

# Grants Awarded Report

From: 8/1/07 to 8/31/07

**Proposal No:** 21200708

**Principal Investigator:** Dennis George, Water Center

**Co-PI's:**

**Support Personnel:**

**Project Title:** Protocol for Determination of Maximum Safe Loading Rate Increase during Anaerobic Digester Start-Up with Waste Activated Sludge

**Activation Amount:** \$41,650.00

**Agency:** Earth Tech

**Abstract:**

The City of Nashville plans to commission the use of three 2.5 MG anaerobic digesters. To start up these large digesters in the shortest possible time, and without jeopardizing their performance by possible "pickling" from overloading, a laboratory pilot study is proposed to establish a safe protocol for the prototype start-up. Using aerobic waste activated sludge (WAS), which has been shown to have several advantages over anaerobic digested sludge, as the seed for the new anaerobic digesters, the City must know the maximum safe rate increase at which the solids loading can be brought up to the design organic loading rate (OLR). To determine this rate, "canary" pilot test reactors will be conducted using multiple, expendable, small digesters that operate at a range of loading rates. The objective of this laboratory study is to establish the maximum safe ramp-up of the OLR that can be applied to the prototype reactors without jeopardizing the performance of such large reactors. The results of these "canary" pilot digesters will then be used to determine the protocol for loading rate increase that minimizes the time to reach the design OLR without risking overloading, which is associated with "pickling" that comes from excessive build-up of volatile fatty acids (VFA). The project will be conducted in four phases, and the first will include determining the time required to achieve hydrolysis and methane conversion of approximately 30-40% of the VSS in the initial inoculums seeded in the respective 8-L reactors. For WAS, this would represent stable digested sludge. In the second phase, a determination of the impact of solids retention time on start-up performance of pilot digesters, fed with 3.2% WAS, will be made. In phase three, the feed will change to 5.6% combined sludge. The project will conclude with a report of results and recommendations that delineate start-up conditions for the 2.5 MG digesters.

**Proposal No:** 29200708

**Principal Investigator:** Sastry Munukutla, Energy Center

**Co-PI's:**

**Support Personnel:**

**Project Title:** Center for Energy Systems Research Carryover 2007-08

**Activation Amount:** \$29,702.00

**Agency:** Tennessee Higher Education Commission

**Abstract:**

**Proposal No:** 31200708

**Principal Investigator:** Wenzhong Gao, Energy Center

**Co-PI's:** Ghadir Radman, Electrical and Computer Engineering; Sastry Munukutla, Energy Center; Satish Mahajan, Electrical and Computer Engineering

**Support Personnel:** Robert Craven, Energy Center

**Project Title:** Power System Application Development Using FNET Data

**Activation Amount:** \$310,000.00

**Agency:** Oak Ridge National Laboratory

**Abstract:**

The objective of this project is to develop better analytical methods to detect anomalous events and to improve operations over a wide-area power system by increasing the density (number) of system frequency disturbance recorders installed on the frequency monitoring network (FNET) system. Power system frequency is one of the most critical parameters for understanding and controlling power system dynamics. FNET is a synchronized wide-area frequency monitoring network which has been developed by Virginia Tech. Inexpensive frequency disturbance recorders (FDR) are plugged into standard 110V outlets at various university office locations nationwide. The global positioning system (GPS) is used to time synchronize measurements which are then centrally collected in real-time using the Internet. The FNET system is based on the concept that power system frequency remains the same regardless of voltage level. When a significant disturbance occurs, the frequency varies in time and space exhibiting identifiable wave characteristics. As a result, by constantly measuring frequency, system operators can monitor system status and detect disturbances. One key application of FNET data is the ability to determine the location of a generator tripping. Other important applications are power system model validation, post event analysis, wide-area protection and control, etc.

