Principles from many scientific and engineering disciplines are applied to address opportunities and problems of agricultural and biological productions, processing, and utilization. Life and engineering sciences are developed, applied, and integrated for analyzing and designing bio-based systems (the concept of “integrating life and engineering,” i.e., using life sciences as resources for engineering work and vice versa). The overarching goal of agricultural and biological engineering work is to “enhance complex living systems” involving agriculture, food, environment, and energy.

The department is organized into four sections: Bioenvironmental Engineering, Food and Bioprocess Engineering, Off-Road Equipment Engineering, and Soil and Water Resources Engineering. A fifth section of Biological Engineering is being formed. The research program areas of the department include Bio-Based Processing and Production Systems; Biomass and Renewable Energy; Precision and Information Agriculture; Agricultural and Biosystems Management; Agricultural Safety and Health; Food Quality and Safety; Environmental Stewardship; Land and Water Resources; Spatially Distributed Systems; Structure and Facilities for Living Systems; Indoor Environmental Control; Biosensors, Bio-instrumentation, Bio-informatics, and Bio-nanotechnology; Intelligent Machinery Systems; Automation of Biological Systems; and Advanced Life Support Systems.

More cooperation with industries that purchase, transport, process, and package agricultural commodities has broadened the scope of agricultural and biological engineering research, especially in the development of intelligent monitoring sensors and process control systems. Research aimed at improving performance and reducing cost at all levels of production with minimal environmental impact is receiving considerable attention in an attempt to keep the U.S. food and agricultural system competitive in the world market. Additionally, new processes, new products, new uses, and new markets are being sought for using abundant agricultural commodities in achieving sustainable energy utilization and environmental quality.

Geographically located in an area of intense agricultural production, with access to good transportation facilities and surrounded by a large concentration of agricultural and industrial equipment manufacturers and food processors, the department is in an enviable position to serve all areas of the agricultural community. Many agricultural engineering graduates who have been educated and trained in the modern teaching facilities and research laboratories of the University of Illinois Agricultural Engineering Sciences Building are employed throughout the nation. Interaction and cooperation with these graduates and other alumni scattered throughout the world help maintain a viable, useful research program.

Faculty and Their Interests

Robert A. Aherin
Agricultural safety and health, safety behavior analysis, confined space safety, using sensors in safety systems, older farm safety issues, disabled farmers

Kaustubh D. Bhalerao
Biological nanotechnology, probabilistic methods, synthetic biology

Loren E. Bode
Spray atomization, transport, and deposition; spray nozzle design, spray drift reduction

Philip Buriak
Technical systems management, learning theory, implications to college teaching

Leslie L. Christianson
New product development; engineering design; agricultural buildings; heating, ventilation, and air-conditioning; air quality; swine facilities

Richard A. Cooke
Subsurface drainage, vadose zone water and contaminant transport, modeling of watershed-scale drainage systems
Steven R. Eckhoff
Corn fractionation, wet milling, dry milling, ethanol production, hybrid specific processing

Bruce Elliott-Litchfield
Food engineering

Ted L. Funk
Livestock confinement structures, indoor climate control systems for livestock, manure management systems, residential housing structures, indoor air quality

Tony E. Grift
Sensors and controls in biosystems automation, machine vision systems, agricultural data acquisition systems, mathematical modeling and control, granular mass flow measurement

Alan C. Hansen
Biofuels for diesel engines, simulation modeling of material handling systems, off-road machinery systems, precision agriculture

Joe G. Harper
Technical systems management

Michael C. Hirschi
Erosion and sediment control, water quality

Prasanta K. Kalita
Hydrology, watershed-water quality modeling, pathogen transport, erosion and sediment control

Marvin R. Paulsen
Food and bioprocess applications, grain quality measurements, near-infrared and FT-NIR spectroscopy

Kent D. Rausch
Recovery of nutrients from bioprocesses, corn quality effect on co-product value, variability of co-product quality, co-product quality for human and animal consumption

Luis F. Rodriguez
Modeling and analysis of biological systems, reliability and sustainability, decision support, life support systems, integrated controls

Vijay Singh
Engineering economic analysis and modeling of bioprocesses, design of processes for corn fractionation and ethanol production, recovery and concentration of nutraceuticals and biobased products

Lei Tian
Sensors and information systems for precision agriculture, applied machine vision, remote sensing, variable-rate technology

K. C. Ting
Automation, systems informatics for analysis, alternative energy and thermal control; computerized simulation, optimization, and decision support for bioproduction and bioprocessing systems

Xinlei Wang
Air quality, diesel engine emission control, renewable energy, building environment control, system modeling

Yuanhui Zhang
Indoor air quality; effect of indoor air quality on occupants; sensor technology for bioenvironmental systems; heating, ventilation, and air-conditioning control; waste treatment

Agricultural Infotronic Systems

Research on Agricultural Infotronic Systems
Q. Zhang*
qinzhang@uiuc.edu
U.S. Department of Agriculture Hatch Funds

This research is to establish an agricultural infotronics technology for production agriculture. This technology is aimed at providing farmers with “actionable” information for performing precision farming operations, such as “where and how much nitrogen to apply” while operating a sprayer in the field. Specific objectives include: design of a general framework of an agricultural infotronic system, which will consist of data collection, operation planning, and automatic implementation modules; development of core information processing algorithms, including information classification, fusion, and attributes tracking algorithms for handling production information;

* Denotes principal investigator.
and validation of the developed agricultural systems in precision farming operations.

Agricultural Safety

Confined Space Entry Training for Agricultural Environments
R. A. Aherin,* L. Nickels, A. Hunter
raherin@uiuc.edu
University of Iowa Great Plains Center for Agricultural Health; University School of Public Health; Carle Center for Rural Health and Farm Safety

This project will revise a confined space training one-day short course that was developed by the University of Illinois approximately ten years ago. The program will be evaluated for knowledge transfer, format acceptability and safe practice improvement. The course will be offered in the states of Illinois, Iowa, Missouri, and Nebraska. The primary audience will be agricultural businesses that service silos, grain storage structures, and livestock waste handling facilities.

