design of the dancer mechanism. Disturbances arising from unevenly wound rolls and misalignment of the rolls have to be attenuated by the dancer mechanism, thus negating their propagation into the in-feed section. Currently, passive dancers are used as dancer mechanisms. Passive dancers have been known to act as a good tension feedback element for low speed web lines. Passive dancers have limitations in dealing with a wide range of dynamic conditions experienced in high speed web lines. It is expected that introducing an active element into a dancer mechanism gives a control engineer more flexibility in attenuating disturbances and also in maintaining lower tension fluctuations. In this project, modeling and control of active dancers leading to a better overall tension control systems will be explored.
Sponsor: Web Handling Research Center
PI: Prabhakar R. Pagilla

Characterization and Modeling of Nanostructured Aerogels
The goal of this project is to complete a comprehensive materials characterization of the thermo-mechanical behavior of nanostructured silica and iron-oxide aerogels. This characterization will be done by completing the following experiments: 1) four point bending tests; 2) compression experiments; 3) compressive relaxation tests at various strain levels, several temperatures, at different aging times, and in water; 4) nanoindentation experiments; and 5) measurement of fracture toughness. The results of these tests will be used to create materials modeling and optimization predictions.
Sponsor: University of Oklahoma for NASA, University of Oklahoma for Oklahoma State Regents for Higher Education
PIs: Samit Roy, Hongbing Lu

Characterization of Environmental Durability of Polymer Matrix Composite
The objective of this study is to continue laboratory testing for material characterization and verification of life modeling methodologies for a polymer matrix composite and resin matrix material for aircraft engine applications. The environmental testing task consists of three main subtasks: 1) Hygrothermal Testing, 2) Physical Aging Testing, and 3) Nonlinear Creep Characterization of PR500 Resin.
Sponsor: NASA Glenn Research Center
PI: Samit Roy

Micro-Macro Modeling of the External Strengthening of Concrete with Fiber Reinforced Polymer
The objective of the project is to develop innovative short-term tests that would allow the development of analytical models for accurate prediction of long-term performance of retrofitted highway bridge structures. Specifically, the interfacial bond between the concrete substrate and the FRP composite material used for external strengthening must remain durable for the specified lifetime over a range of mechanical loads, temperature cycles, moisture diffusion, and de-icing salt ingress. The technical approach for developing a bond durability prediction methodology consists of understanding the fundamental mechanisms of degradation at the bond interphase using nano-scale fractograhic inspection and incorporating these in analytical models using global-local substructuring to bridge length-

scales. The models developed will be incorporated in an in-house test-bed finite element software.
Sponsor: National Science Foundation
PI: Samit Roy

Modeling the Interaction between Permeability and Damage in Polymer Matrix Composite (PMC) Laminates for the Reusable Launch Vehicle (RLV)
The objective of this research project is to perform laboratory tests and develop mechanism-based analytical models for cryogenic fluids and gas permeation in polymer matrix composite (PMC) materials.
Sponsor: NASA Langley Research Center
PI: Samit Roy

NanoNet Seed Grant
The proposed project will focus on enhancing the compressive strength of polymer matrix composites (PMC) through a series of modifications in material composition and thermoplastic pultrusion manufacturing process variables. Specifically, we propose to: 1) enhance the stiffness and strength of the matrix material, such as polypropylene, by including exfoliated nano-scale montmorillonite particles in the fabrication of resin pre-impregnated (prepreg) glass fiber filaments, 2) chemically modify surface of montmorillonite particles to facilitate nanoparticle dispersion in the polymer matrix, and 3) perform a sensitivity study on the effect of pultrusion manufacturing process variables such as pre-heater temperature profile, nanoparticle content, fiber volume fraction, pull speed, and ultrasound energy input on the dispersion and orientation of nanoparticles in the polymer matrix. Nanocomposite recyclability issues will also be investigated.
Sponsor: National Science Foundation
PI: Samit Roy

Nano Particles Generation by Electrostatic Breakup of Liquid Metal Jets
In view of the recent studies on liquid metal electrostatic atomization, there are important unresolved questions with respect to these flows that should be resolved. First, what is the effect of crosswise injection on the electrostatic breakup mechanism of liquid metal jets? Next, what are the properties of the liquid metal jet surface and the properties of the particles after breakup? Thus, it is proposed to exploit findings to date to address these issues with the following specific objectives: 1) identify near-field breakup mechanisms, 2) complete measurements of the particles size and velocity distributions after breakup and rate of particles production, and 3) develop phenomenological analyses of these processes to help interpret and correlate the new measurements.
Sponsor: Oklahoma EPSCoR for Oklahoma State Regents for Higher Education
PI: Khaled A. Sallam