**Proposal No:** 33200708

**Principal Investigator:** Larry Peach, Curriculum and Instruction

**Co-PI's:** Angie Smith, Curriculum and Instruction; Matthew Smith, Curriculum and Instruction

**Support Personnel:**

**Project Title:** Child and Adult Food Care Program (CACFP) 2007-08

**Activation Amount:** \$33,264.00

**Agency:** Tennessee Department of Health and Human Services

**Abstract:**

**Proposal No:** 37200708

**Principal Investigator:** Kenneth Currie, Manufacturing Center

**Co-PI's:**

**Support Personnel:**

**Project Title:** UT-CIS Contract for Employee Services 2007-08

**Activation Amount:** \$50,000.00

**Agency:** The University of Tennessee Center for Industrial Services

**Abstract:**

**Proposal No:** 39200708

**Principal Investigator:** Dennis George, Water Center

**Co-PI's:**

**Support Personnel:**

**Project Title:** Center for the Management, Utilization and Protection of Water Resources -  
Carryover

**Activation Amount:** \$17,300.00

**Agency:** State of Tennessee

**Abstract:**

**Proposal No:** 56200405

**Principal Investigator:** Ismail Fidan, Manufacturing and Industrial Technology

**Co-PI's:**

**Support Personnel:**

**Project Title:** Integrating Rapid Prototyping Technology into a Manufacturing and Industrial Technology Curriculum

**Activation Amount:** \$43,993.00

**Agency:** National Science Foundation

**Abstract:**

This project is providing guidance in the development of technical transfer approaches, marketing material, understanding of the incorporation of Rapid Prototyping integrated in the design process for manufacturing, and maintenance procedures for the purchased Rapid Prototyping equipment. Developed materials will be presented in various distance learning formats and disseminated through P16 teacher and student workshops.

**Proposal No:** 66200607

**Principal Investigator:** Hayden Mattingly, Biology

**Co-PI's:** Vincent Neary, Civil and Environmental Engineering

**Support Personnel:**

**Project Title:** Conservation and Recovery of Barrens Topminnow Populations Exposed to Invasive Mosquitofish

**Activation Amount:** \$15,000.00

**Agency:** Tennessee Wildlife Resources Agency

**Abstract:**

Over the past several years, numerous partners including federal, state, non-government organizations, and private landowners have worked cooperatively to restore habitat for the globally rare Barrens topminnow, *Fundulus julisia*, with the Barrens Plateau region of middle Tennessee. Although habitat restoration activities have been successful, the establishment of self-sustaining topminnow populations has been less successful. Recent research has demonstrated that the survival of recently hatched topminnows is nearly non-existent in areas co-habitated by the invasive mosquitofish, *Gambusia affinis*. The goal of this study is to identify methods of mosquitofish control that will be ecologically sensitive and minimally disruptive to the natural structure and function of the local ecosystems. Topminnows and mosquitofish swimming performance will be assessed in a laboratory flume to determine whether an engineered water velocity barrier could selectively allow topminnow passage while preventing mosquitofish passage to protected upstream habitats. Because mosquitofish barriers may not be feasible at all field sites, this study will also investigate an ideal density ratio of topminnows to mosquitofish that could permit the two species to coexist. Furthermore, artificial habitat refuges will be tested in a laboratory setting to determine whether such structures could enhance survival of topminnow offspring in the wild. The potential benefits of the project include identification of a set of strategies to prevent topminnow extinction and to boost natural and reintroduced populations of topminnow in their native ecosystem.

**Proposal No:** 67200405

**Principal Investigator:** Joseph Biernacki, Chemical Engineering

**Co-PI's:**

**Support Personnel:**

**Project Title:** Multi-Scale Kinetics-Based Model for Predicting Mechanical Property Development of Concrete Containing Supplementary Cementitious Materials