Disabled Farmers Project
R. A. Aherin,* R. E. Petrea
raherin@uiuc.edu, repetrea@uiuc.edu
University of Illinois; State of Illinois

The primary objective of this project is to develop a model program that will provide comprehensive assistance to Illinois farmers with physical disabilities. This includes conducting research to identify the level of need for assistance among farmers in the state and the impact of services provided.

Farm Safety Mobile Program for Rural Youth
R. A. Aherin,* A. Hunter
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National Children’s Center for Rural and Agricultural Safety and Health; Carle Center for Rural Health and Farm Safety

The project involves the development and evaluation of interactive agricultural safety and health training modules that are transported to rural communities in a converted mini bus. Community instructors will be trained in the second year of the project. The goal is to reach rural area youth who are not readily exposed to farm safety training. One targeted group is Amish youth. Approximately 12 training modules were developed for pilot testing. Project team members consulted with the Amish safety committee in Douglas and Moultrie counties in the development of the Amish portion of the project. Amish instructors were trained to deliver programs to Amish youth.

Occupational Exposures and Health Outcomes in Swine Confinement Facilities
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National Institute for Occupational Safety and Health; University of Illinois School of Public Health

The study evaluated worker’s exposure to airborne contaminants, such as dust, bacteria, and ammonia, in a swine confinement facility. Measurements were taken that evaluated exposures by looking at symptoms and biological markers of inflammation before and after work. Each worker and control group participants completed a health history questionnaire. Each participant provided blood samples, exhaled air samples, and performed a lung function test. Tests were conducted before and after work for two consecutive workdays in the winter. Participants wore air-sampling devises that measured for dust, bacteria, and ammonia during their work shift. Data analysis is being completed.

Assistant Director for Agricultural Continuing Education
R. E. Petrea*
repetrea@uiuc.edu
Great Lakes Centers for Occupational and Environmental Safety and Health; University of Illinois–Chicago

This project is to assist in the assessment, planning, and implementation of agriculturally related health and safety programs and training that meet the Great Lakes Centers goals of providing graduate and professional education in occupational safety and health and continuing education.

Secretary–Administration
R. E. Petrea*
repetrea@uiuc.edu
National Institute for Farm Safety

This project is to assist the Board of Directors of the National Institute for Farm Safety by performing administrative functions as needed and as directed by the board. Assistance activities include minutes of board meetings, board member communications, board communications with members, member to member communications, and board and member communications as needed to outside entities.

* Denotes principal investigator.
Alternative Fuels

Impact of Biofuels on Emissions Reducing Technologies for Off-Road Diesel Engines
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U.S. Department of Agriculture Hatch Funds

Emissions reducing strategies and technologies are at the forefront of research and development efforts of all major diesel engine manufacturers in order to meet future Environmental Protection Agency regulations. Very little work has been done to investigate the use of these technologies in conjunction with biofuels such as biodiesel and E-diesel (ethanol-diesel blended) fuels. The purpose of this study is to evaluate the impact of biofuels on both present and emerging emissions reducing technologies for diesel engines. Preliminary results with the exhaust gas recirculation NOx emissions reducing strategy show that a greater rate of emissions reduction occurs with biodiesel fuel.

Graduate Automotive Technology Education (GATE) Center of Excellence: Advanced Automotive Bio-Fuel Combustion Engines
C.-F. Lee,* A. C. Hansen, D. Kyritsis
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U.S. Department of Energy

Increasingly stringent emissions regulations and concerns about U.S. dependence on foreign oil have generated an urgency to seek new technologies and fuels for automotive engines. The objective of this Center of Excellence is to create an education and research program that provides automotive engineers with knowledge and skills to be able to develop advanced engines for the future that can run on renewable biofuels such as ethanol and biodiesel. The curriculum will be based on courses drawn from both the mechanical engineering and agricultural and biological engineering disciplines with research projects relying on interdisciplinary expertise and facilities.

Investigation of Biodiesel Fueled Engines under Low Temperature Combustion Strategies
C.-F. Lee,* A. C. Hansen
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U.S. Department of Energy

There is considerable interest in reducing U.S. reliance on imported petroleum. Biodiesel manufactured from vegetable oil is seen as a viable alternative to regular diesel. The objective of this research is to investigate a novel low-temperature combustion (LTC) strategy with biodiesel that is able to simultaneously reduce regulated NOx and particulate emissions while achieving high combustion efficiency. LTC combustion with biodiesel will be investigated via laser diagnostic and multidimensional modeling techniques. Experiments will be conducted in both optical and metal engines. Optimum strategies for reducing exhaust emissions and increasing the efficiency of biodiesel LTC engines will also be investigated.

Engineering–Economic System Models for Rural Ethanol Production Facilities
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Illinois Council for Food and Agricultural Research

The rural economy is bolstered by the explosion of small dry grind ethanol facilities. However, following the rapid increase in the number of these small-sized dry grind facilities, there has been a flurry of announcements of expansions and new plants by major commercial entities. A model is proposed that captures each of these aspects at the facility level and integrates them in a package capable of assisting decision making at two key levels: technology decisions for cooperative board members; and tax incentive decisions at the legislature for handling of potential pollutants.

Bioenvironmental Engineering

Bioenvironmental Engineering Research Laboratory
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National Science Foundation; U.S. Environmental Protection Agency; American Society of Heating, Refrigerating and Air-Conditioning Engineers; Center for Indoor Air Quality Research; U.S. Department of Agriculture; U.S. Department of Energy; University of Illinois

In cooperation with the departments of Animal Sciences, Natural Resources and Environmental Sciences, Civil and Environmental Engineering, Mechanical and Industrial Engineering, Nuclear, Plasma and Radiological Engineering, and Theoretical and Applied Mechanics; College of Veterinary Medicine; and the Small Homes Council/Building Research Council

An interdisciplinary research laboratory was established involving faculty from engineering and biological
sciences. The purposes are to characterize and assess the microenvironment and its effects on organisms and biological products. Focus areas include animal and plant interactions with their microenvironments, sensors and instrumentation, indoor air quality, air and air contaminant movement, environmental conditioning equipment, and building materials.