Aerodynamic Dancer and Tension Transducer
The objectives of the research include the following: 1) to develop a dynamic model of an aerodynamic dancer; 2) to develop an aerodynamic dancer and a tension transducer that are effective in a wide frequency range and do not cause excessive lateral web deflection, touching, or flutter; 3) to experimentally verify the performance and stability of the aerodynamic dancer and tension transducer; 4) to establish a method of accurate

measurement of tension at frequencies lower than a predictable limit, for industrial applications where a high frequency response is needed, as well as for precise measurement of tension in laboratory tests; and 5) to minimize the consumption of compressed air of the aerodynamic dancer or tension transducer.
Sponsor: Web Handling Research Center
PIs: John J. Shelton, Bruce A. Feiertag
School of Mechanical Engineering Technology: Young B. Chang

Lateral Control of a Web
Imperfections of thickness, flatness, and other properties of a web, as well as imperfections of web-handling machinery, cause the web to run off center of the process line, often resulting in damage to the web as well as waste. Automatic web guides are therefore commonly required for maintaining lateral alignment of the web. This analytical research is concentrating on prevention of wrinkles, oscillation, stretching of an edge, other potential problems which can result from guiding, and improvement of the accuracy of guiding.
Sponsor: Web Handling Research Center
PI: John J. Shelton

Oklahoma State University Geothermal Smart Bridge
This proposal describes a project aimed at research, development, and technology transfer associated with a bridge deck heating system to eliminate preferential icing. The proposed bridge deck heating system will have the following characteristics: 1) is hydronic (i.e., a heated fluid is circulated through tubes embedded in the bridge deck; 2) makes use of a ground source heat pump system, which recovers energy stored in the earth, and uses it to heat the fluid circulated through the bridge deck; 3) is automatic, integrates with the available intelligent transportation systems, and makes use of local and remote weather stations to forecast potential icing conditions; and 4) is expected to enhance both safety, by eliminating preferential icing conditions, and bridge deck life, by eliminating the application of salt on the bridge and reducing corrosion of the reinforcing steel.
Sponsor: Federal Highway Administration
PIs: Jeffrey D. Spitler, Daniel E. Fisher, Ronald D. Delahoussaye
Division of Engineering Technology: Marvin D. Smith
School of Civil and Environmental Engineering: M. Samir Ahmed
School of Chemical Engineering: J. Rob Whiteley
Biosystems and Agricultural Engineering: Ronald L. Elliott
Environmental Institute: Edward T. Knobbe

Updating the ASHRAE/ACCA Residential Heating and Cooling Load Calculation Procedures and Data
OSU has joined Wrightsoft in developing all aspects of the updated cooling and heating load calculation procedures for the ASHRAE handbook. This includes planning and developing an analysis tool to evaluate the updated method.
Sponsor: Wrightsoft Corporation for American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
PIs: Jeffrey D. Spitler, Daniel E. Fisher

DIVISION OF ENGINEERING TECHNOLOGY

Rehost Digital Engine Control Monitor Software
This research project consists of developing a replacement Digital Engine Control Monitor (DECMON) system for use at the Tinker AFB engine test cell facilities. The DECMON system is used to relay 1553 bus traffic from the engine under test to the test cell computers. This traffic is the performance data from the engine during testing. Without this data, engine acceptance testing is impossible. The existing DECMON system is aging and has maintainability issues with both hardware and software. Bios limitations, limited processor speeds, and RAM limitations prevent newer technologies from being implemented in the existing computer.
Sponsor: Automated Sciences Group, Inc.
PI: Scott D. Baldwin

Aerodynamic Dancer and Tension Transducer
The objectives of the research include the following: 1) to develop a dynamic model of an aerodynamic dancer; 2) to develop an aerodynamic dancer and a tension transducer that are effective in a wide frequency range and do not cause excessive lateral web deflection, touching, or flutter; 3) to experimentally verify the performance and stability of the aerodynamic dancer and tension transducer; 4) to establish a method of accurate measurement of tension at frequencies lower than a predictable limit, for industrial applications where a high frequency response is needed, as well as for precise measurement of tension in laboratory tests; and 5) to minimize the consumption of compressed air of the aerodynamic dancer or tension transducer.
Sponsor: Web Handling Research Center
PIs: Young B. Chang
School of Mechanical and Aerospace Engineering: John J. Shelton, Bruce A. Feiertag