**Activation Amount:** \$6,000.00

**Agency:** University of Michigan Ann Arbor via NSF

**Abstract:**

Multi-scale kinetics-based model for predicting mechanical properties development of concrete containing supplementary cementitious materials is a collaboration between the University of Michigan and Tennessee Technological University. The objective of the project is to develop (1) a new multi-scale kinetic-based mechanistic model for predicting early-age strength development for varying temperature-time histories, and (2) a similar model for predicting early-age stresses due to thermal and shrinkage gradients. The cementitious systems to be investigated are binary blends of slag-cement, which is the basis for further work. The model will be expanded to incorporate an additional third component consisting of flyash (C/F) or alkali-based activator. Binary and ternary cements consisting of ground granulated blast furnace slag (GGBFS) have been found to develop improved long-term durability and strength. These blends, typically called slag-cements, are now widely used in practice. Slag-cements however are more temperature sensitive than regular OPC's (ordinary Portland cement). This is especially a concern for construction at low temperatures and in the presence of fly ash as the third component since fly ashes are less reactive than slag. For massive sections a major benefit of using slag-cement is the lower heat of hydration at early ages (typically the first seven days) and improved thermal crack resistance as compared to OPC concretes of same current content. The major intellectual contribution of this proposed research is the development of a multi-scale kinetics-based mechanistic model for predicting the early-age strength and stresses from thermal and drying shrinkage gradients of concrete containing supplementary cementitious materials (GGBFS and fly ash). This study will link hydration kinetics of the cementitious system to the macro-scale mechanical behavior of concrete, something that has only been done on a lumped parameter basis using maturity methods in the past. The multi-scale approach is expected to provide insights into the design of binary and ternary cement-systems, whereas conventional heuristic macro-scale models can, at best, predict the behavior of a narrowly defined system. A significant broader impact on students is expected. The proposed collaboration will offer interdisciplinary opportunities that could not otherwise be possible.

**Proposal No:** 75200607

**Principal Investigator:** Steven Hayslette, Biology

**Co-PI's:**

**Support Personnel:**

**Project Title:** Mourning Dove Recruitment in Tennessee

**Activation Amount:** \$26,099.00

**Agency:** U. S. Fish and Wildlife Service

**Abstract:**

Current nationwide efforts to better understand mourning dove population dynamics require estimates of annual recruitment. Previous mourning dove nesting studies have generated estimates of reproductive parameters such as nesting success and fledglings produced/minimum number of nesting pairs, but such studies do not permit direct documentation of reproductive output per female and do not address fledgling survival. Radiotelemetry offers an alternative approach to estimating recruitment that addresses both of these limitations. This study will continue ongoing research (year 2 of a 2-year study) to document survival (nesting females, nests, and post-fledging juveniles) and recruitment in an EMU mourning dove population. Field work will take place during March-September 2008 on a 162-ha former cattle farm in western Wilson County, Tennessee. Mourning doves will be trapped using Kniffin modified funnel traps, and radiotransmitters will be subcutaneously implanted in approximately 30 adult females during March, prior to the onset of nesting. Females with transmitters will be monitored regularly throughout the nesting season to determine survival and total productivity. Nests initiated by radio-marked doves will be monitored to determine number of young fledged. Prior to fledging (at approximately 8 days of age), young will be banded, and transmitters will be implanted. Radio-marked fledglings will be monitored regularly throughout the breeding season. Mortality among radio-marked doves will be investigated to determine cause, if possible. Telemetry data will be used to estimate survival of both nesting females and post-fledging juveniles, as well as recruitment. Recruitment will be estimated as number of HY doves entering the fall (September) population per adult nesting female. Total number of fledglings produced by radio-marked females will be multiplied by rate of survival of fledglings to harvest to generate total number of HY doves recruited for these calculations. Data analysis and preparation of the final report and manuscripts will follow the conclusion of field work in September 2008. The final report for this project will be completed by June 2009.

**Proposal No:** 91200607

**Principal Investigator:** Sharon Berk, Water Center

**Co-PI's:**

**Support Personnel:**

**Project Title:** Interactions of Salmonella enterica and E. coli O157:H7 with Protozoa from Fresh Produce

**Activation Amount:** \$195,979.00

**Agency:** U. S. Department of Agriculture

**Abstract:**

Our ability to develop good agricultural practices and controls to reduce contamination of fresh produce relies on identifying critical elements for growth and survival of human pathogens in the produce production environments. Protozoa, common in soil, fresh produce and aquatic environments such as irrigation water and flume water, can harbor pathogenic bacteria, and are key factors in virulence and persistence of air-borne pathogens. The role of protozoa in survival and virulence of food-borne pathogens has not been addressed to date; however, we previously revealed that protozoa are abundant on fresh produce, and that Tetrahymena sequesters Salmonella enterica within expelled vesicles, thereby enhancing the pathogen's survival in fresh and chlorinated water. For the present proposed study, we will investigate the interaction of S. enterica and E. coli O157:H7 with Tetrahymena and the effect of containment in vesicles on the survival of the pathogens to desiccation, UV irradiation, and food sanitizer stress. Survival will be assessed in vitro by viability assays using epi-fluorescence microscopy, and on lettuce by population dynamics. In order to better understand the role of pathogen/protozoan interaction in virulence and persistence of the pathogens, microarray analysis will be used to identify genes induced in the pathogens while they reside in vacuoles of Tetrahymena. Finally, amoebae isolated from packaged spinach will be examined with the pathogens to determine the presence and persistence of the pathogens in amoebal cysts. This work will address the CSREES strategic goal of enhancing protection and safety of the nation's food supply.