**Design and Planning for a Pilot Scale TCC System**
L. L. Christianson,* Y. Zhang, T. L. Funk, S. Chen llici@uiuc.edu, yzhang1@uiuc.edu, funkt@uiuc.edu, shxchen@uiuc.edu
*World-Wide Bio-Energy L.L.C.*

An industry partner has licensed rights to the laboratory-scale thermo-chemical conversion research being conducted at the university. The industry partner provides financial support, is advising on research directions and approaches, and is working cooperatively with the university research team to design a farm-scale swine waste system and a human waste processing plant. These prototypes are being used to optimize the process and to evaluate the economic, energetic, and environmental benefits that can be achieved.

**Development of Improved Trailer Designs and Transport Management Practices to Improve the Microenvironment**
M. Ellis,* X. Wang, T. L. Funk, A. C. Lenkaitis xwang2@uiuc.edu, funkt@uiuc.edu; *National Pork Board*

Transport is the most influential pre-slaughter treatment because it affects both meat quality and profit in pork production. It is estimated that 80,000 pigs die annually during transport, at a cost of 8 million dollars to the industry. The objectives of this project are to measure the environmental conditions experienced by finishing pigs under typical transport conditions and to develop a model to predict the changes in microenvironment. This study will provide the basis for new trailer designs and management practices that will lead to improved environmental conditions during transport. Ultimately, this will reduce losses and improve animal welfare in transit.

**Effect of Variability in Gestation Stall Micro Environment on Sow Well-Being, Physiology, and Productivity**
R. Knox,* J. Salak-Johnson, X. Wang, K. Bhalerao, A. C. Lenkaitis, S. E. Ford xwang2@uiuc.edu, bhalerao@uiuc.edu
*Illinois Council for Food and Agricultural Research*

Variations in the microenvironment in commercial sow gestation facilities have an adverse impact on the well-being of the sow, which in turn affects the reproductive success and overall profitability and sustainability of the industry. Understanding the relationships between microenvironmental exposure of the sow and its impact on well-being, as measured by physiological, immunological, reproductive, and behavioral responses will directly benefit the pork industry in Illinois and the nation. A unique research facility will be developed to allow us to pursue scientific questions related to animal production facilities and translate the results into producer profitability.

**Development of a New Low-Reynolds-Number Turbulence Model for Indoor Air Flows**
X. Wang,* J. B. Jiang, Y. Zhang xwang2@uiuc.edu, yzhang1@uiuc.edu
*U.S. Department of Agriculture; University of Illinois*

Information on air motion in a ventilated room is very important for study of contaminant transport and indoor air quality. During the past several decades, computational fluid dynamics (CFD) based on turbulence modeling has become a very powerful tool in the prediction of indoor airflows. However, their applications are limited due to low Reynolds number effects that are very common in full-scale indoor airflows. In this project, low-Reynolds effects are combined into RANS turbulence models by introducing the intermittency factor that reflects the ratio of turbulence and nonturbulence. The model will predict the transitional flow behaviors.

**Diesel Emission Reduction for Champaign-Urbana MTD**
X. Wang,* A. C. Hansen, A. Nayak xwang2@uiuc.edu
*U.S. Environmental Protection Agency; Champaign-Urbana Mass Transit District (CUMTD)*

In this project, we work with CUMTD, EPA, and Cummins to develop technology for retrofitting public transit buses to reduce diesel emissions in the metropolitan area of Champaign-Urbana. This project will develop a program appropriate for midwestern conditions that can be replicated to retrofit other mass transit fleets in other cities. These activities will increase public understanding of the

* Denotes principal investigator.
environmental or economic effectiveness of the demonstrated clean diesel technology. More importantly, this project will improve ambient air quality and achieve significant health benefits to the public by reducing the number of illnesses, health care costs, and missed work/school days.

**Engine Emission Control and Aftertreatment On-Board Diagnosis**
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* Denotes principal investigator.

**International Truck and Engine Corporation**

In order to meet the EPA emission regulations, some control devices, such as an oxygen catalytic converter, diesel particulate filter, and lean NOx trap (LNT), will be required. However, such “add-on” devices can experience deterioration and malfunction that can go unnoticed by both the driver and repair technician. Those types of malfunctions could result in high emissions without a corresponding adverse drivability or fuel economy impact. This problem could be avoided by incorporating a well-designed OBD-II system to detect emission system malfunctions. In this project, we are investigating various diagnostic methods to develop an aftertreatment OBD-II system for 2010 applications.

**Evaluate Occupational Exposure to Contaminants in Truck Cabins**
X. Wang,* A. Nayak, X. Yang
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* Denotes principal investigator.

**National Institute for Occupational Safety and Health (NIOSH); Illinois Occupational and Environmental Health and Safety Education and Research Center (Illinois ERC)**

Trucking has become one of the most important industries in the United States. There were over 3 million truck drivers in the United States in 2004. Concerns about the occupational health and safety of truck drivers are rising as more and more professional drivers join the trucking industry. This project is to study the air quality in truck cabins to improve the understanding of a major occupational health and safety issue confronting truck drivers. It could ensure a healthy and productive work force in the commercial transport sector and lower health care costs.

**Hydrogen Production from Animal Manure by Using Mediator-Less Microbial Fuel Cell**
X. Wang,* X. Yang
xwang2@uiuc.edu

* Denotes principal investigator.

**University of Illinois Campus Research Board; U.S. Department of Agriculture**

One big challenge to keeping the livestock industry sustainable is to utilize animal manure as an alternative energy source instead of an environmental liability. In this project, we investigate the feasibility of hydrogen production from animal manure by using mediator-less microbial fuel cells. We apply microbial fuel cells (MFCs) to generate hydrogen from the animal manure. Unlike previous researchers, our focus particularly will be on the engineering aspects including reactor design, operating conditions, and mass transfer. The final objective is to develop an optimum reactor design and efficient operating conditions for future applications.

**Modeling of Dust Spatial Distribution in Indoor Environment**
X. Wang,* Y. Zhang, J. B. Jiang
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* Denotes principal investigator.