Air Jet Technology in Web Handling
The goal of the research is to develop new methods of handling flexible materials without contact, mainly using air jets. One important phenomenon involved in this research is the Coanda effect. The behavior of an air wall jet ejected from a slot nozzle toward a curved surface was modeled and examined. The study was extended by including the effect of a web placed near the Coanda nozzle. The aerodynamic pressure and traction (frictional force) on the web subjected to the Coanda air jet were determined experimentally and also computationally. Design guidelines for energy-efficient air nozzles were developed. Also an analytical model was developed for prediction of the uniformity of flow profile of the air jet from a slot nozzle.
Sponsor: Web Handling Research Center
PI: Young B. Chang

Electrohydraulic Tech for Two Actuators
Project objectives include: 1) the design of hydraulic and pneumatic setups, each of which consists of two actuators that support two ends of a beam, solenoid or proportional valves, PLC, and motion sensors to demonstrate an unbalanced motion of the beam; and (2) to develop feedback control methods for synchronized motion of two actuators which may not have identical characteristics.
Sponsor: National Fluid Power Association
PI: Young B. Chang

Lateral Statics of a Web over an Air Reverser
Air reversers are noncontact supporting devices with a large wrap angle (typically 180 degrees). One problem of a web supported by air reversers is that the web, when disturbed, tends to oscillate with increasing amplitudes as it moves downstream. This phenomenon is called weaving or weave amplification. Misalignment at a splice, which in turn causes tilting of the web, is considered one major disturbance that triggers this type of instability. Perforated drum-type air reversers are considered in this research. Two-dimensional analyses and computations were done to predict the aerodynamic forces on a tilted web over an air reverser. The study model will be extended to include the three-dimensional effect. Experimental verification of the analytical models will be conducted by measuring aerodynamic pressure profile under the web, mass flow rate of the air, and lateral deflection of a stationary web.
Sponsor: Web Handling Research Center
PIs: Young B. Chang, Kenneth Belanus

Geothermal Heat Pump Project (Phase II)
The project objective is to conduct a detailed investigation of opportunities for implementation of geothermal heat pump technology by recovering energy from the GWTP/ IWTP discharges before it is reused or discharged. This is a continuation of a 2002 Summer Research Program that has significant energy savings base-wide. The project shall investigate opportunities at Building 3001 and the new Corrosion Control Facility [B3225].
Sponsor: Tec-Masters, Inc.
PI: Marvin D. Smith

Oklahoma State University Geothermal Smart Bridge
This proposal describes a project aimed at research, development, and technology transfer associated with a bridge deck heating system to eliminate preferential icing. The proposed bridge deck heating system will have the following characteristics: 1) is hydronic (i.e., a heated fluid is circulated through tubes embedded in the bridge deck; 2) makes use of a ground source heat pump system, which recovers energy stored in the earth, and uses it to heat the fluid circulated through the bridge deck; 3) is automatic, integrates with the available intelligent transportation systems, and makes use of local and remote weather stations to forecast potential icing conditions; and 4) is expected to enhance both safety, by eliminating preferential icing conditions, and bridge deck life, by eliminating the application of salt on the bridge and reducing corrosion of the reinforcing steel.
Sponsor: Federal Highway Administration
PIs: Marvin D. Smith
School of Mechanical and Aerospace Engineering: Jeffrey D. Spitler, Daniel E. Fisher, Ronald D. Delahoussaye
School of Civil and Environmental Engineering: M. Samir Ahmed
School of Chemical Engineering: J. Rob Whiteley
Biosystems and Agricultural Engineering: Ronald L. Elliott
Environmental Institute: Edward T. Knobbe

U.S. Fire Administration Fire Prevention and Safety
OSU proposes to specifically address issues identified in the *Beyond Solutions 2000*