**Proposal No:** 93200607

**Principal Investigator:** Gail Gentry, Craft Center

**Co-PI's:**

**Support Personnel:**

**Project Title:** Hands-on Art/Craft Experience for Elementary School Students 2007-08

**Activation Amount:** \$4,000.00

**Agency:** Tennessee Arts Commission

**Abstract:**

**Proposal No:** 101200607

**Principal Investigator:** Barry Stein, Counseling and Psychology

**Co-PI's:** Ada Haynes, Sociology and Political Science; Michael Redding, Biology

**Support Personnel:**

**Project Title:** CAT National Dissemination Assessment and Improvement of Learning

**Activation Amount:** \$244,474.00

**Agency:** National Science Foundation

**Abstract:**

The primary goal for this project is to nationally disseminate an innovative assessment instrument and encourage its use for improving students' critical thinking skills. The CAT instrument (Critical Thinking Assessment Test) was refined with previous NSF support and collaboration with six other institutions across the country (University of Texas, University of Colorado, University of Washington, University of Hawaii, University of Southern Maine, and Howard University). This support allowed us to refine the CAT instrument so that it has (1) high face validity when evaluated by a broad spectrum of faculty across the country in STEM and non-STEM disciplines; (2) good criteria validity when compared to other instruments that measure critical thinking and intellectual performance; (3) good construct validity by using expert input from learning sciences; (4) good reliability; and (5) demonstrated cultural fairness. The current project will focus on both the dissemination of this instrument and expanding its use for program improvements in institutions across the country. The project activities will focus on five interrelated goals: (1) Designing and conducting CAT workshops to train the trainers from universities and community colleges across the country; (2) Expanding institutional use of the CAT instrument for both assessment and instructional improvement using best practices; (3) Developing a web version of the instrument; (4) Collecting national user norms; and (5) Establishing a center for assessing and improving student learning that will coordinate and sustain these efforts.

**Proposal No:** 109200607

**Principal Investigator:** Xubin He, Electrical and Computer Engineering

**Co-PI's:**

**Support Personnel:**

**Project Title:** CSR-PDOS: A Benchmarking Framework for High-Availability Distributed Storage Systems

**Activation Amount:** \$85,000.00

**Agency:** National Science Foundation

**Abstract:**

The availability and robustness of the I/O system is crucial to large-scale applications that generate and analyze terabytes of data. Storage systems are vulnerable to numerous hardware failures (I/O and metadata server crashes) and contribute to as much as 25% of all system failures. Actually, highly available data storage for high end computing is becoming increasingly more critical as high-end computing systems scale up in size. To achieve high availability storage systems, a challenging issue is to characterize the availability metric in addition to performance of these systems. This research investigates high-availability data and I/O services and benchmarking. The investigators develop a benchmarking framework to measure the storage performance in consideration of availability under various faulty conditions. The research involves four tasks: 1) develop faults/errors model and design fault injection schemes for storage systems; 2) develop an innovative benchmarking framework for high availability distributed storage systems under different faulty conditions; 3) implement an Availability and Performance Evaluation Toolset (APET) to integrate the fault injection and capture raw performance of storage systems at block level under various faults; 4) validate the benchmarking framework using APET for block-level storage systems.