**U.S. Department of Agriculture; University of Illinois**

One of the challenges in indoor air quality research is to study the dust spatial distribution so that the nature of dust transport can be better understood and appropriate control strategies can be implemented. Numerical modeling will enhance the understanding of the mechanisms of dust transport and provide useful information to control dust sources, improve the design of ventilation systems, and implement the mitigation technologies. A mathematical model was developed based on mass-balance of particulate matter. The numerical simulation indicated that the dust spatial distribution was highly related with the airflow pattern, dust source strength, and gravitational sedimentation of particles.

**Physical, Chemical, and Biological Characterizations of Particulate Matter from Confinement Livestock Buildings**
xwang2@uiuc.edu, yzhang1@uiuc.edu

* Denotes principal investigator.

**U.S. Department of Agriculture, National Research Initiative**

Particulate matter (PM) emitted from confinement animal feeding operations (CAFOs) contains harmful components that can have an adverse influence on human and animal health as well as the environment. The objective of this project is to characterize the physical, chemical, and
biological properties of PM from CAFOs and to establish a comprehensive database of PM properties so that adverse health and environmental effects can be assessed, and appropriate mitigation technologies can be developed and deployed. This database will also provide useful data for the development of regulations on PM emissions from confinement livestock buildings.

**Quantification of Ventilation Effectiveness for Air Quality Control**

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*American Society of Heating, Refrigeration and Air Conditioning Engineers*

The existing methods or procedures used to determine ventilation effectiveness are primarily for researchers to use, usually require sophisticated instrumentation, and are labor intensive. There is a lack of practical and economical methods for field engineers and researchers to quickly determine the ventilation effectiveness for zones of concern. The focus of this project is to analyze the existing ventilation effectiveness measurement techniques or procedures for production animal facilities and then to develop a practical method of measuring the ventilation effectiveness in animal facilities.

**Aerodynamic Dust Collection System for Federal Signal Environmental Products**

Y. Zhang,* S. E. Ford, Y. Sun, W. Yan

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*Federal Signal Corporation*

The goal of this project is to improve the dust collection efficiency so as to comply with the increasingly stringent EPA PM emission requirement. The immediate objectives of this project are focused on system analysis and simulation and prototype design. Analysis includes examining the existing design and performance, and simulation includes CFD and particle separation efficiency of the proposed prototype, in accordance to the design parameters and limitations provided by EPG. Considering results of the system analysis and simulation, the prototype design will be developed and evaluated in terms of dust collection efficiency (particle cutsize), pressure drop (power consumption), and dust loading capacity (maintenance requirement).

**Continuous Thermochemical Conversion (TCC) of Livestock Manure to Produce Oil**

Y. Zhang,* E. Morgenroth, T. L. Funk, S. Chen, X. Wang, A. C. Hansen

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*Council for Food and Agriculture Research of Illinois*

A continuous TCC process is in development. This technology involves major changes in conventional waste handling processes, and there are no manufacturers currently supplying the systems needed for the process. We envision a single unit CTCC system being able to process manure of a 2,000 hog farm or an equivalent amount, and the unit should be no larger than a hot-water boiler in a residential house. The crude oil produced on the farm can be trucked to a central refinery for further process. This research can have important benefits to society.

**Development of an Aerodynamic Deduster to Enhance Existing CP-CBR Filters and Reduce the CPS Logistics Burden**

Y. Zhang,* Y. Sun, S. E. Ford, D. Barker

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*U.S. Navy*

The Navy has experienced deficiencies with shipboard CPS that lead to increased logistical burden and reduced protection capability. The CPS pre-filters, which under normal conditions require a change out every 3-6 months, become clogged within 1-2 weeks in dusty conditions. This project is aimed at further developing an aerodynamic air-cleaning device, called an aerodynamic deduster, to address current capability gaps in CP. Applying an aerodynamic deduster system to CP can eliminate the current issues experienced in dusty environments, reduce maintenance cost, and provide enhanced capabilities to CBR filters.

**Experimental Characterization of Airflows in Aircraft Cabins**

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*The National Institute for Occupational Safety and Health*

In this project, we have developed a full-scale Boeing 767 aircraft cabin section, containing 35 dummies, and capable of simulating the cabin environment under tarmac and cruise conditions. We have developed a 3-D volumetric particle tracking velocimetry (VPTV) technology to measure the cabin air flow under iso- and non-isothermal conditions, and various obstruction conditions. We are focused on measuring pollutant trajectories from point to point in a spatial-temporal domain. The outcome of the
study will allow scientists to gain better understanding of air flow and pollutant transmission and, ultimately, to improve the air quality and human health within aircraft cabins.

**Hydrothermal Process for Fiber Stream**  
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*Denotes principal investigator.

The long-term goal of this subproject is to develop and pilot-test the continuous thermal hydrolysis process and operating parameters to convert the fiber stream from corn milling and miscanthus into value-added products, or products that can be easily further processed (such as fermentation or thermochemical conversion). The short-term goal is to define key parameters for the fiber feeding system and the reactor for pilot plant development. A batch reactor and a laboratory-scale continuous reactor have been developed for the study.

**Microvolumetric Particle Tracking Velocimetry to Study Stenosis Flow in Arteries**  
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U.S. Department of Agriculture

The long-term goal of the investigators is to develop technologies to measure and predict flow velocity profiles in a flow field such as a human artery. In this study, the objectives are to develop a 3-dimensional microvolumetric particle tracking velocimetry (MVPTV) system for measurement of fluid flow in a simulated artery system. An MVPTV experimental set-up including image acquisition, laser illumination particle seeding, and flow generation systems has been developed.

**Particle Characterization for Off-Road Machinery Cooling Systems**  
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Deere & Company

Dust and debris properties vary with different machine working environments, including harvesting different crops and construction. It is critical to have a clearer understanding of the physical properties, mechanical behavior, and testing procedures to evaluate the performance of the air cleaning and cooling system. The objectives of this project are to characterize the physical properties and plugging mechanisms of different types of debris.

**Size Distribution and Its Effect on Sampling Performance of Particulate Matter in Concentrated Animal Feeding Operations**  
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U.S. Department of Agriculture National Research Initiative

Particulate matter (PM) emitted from confined animal feeding operations (CAFOs) has increasingly become subject to state and federal air quality regulations. However, fundamental data regarding PM, such as particle size distributions (PSDs), do not exist or are not representative of CAFOs. This project is aimed at answering two fundamental questions: What are the PSDs in typical CAFOs? How does particle size distribution affect the existing particle sampling methods and regulations of agricultural operations? The expected outcome from this project will be a preliminary database for particle size distributions for concentrated animal feeding operations and a protocol to evaluate the performance of samplers used in agricultural operations.