Report, targeting fire safety issues for young children, older adults, and people with disabilities. The three projects in the proposal are: Project A - A National Review of Fire Safety Information for People with Disabilities; Project B - Translating Fall and Fire Prevention Materials for Older Adults; and Project C - Fire Safety Messages for Young Children Three to Five Years Old
Sponsor: Federal Emergency Management Agency
PIs: Tom J. Woodford
Fire Protection Publications: Nancy J. Trench

WEB HANDLING RESEARCH CENTER

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measuring aerodynamic pressure profile under the web, mass flow rate of the air, and lateral deflection of a stationary web.
Sponsor: Web Handling Research Center
PIs: School of Mechanical Engineering Technology: Young B. Chang, Kenneth Belanus

Mechanics 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. A further objective is 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. The project also aims to study and develop models for nip related defects.
Sponsor: Web Handling Research Center
PI: School of Mechanical and Aerospace Engineering: 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 Research Center
PIs: School of Mechanical and Aerospace Engineering: Keith Good, John J. Shelton

Viscoelastic and Hygroscopic Effects on the Formation of Baggy Lanes in Webs
The objective of this project is to develop methodologies to wind viscoelastic webs to produce rolls that have dimension stability to minimize the formation of baggy lanes. Research will be focused on the understanding of baggy lane formation in *viscoelastic* webs with non-uniform width direction thickness profile.
Sponsor: Web Handling Research Center
PI: School of Mechanical and Aerospace Engineering: Hongbing Lu

Out-of-Plane Dynamics of a Flat Web
The objectives of this project are: 1) to develop analytical models of dynamic air/web interaction, 2) to develop experimental techniques for web dynamics, and(3) to develop guidelines for improving runnability.
Sponsor: Web Handling Research Center
PI: School of Mechanical and Aerospace Engineering: Peter M. Moretti

Dynamics of Motor, Controller, and Mechanical Drive for Tension Control
The objectives of this research are: 1) determination of the state of knowledge of motor/ controller dynamics from literature and by consultation with experts in the sponsoring companies; 2) development of experimental methods for determination of the motor/ controller dynamics for undocumented systems; 3) analysis of resonances caused by flexible drive components, as well as the effects of backlash and saturation; and 4) furnishing the results of the projects to the WTS programmer(s) for improvement of simulation of process lines.
Sponsor: Web Handling Research Center
PIs: School of Mechanical and Aerospace Engineering: Prabhakar R. Pagilla, John J. Shelton

The Role of Active Dancers in Tension Control of Webs
With the need for increased performance and productivity in the web processing industry, accurate modeling and effective controller design for web handling systems is essential for increasing the web processing speed and the quality of the processed web. Accurate tension control has always been a key element of web handling systems. An important objective of the tension control system is to maintain tension within the desired limits under a wide range of dynamic conditions such as speed changes, variations in roll sizes, and web property. Tension variations affect printing quality and tend to cause web breakage and wrinkles. A dancer mechanism is typically used as a feedback element in a majority of tension control systems. The tension controller is driven by the variations in the position of the dancer mechanism as opposed to the variations in actual tension from the desired tension. The requirement to maintain the desired tension within a narrow range from the unwinding zone to the first printing unit places a demand for better design of the dancer mechanism. Disturbances arising from unevenly wound rolls and misalignment of the rolls have to be attenuated by the dancer mechanism, thus negating their propagation into the in-feed section. Currently, passive dancers are used as dancer mechanisms. Passive dancers have been known to act as a good tension feedback element for low speed web lines. Passive dancers have limitations in dealing with a wide range of dynamic conditions experienced in high speed web lines. It is expected that introducing an active element into a dancer mechanism gives a control engineer more flexibility in attenuating disturbances and also in maintaining lower tension fluctuations. In this project, modeling and control of active dancers leading to a better overall tension control systems will be explored.
Sponsor: Web Handling Research Center
PI: School of Mechanical and Aerospace Engineering: Prabhakar R. Pagilla

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: Office of the Dean: Karl N. Reid

Lateral Control of a Web
Imperfections of thickness, flatness, and other properties of a web, as well as imperfections of web-handling machinery, cause the web to run off center of the process line, often resulting in damage to the web as well as waste. Automatic web guides are therefore commonly required for maintaining lateral alignment of the web. This analytical research is concentrating on prevention of wrinkles, oscillation, stretching of an edge, other potential problems which can result from guiding, and improvement of the accuracy of guiding.
Sponsor: Web Handling Research Center
PI: School of Mechanical and Aerospace Engineering: John J. Shelton