**Proposal No:** 115200607

**Principal Investigator:** Stephen Canfield, Mechanical Engineering

**Co-PI's:** Kenneth Hunter, Basic Engineering

**Support Personnel:**

**Project Title:** Enabling Families, Infants, Toddlers and Preschoolers through Technology  
EIME Project 2007-08

**Activation Amount:** \$35,000.00

**Agency:** Tennessee Department of Education

**Abstract:**

**Proposal No:** 121200607

**Principal Investigator:** Margaret Phelps, Education Administration

**Co-PI's:** Kenneth Wiant, Economics, Finance and Marketing; Laura Graves,  
Curriculum and Instruction; Michael Allen, Mathematics; Sandi Smith,  
Curriculum and Instruction

**Support Personnel:** David Smith, Arts and Sciences; Sammie Young, Disability Services; Sandy  
Smith, Curriculum and Instruction

**Project Title:** Effects of Teaching w/ Tablet PC's w/ Asynchronous Student Access in  
Postsecondary STEM Courses on Students w/ Learning Disabilities

**Activation Amount:** \$144,214.00

**Agency:** National Science Foundation

**Abstract:**

This project is investigating the academic success, academic persistence and attitude of students with learning disabilities in postsecondary STEM courses when instructors use tablet PCs and provide students with asynchronous access to all course lecture content. This experienced project team is training approximately 20 STEM faculty and recruiting 40 students with learning disabilities enrolled in STEM coursework from Tennessee Tech University (TTU) and from three (3) partnering institutions: Tennessee State University (TSU), an Historically Black University; Nashville State Community College (NSCC); and Roane State Community College (RSCC). STEM faculty who already use tablet PCs are receiving training about how to teach students with learning disabilities and how to use asynchronous instruction, and STEM faculty who are unfamiliar with tablet PCs are participating in the same training as well as additional sessions about how to maximize the use of tablet PCs in STEM education. The effects of STEM faculty using tablet PCs and the accessibility of asynchronous course content are being studied with two (2) experimental groups of students with learning disabilities, two (2) control groups of students with learning disabilities, and two (2) comparison groups of students without learning disabilities. The project addresses two (2) of the FRI track goals: To investigate effective instructional methods and practices for people with disabilities in STEM; and to add value to the education of persons with disabilities in STEM by implementing the use of technologies in educational environments. There is a formative and summative project evaluation plan which includes working with an experienced independent external evaluator on a regular basis. There is also a dissemination plan that includes providing study results on the TTU STEM Center website, presenting findings at national professional meetings in the areas of STEM college teaching and university disability services, and publishing in peer-reviewed post-secondary science and engineering education journals.

**Proposal No:** 144200607

**Principal Investigator:** Thomas Roberts, Biology

**Co-PI's:** Kenneth Morgan, Biology

**Support Personnel:**

**Project Title:** Monitoring Groundwater Hydrology and Selected Plant Communities at the Three Rivers Mitigation Bank

**Activation Amount:** \$16,620.00

**Agency:** Tennessee Wildlife Resources Agency

**Abstract:**

**Proposal No:** 174200607

**Principal Investigator:** George Buchanan, Civil and Environmental Engineering

**Co-PI's:** John Peddieson, Mechanical Engineering

**Support Personnel:**

**Project Title:** Mechanical Modeling of Foam Mattresses

**Activation Amount:** \$12,500.00

**Agency:** proprietary

**Abstract:**

A one dimensional mechanical model of multilayer foam mattresses will be developed. Mechanical properties of individual foam layers will be determined through a testing program. Based on the information thus obtained, appropriate mechanical models will be selected for each layer and combined into a composite model of the mattress. A numerical method will be developed to solve the differential equations of the composite model and a software will be created to implement the numerical solution process.

**Proposal No:** 177200607

**Principal Investigator:** Robert Qiu, Manufacturing Center

**Co-PI's:** Periasamy Rajan, Electrical and Computer Engineering

**Support Personnel:**

**Project Title:** IREE Supplement to Time-Reversed Ultrawideband MIMO (UWB-MIMO) for Low Cost, High Data Rate Communications