**Thermochemical Conversion (TCC) of Swine Manure to Produce Fuel and Reduce Odor**  
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U.S. Department of Energy; Worldwide Water Solutions

Thermochemical conversion (TCC) is a chemical reforming reaction of organic compounds in a heated enclosure. Swine manure with 5% to 20% solid matter was processed in a scale batch TCC reactor, which converted 70% of volatile solids into a crude oil. Based on the batch reactor, we have developed a continuous thermochemical conversion (CTCC) reactor that has a capacity of processing 50 liters of slurry and producing 5 liter of crude oil per day.

**Ventilation Equipment Testing Program in BESS Laboratory**  
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*Denotes principal investigator.

This continuous program attracts more than 95% of agricultural ventilation fan manufacturers, and many other ventilation equipment companies test their products at the University of Illinois. An annual fan book is produced to report on research related to ventilation, air flow...
characterization, and equipment development. The program is managed through the Bioenvironmental Engineering Division and conducted within the Bioenvironmental Structure and Systems (BESS) Laboratory. The program has resulted in a 25% increase in fan efficiency across the United States in the past decade, and the income supports a full-time research engineer and several research assistants.

**Biological Nanotechnology**

**Biological Nanotechnology**  
K. Bhalerao,* K. D. Rausch, H. Nguyen  
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*University of Illinois*

A corn prolamin called "zein" is one of a class of hydrophobic proteins that have limited nutritive value, but zein does have potential as a novel biomaterial. Zein is insoluble in water or anhydrous ethanol. It does dissolve in aqueous ethanol (75%). We are currently studying the dissolution and aggregation properties of this protein in mixtures of ethanol and water. This work will lead to an increased understanding of the colloidal properties and biophysics of hydrophobic proteins.

**Fabrication and Characterization of Corn Protein Based Films**  
K. Bhalerao,* G. W. Padua  
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*University of Illinois*

Corn zein, a protein coproduct of the ethanol industry can be fabricated into sturdy films. The structural properties of these films depend upon the orientation of the zein molecule. We are developing methods to analyze and control the nanoscale architecture of the zein films in order to study the feasibility of using zein films in diverse applications, such as flexible electronics, food packaging, and drug delivery.

**Synthetic Biology**  
K. Bhalerao,* C. Rao  
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*University of Illinois*

The idea of manipulating gene expression networks at the sub cellular level has led to an unprecedented, rational, systems-based approach to designing genetic "circuits" in simple unicellular organisms. This opportunity will be made possible only through the development of suitable molecular tools and processes to effectively perturb, study, and reprogram genetic networks. Using novel synthetic networks, we are actively developing programmable gene expression systems that may be used in fundamental life sciences research and industrial biotechnology.

**Decision Support**

**Concurrent Science and Engineering for Life Support**  
L. F. Rodriguez,* D. Kortenkamp, A. B. O. Soboyejo, K. C. Ting  
lfr@uiuc.edu, kcting@uiuc.edu  
*National Aeronautics and Space Administration; University of Illinois*

A working group is established within NASA to study redundancy, reliability and contingency issues related to advanced life support (ALS) for exploration mission. The objectives are to consider NASA's current approach to reliable design; to consider life support system specific failure modes; to consider reliability improvement; to make recommendations for how and when to bring the issues of redundancy, reliability, and contingency into systems analysis; to identify specific impacts these issues may have on ALS technology and model development; and to suggest new analysis or testing activities to address these issues.

**Food and Bioprocess Engineering**

**Optimizing Food and Fuel Production**  
L. Berger,* S. R. Eckhoff  
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*University of Illinois, C-FAR Sentinel*

Concern over the use of corn for fuel at the expense of animal feed can be partially mitigated by harvesting the corn near physiological maturity (35-40% moisture, wb), where the stover has higher digestibility than in field dried corn. The study will compare ruminant digestibility corn stover harvested at different corn moistures and will evaluated methods to dry or preserve the high moisture corn.

**Recovery of Coproducts**  
S. R. Eckhoff,* S. Eckhoff  
seckhoff@uiuc.edu  
*Archer, Daniels, Midland Company; U.S. Department of Agriculture*

Tempering in corn dry milling is a mechanical process, relying on the differential rates of water absorption by the various corn components to create a shearing effect at the boundaries of the components. However, the separation is

* Denotes principal investigator.
not clean enough for use as a preprocess for dry grind ethanol. This study explores the use of adjunct chemicals in steeping and the use of puffing to recover the germ and pericarp fiber with less attached endosperm material.

**Evaluation of Ethanol Production Technologies**
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National Center for Agricultural Utilization Research; Agricultural Research Service; U.S. Department of Agriculture

The fuel ethanol industry is rapidly growing and becoming more competitive. As a result, more value needs to be extracted from coproducts made with ethanol. This collaborative project seeks to understand the role of raw material (corn) in optimally producing ethanol and other bioproducts and to identify process methods that generate multiple coproducts with increased value. A small-scale (25g) dry grind procedure is being developed and evaluated to serve as a reference for the fuel ethanol and corn genetics industries. As new sources of genetic material are developed, the procedure will determine ethanol yields accurately.

**Fractionation of Thin Stillage from Dry Grind Process to Determine Water Recycling Rates and Heat Transfer Properties**
K. D. Rausch,* V. Singh, R. L. Belyea
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Illinois Council for Food and Agricultural Research (C-FAR)

The dry grind process is used to produce fuel ethanol and results in one coproduct, distillers dried grains with solubles (DDGS). Knowledge is limited on thin stillage and wet grains that are used to produce DDGS; effects of process modifications on these process streams is unknown. Compositions of the thin stillage streams from modified processes will be affected; membrane filtration and heat transfer fouling characteristics are expected to be different. Our overall goal is to determine membrane filtration and heat transfer fouling characteristics to identify potential for increasing water recycle and reducing energy requirements during ethanol production.