**Activation Amount:** \$40,750.00

**Agency:** National Science Foundation

**Abstract:**

This proposal focuses on a novel theory and testbed for high-data-rate ultrawideband (UWB) wireless multiple-input multiple-output (MIMO) transceivers. UWB radio is a revolutionary, power-limited technology for its unprecedented system bandwidth and the potential of low-cost and low-power. The most pressing challenge is, however, how to reduce the transceiver complexity of coherent reception caused by the high sampling rate and stringent timing requirements. The proposed system paradigm uses time-reversal with noncoherent detection as an alternative to coherent reception. It exploits the hostile, rich-multipath channel as part of the receiver chain. This new method also integrates time-reversal with MIMO, the most promising approach to use spectrum and transmission power. As a result, time-reversal trades the huge bandwidth of UWB radio and the high power efficiency of MIMO for the noncoherent detection of extremely low cost. This proposed new system paradigm is to take advantages of the impulse nature of UWB signals, a new dimension of a communication channel, through time-reversed MIMO. The new dimension of impulsive time-reversal adds more degrees of freedom in exploiting the spatiotemporal dimensions. The interdisciplinary nature of the proposed research is ideal for the exposure of graduates and undergraduates to theory, simulation, hardware, and software. It is particularly suitable to the international collaboration to put students in a view of global knowledge economy. The engineering and technical nature of some parts of research allows the students to understand the necessity for the conceptualization, design, and manufacture of devices and systems from a perspective of global market analysis and implementation through distributed work centers and worldwide supply chains.

**Proposal No:** 183200607

**Principal Investigator:** Kevin Liska, Business Media Center

**Co-PI's:**

**Support Personnel:** Ferdinand Difurio, Economics, Finance and Marketing; J. D. Weinrauch,  
Economics, Finance and Marketing; Michael Aikens, Business Media Center;  
Paul Harrison, Business Media Center

**Project Title:** TBR Marketing RODP Campaign 2007-08

**Activation Amount:** \$486,450.00

**Agency:** Tennessee Board of Regents

**Abstract:**

**Proposal No:** 185200607

**Principal Investigator:** Phillip Bettoli, Cooperative Fisheries Unit  
**Co-PI's:**

**Support Personnel:**

**Project Title:** Evaluation of Fish Stockings into Tennessee Warm Water and Cool Water Reservoirs

**Activation Amount:** \$35,850.00

**Agency:** Tennessee Wildlife Resources Agency

**Abstract:**

**Proposal No:** 189200506

**Principal Investigator:** Bradford Cook, Biology

**Co-PI's:**

**Support Personnel:**

**Project Title:** Habitat Characterization of the Nashville Crayfish (*Orconectes Shoupi*) in Mill Creek Watershed, TN

**Activation Amount:** \$18,318.00

**Agency:** U. S. Fish and Wildlife Service

**Abstract:**

The Nashville crayfish (*Orconectes shoupi*), the only federally listed endangered crayfish in Tennessee, is endemic to the Mill Creek watershed in Davidson and Williamson counties, Tennessee. Due to increasing anthropogenic activity in the Mill Creek watershed, this crayfish was federally listed as endangered on September 26, 1986, with no designation of critical habitat. Nashville crayfish are known to inhabit runs with gravel and cobble, pools with up to 10 cm of settled sediment and intermittent flows, and seek shelter under slabrocks and other forms of cover. They have been found to select large stones for cover and tend to inhabit non-flowing rather than flowing water. The species has been observed excavating burrows in habitats with sediment deposits. Although these habitat descriptions have been documented, a habitat utilization model has not been developed for this species. Objectives will be to: (1) identify seasonal macro-habitat variables that influence the distribution of Nashville crayfish; (2) identify seasonal micro-habitat variables influencing habitat utilization by Nashville crayfish; and (3) develop a predictive habitat model for Nashville crayfish. Sample sites will be identified such that a representative number of locations will be sampled within the known distribution of the Nashville crayfish, and locations will be based upon ability to effectively sample, historical records, and accessibility. Sites will include, not only the mainstem of Mill Creek, but also the major tributaries. A random sample of sites in secondary tributaries to the five major Mill Creek tributaries will also be sampled to determine when Nashville crayfish use these waters and to describe the habitat used. When possible, each sample reach will be a minimum of 200-m in length. GPS coordinates will be obtained for each sample reach. Physical macro-habitat features of each site will be delineated. Field water quality parameters (pH, temperature, dissolved oxygen, conductivity, flow, and turbidity) will be measured during each sampling event. All sites will be sampled seasonally to document seasonal use of habitats. After each reach is systematically sampled, micro-habitat data will be collected at randomly selected sites that either contain or do not contain Nashville crayfish and will include: water temperature, dissolved oxygen (substrate), depth, substrate composition, embeddedness, flow (60% depth and substrate), and habitat unit occupied. In addition, when Nashville crayfish are located, digital photography of their habitat use will be employed. Data analysis will involve logistic regression techniques. Habitat variables will be evaluated to determine which variables explain seasonal habitat use by this species.