**Process Development to Recover Nutrients from Agricultural Solids**
K. D. Rausch,* V. Singh, M. E. Tumbleson
krausch@uiuc.edu, vsingh@uiuc.edu, mtumbles@uiuc.edu
U.S. Department of Agriculture

Bioprocessing of agricultural materials typically uses an intensive amount of water. As a result, bioprocess streams carry nutrients in dilute quantities, causing difficult recovery and low or negative economic value of recovered solids. Conventional drying methods are inherently energy-intensive because of evaporation of water and other solvents. This project investigates emerging technologies or technologies from other industries for use in bioprocesses that dewater, dry, or convert solids into higher valued products. Currently, work has applied membrane filtration technology to corn processes to conserve water and recover nutrients.

**Effect of Hybrid Variability and Planting Location on Ethanol Yields**
V. Singh,* J. Graeber
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Syngenta Seeds, Inc.

This study investigates the effect of hybrid variability and planting location on the ethanol yield. Approximately 100 different dent corn hybrids grown at multiple locations in the Midwestern United States will be processed using a laboratory dry grind procedure to determine ethanol yield. Influence of the growing location and hybrid on ethanol yields will be observed. Selected hybrids also will be laboratory wet milled to determine starch yield and the correlation between the starch extractability and ethanol yield.

**Enhanced DDGS from the Elusieve Process: Foodstuff for Nonruminants**
V. Singh,* C. Parsons, J. E. Pettigrew, K. D. Rausch
vsingh@uiuc.edu, krausch@uiuc.edu
Illinois Council for Food and Agricultural Research

DDGS produced from the elusieve process as a foodstuff for nonruminants will be investigated. A process called elusieve has been developed to separate fiber from distillers dried grains with solubles (DDGS). This process uses sieving and elutriation to separate fiber from DDGS. Separation in a dry grind ethanol plant increases protein and fat content and reduces fiber content in the resulting DDGS (enhanced DDGS). Enhanced and original DDGS will be evaluated by precision-fed rooster assay to determine total metabolized energy and true digestibility.

* Denotes principal investigator.
of amino acids. Digestible energy values of enhanced and original DDGS in 30-kg pigs will be measured.

**Evaluation and Development of Enzymes for Modified Corn Dry Grind Processes**

V. Singh,* K. Wenger, P. Lindergaard
vsingh@uiuc.edu

Novozymes NA

In the proposed study, we will evaluate use of amylases and proteases in dry grind corn fractionation processes to improve rate of fermentation and increase ethanol yield. Use of corn fiber as feedstock for ethanol production will also be evaluated.

**Modified Milling Technologies for Dry-Grind Ethanol**

V. Singh,* K. D. Rausch, D. B. Johnston
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Eastern Regional Research Center, U.S. Department of Agriculture, Agricultural Research Service

The objective of this research is to develop new or modify existing corn milling technologies that allow value-added processing and lower the capital and operating costs of ethanol production facilities. The project involves recovering multiple coproducts and improving the efficiency of dry-grind corn processing. Economic assessment of process improvements will be done by process simulation and economic modeling.

**Use of Enzymes to Reduce Steep Time, Reduce SO\textsubscript{2} Emissions and Improve Product Yield in the Corn Wet Milling Process**

V. Singh,* D. B. Johnston
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Cooperative State Research, Education, and Extension Service; U.S. Department of Agriculture

An enzymatic corn wet milling process is being developed to reduce or eliminate sulfur dioxide (SO\textsubscript{2}) requirements during steeping, reduce steep time and produce starch yields comparable to conventional processes. Benefits of the process are that it reduces use of sulfur dioxide in the wet milling process. This change would have an effect on reducing environmental and health risks associated with use of SO\textsubscript{2}. Enzymatic milling reduces process time by 70% while maintaining product yields and quality. We are working with corn wet milling processors to evaluate this process at commercial scale.

**Use of Transgenic Corn for Processing Facilities**

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Syngenta Biotechnology, Inc.

A transgenic corn that produces high levels of endogenous amylase is being evaluated for dry grind corn processing. The enzyme is activated in the presence of water and high temperature. In a conventional process, exogenous alpha amylase enzymes are added during liquefaction to break down starch into dextrans. In this study, liquefaction and fermentation properties of transgenic corn are being tested using a small-scale laboratory dry grind procedure and compared to the fermentation properties of a control sample of isogenic corn.

**Grain Qualities and Properties**

**Near-Infrared Spectroscopy for Ethanol Processes**

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Dickey-John Corporation

The objective of this work was to investigate the feasibility of developing calibrations for ethanol yield based on ground corn samples using a Fourier-Transform Near Infrared (FT-NIR) Perkin Elmer Model 6750 Spectrum One NTS spectrometer. Calibration models using PCA, PLS, and discriminant PLS were investigated. Fourier-Transform NIR calibrations were made based on HPLC tests of fermented corn slurries. The wavenumbers (wavelengths) of 5170 cm\textsuperscript{-1} (1934 nm), 4764 cm\textsuperscript{-1} (2100 nm), 4518 cm\textsuperscript{-1} (2210 nm), 5782 cm\textsuperscript{-1} (1729 nm), and 5938 cm\textsuperscript{-1} (1684 nm) were found to be important for the classification of corn hybrids for ethanol values.

**Life Support Systems Reliability and Sustainability**

**Design Architectures for Life Support**

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National Aeronautics and Space Administration

When considering long-term missions to Mars, the design paradigm for life support systems may need to be adjusted from that of existing systems, such as those for the Space Shuttle and the International Space Station. The primary differences would include increasing amounts of resource recycling. This study focuses on the relative merits of

* Denotes principal investigator.
design architectures with respect to design, contingency, maintenance, and operations. Having a fundamental understanding of the effect of various design, contingency, maintenance, and operations decisions will assist NASA in determining the most advantageous technology development strategies going forward toward Lunar and Martian missions.

Early Life Testing for Costly Life Support Systems
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National Aeronautics and Space Administration

Conducting life testing and addressing reliability of life support systems are frequently challenging due to extremely high cost of test items, the scarcity of test items, or the risk of endangering test subjects. When considering implementation of life testing, it is critical to control costs and risks. Furthermore, it is possible that the subsequent analysis of test data may not yield worthwhile results unless careful experimental designs and controls are utilized. To address this need, a new statistical model for use with the design of experiments is under development that is suited to the life testing of high-cost, high-risk hardware and systems.

Integrated Modeling of Life Support Systems Modeling for Reliability and Robustness
L. F. Rodríguez,* H. Jiang, S. Bell, K. Bhalerao, D. Kortenkamp, A. B. O. Soboyejo, K. C. Ting
lfr@uiuc.edu, bhalerao@uiuc.edu, kcting@uiuc.edu
National Aeronautics and Space Administration

Robustness is often reduced to hardware reliability. However, the operation of a system has a great deal of impact on its robustness. Robust operation will be a combination of manual operations supported by software and automated operations supported by people. We will look at increasing the robustness of life support systems by applying the appropriate mix of people and software; model-based techniques for diagnosis, prognosis and control; and procedural techniques for support manual operations. Integrated models will be developed to analyze a wide array of design architectures for the consideration of their inherent reliability and robustness.

Modeling and Analysis of Biological Systems

Holistic Modeling, Analysis, and Control of Modern Production Systems
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Dudley Smith Institute

The business of modern agricultural systems is complex. A preliminary model based on the existing cattle-corn rotation on the Dudley Smith Farm shall be developed to consider these complex interactions. From a systems perspective, this is a good candidate for several reasons. By rotating cattle onto the lands, diversity is introduced into the system. System diversity is likely to be beneficial to overall system stability by offering more opportunities. Effectively, the producer will have more options. Profits can be assured more reliably. However, managing a complex system has its trade-offs requiring tighter system controls and better decision making.

Wetland Modeling Frameworks
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University of Illinois

The study of wetland microbial community dynamics involves monitoring and controlling the composition of the microbial community (MCC). The MCC is affected by climatic, meteorological, physical, and chemical changes. Some of these changes could be developed, not only by the ecosystem forces of the lakes, but also by anthropogenic disturbances and global change issues. Little is known about changes in community composition over annual time scales due to their interaction with ecological factors. Modeling frameworks are under development to predict the behavior of the microbial communities over different time scales for the purpose of designing and controlling ecosystem services.

Bottom-Up Models of the Photosystem at the Molecular Level
L. F. Rodríguez,* S. Bell, R. K. Bradley, D. Kortenkamp, G. Menezes
lfr@uiuc.edu
University of Illinois

The modeling and understanding of biosystems at all levels has been initiated with the development of pathway models of the photosystem. The intention is to integrate such bottom up models with existing models of leaf and canopy level photosynthesis. The integrated multiscale model...
should improve the ability to model and simulate crop biosystems. The levels that might be considered include the molecular, organelle, cellular, tissue, system, organism, and community. Remaining challenges include the identification of events and scenarios that require simultaneous consideration at multiple levels and the identification of critical data that must be shared between models at different levels.

**Off-Road Equipment Engineering**

**Corn Root Evaluation System**
T. E. Grift,* M. Bohn, J. Novais  
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Pioneer Hi-Bred International, Inc.

A system was developed to efficiently image a large number of corn roots. The images were stored and characterized using qualifiers such as fractal dimension and entropy. The qualifiers allow for distinguishing among corn genotypes, and it is anticipated that they can be used to identify genetic markers that have distinct effects on the root development of corn plants under varying soil conditions. A database was developed containing root morphology images featuring a wide spectrum of corn genotypes grown under diverse field conditions (e.g., different plant densities, altered nutritional status, drought, flooding, presence of soil borne diseases, and pests).

**Development of a Yield Monitor for Citrus Fruits**
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Citrus Research and Education Center; University of Florida

Yield monitors, which measure the material flow during harvesting, have been developed for many agricultural crops, but in citrus growing traditionally bins of fruits were used as the basic unit. With the emergence of continuous mechanical harvesting machines, there is a need for a yield monitor for fruits. This method gives a precise indication of the performance on a per tree basis, which can help growers to better manage their groves. A basic yield monitoring method was developed at the University of Illinois and is currently being implemented at the Citrus Research and Education Center.

**Development of Portable Tools with Optimum Configuration for Cutting Sugarcane**
A. C. Hansen*  
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Campus Research Board

A survey of sugar cane cutting tools used in different countries shows considerable variation in design, suggesting that the design of the cutting tool has evolved through trial and error rather than clearly defined engineering ergonomic principles. The objective is to design, build, and test portable tools for cutting sugarcane, based on engineering and ergonomic principles, in order to maximize productivity and quality with the least stress on the body. A platform will be developed on which to measure sugar cane cutting forces and cutting blade acceleration to be used as inputs into a biomechanics model.

**Investigation on Automatic Tuning and Adaptive Control Technologies for Intelligent Vehicle Path Tracking**
Q. Zhang*  
qinzhang@uiuc.edu  
Deere & Company

To obtain a high maneuvering performance on ground vehicles, researchers have developed many high-level controllers, including but not limited to PID, feedforward-PID, fuzzy, sliding mode, and LQR. This study intends to identify relevant approaches and research results of a few selective controllers; identify the strengths and weaknesses of each candidate; and recommend approaches and construct guidelines for vehicle controllers. Some representative controllers will be implemented on a

* Denotes principal investigator.
laboratory-scale, hardware-in-the-loop control system simulator to provide preliminary validation on the results.

**Sensor Fusion Development for AutoTrac Guidance Systems**
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Deere & Company

The goal of this project is to develop sensor fusion methodologies to integrate multiple sensors (e.g., GPS, IMU, vision) to provide accurate and robust navigation inputs for Deere AutoTrac guidance systems. Integrations of a low-cost IMU sensor with GPS and a vision sensor with GPS will be the primary focus of this project. The integrated sensor systems will be tested in multiple fields with AutoTrac guidance vehicles. In addition to identify the current sensor limitations, this project will focus on developing, integrating, implementing, and validating a low-cost IMU and GPS sensor fusion system.

**Robotics**

**Development and Evaluation of High Efficiency Flexible Intelligent Farming Tools: Phase I—Autonomous Weed Control**
T. E. Grift,* M. Bohn, L. Tian, L. Rodriguez, A. Hager
grift@uiuc.edu, lei-tian@uiuc.edu, lfr@uiuc.edu
University of Illinois, C-FAR Sentinel

We propose to develop a flexible weeding system that is capable of identifying weeds and treating them according to their response to glyphosate (Roundup). Weeds that are responsive to glyphosate will be treated chemically, whereas resistant weeds (in particular waterhemp) will be treated mechanically. The operations will be carried out by autonomous robots that have wireless Internet connectivity to facilitate access to a weed image database as well as miscellaneous data gathering (for instance weather data) and remote monitoring of performance.

**Site-Specific Agriculture**

**Precise Application of Agricultural Chemicals**
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bode@uiuc.edu, sbrettha@uiuc.edu
University of Illinois; U.S. Department of Agriculture

Improvements in the application of agricultural chemicals are needed to improve the safe and efficient application of agricultural chemicals. New nozzle designs, sensors and control systems for agricultural sprayers have the potential to improve deposition efficiency with a corresponding decrease in spray drift. The objective of this project is to develop new technology, techniques, and practices that improve the efficiency of applying substances used for control of pests. Specific goals are to characterize new nozzle designs for increasing chemical deposition on plant and pest targets while reducing off-target spray drift.

**Data Collection and Analysis for Future Farms**
L. Tian,* G. Schnitkey, M. Welge
lei-tian@uiuc.edu
Dudley Smith Foundations

High-quality data are essential for future crop management. Site-specific information will have higher value when the sensing system is optimized and error is minimized. This project is a pilot study to see what the future data set might be and how researchers could best plan to analyze it. The team will use state-of-the-art technologies in the development of sensing systems for future farms. High-performance computing systems will be used in the data management study. A prescriptive study will be conducted concerning the value of information from site-specific technologies.

**Developing an Agricultural Remote Sensing Program at the University of Illinois**
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Sentinel Program of Illinois Council for Food and Agricultural Research

Cooperating with NASA researchers, University of Illinois scientists are expanding the agricultural remote sensing program at the University of Illinois. Program objectives are to develop the key technologies needed for NASA remote sensing data applications in precision agriculture settings; design and develop new courses in the area of agricultural remote sensing, spatial data management, and precision agriculture; foster cooperation among scientists from universities, government agencies, and industry working in precision agriculture and remote sensing; and bring new technologies to farmers, assess their needs, target research to address those needs, and maximize the relevancy of the program.

**Improved Application of Pest Control Substances**
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University of Illinois; U.S. Department of Agriculture

Equipment and techniques are being developed to improve the application efficiency of agricultural chemicals. Droplet size spectra from various atomizers are measured

* Denotes principal investigator.
to determine target coverage versus spray drift potential. Field studies of spray drift deposits are used to verify the droplet size evaluations. Sensors and automatic control systems are being developed to apply pest control substances as a function of soil organic matter, travel speed, and other input variables. Techniques for incorporation of herbicides in the soil profile of conservation tillage systems are being developed and evaluated.

Soil and Water Resources

**Evaluation of Range Design Relative to Combat Readiness and Environmental Risks**

P. K. Kalita,* M. C. Hirschi
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*U.S. Army Construction Engineering Research Laboratory*

Training and testing ranges on U.S. Army installations are essential for combat readiness of military personnel. A wide variety of range types are needed to provide realistic training conditions. Problems such as soil erosion and water quality degradation, poor air quality from dust, wildfires, smokes, and obscurants, and heavy metal accumulation that result from live fire activities are environmental risks that can affect training and testing activities on U.S. Army installations. The objectives of this project are to analyze training and testing range design elements with respect to mission, environmental degradation and regulatory noncompliance, and long-term operations and maintenance requirements.

**Water Quality**

**Amount, Timing, and Quality of Water Coming from Managed (Controlled) and Unmanaged Drainage Systems in Illinois**

R. A. Cooke*
rcooke@uiuc.edu
*U.S. Department of Agriculture; Agricultural Research Service*

This research project is designed to quantify and compare the amount, timing, and quality of water discharging from managed and unmanaged drainage systems in Illinois. It involves monitoring flow and obtaining flow-weighted water quality samples from managed and free drainage systems on a range of soil types in various locations in the state. The resulting data will be used for developing management criteria for drainage water management systems in Illinois.

**Combined Drainage Water Management/Bioreactor System for Improving the Quality of Tile Outflow**

R. A. Cooke*
rcooke@uiuc.edu
*Agricultural Watershed Institute*

The goal of this project is to evaluate the effectiveness and cost efficiency of bioreactors, either as stand-alone practices or in combination with drainage water management systems, in reducing nitrogen discharge from agricultural fields with subsurface tile drainage. This information will be helpful in scaling up a regional initiative to reduce nitrogen and other discharges from agricultural lands and to reduce environmental impacts and protect and possibly enhance income to rural communities and landowners.

**Development of Conservation Drainage in Illinois**

R. A. Cooke*
rcooke@uiuc.edu
*University of Illinois*

The objectives of this project are to test the hypothesis that while different drainage practices may result in the same intensity of drainage, thereby producing the same production benefits, they differ in their effect on water quality; to determine the design configurations that optimize production benefits while having the least deleterious impact on the environment; and to involve producers, drainage contractors, educators, and local conservation personnel in drainage research.

**Illinois Conservation Drainage Research and Demonstration Watershed Project**

R. A. Cooke*
rcooke@uiuc.edu
*Natural Resources Conservation Service; Agricultural Research Service Soil Drainage Unit*

The project was established to provide a showcase watershed for drainage water management and other environmentally friendly drainage practices; to conduct research on stream flow, water quality, controlled drainage, and bioreactors; to collect data that can be used to model flow and transport in a tile-drained watershed; and to work in conjunction with local stakeholders to promote conservation drainage.
Understanding Hydrologic and Water Quality Response of a Tiled Watershed
P. K. Kalita,* R. A. Cooke, M. C. Hirschi, R. J. Hudson
pkalita@uiuc.edu, rcooke@uiuc.edu, mch@uiuc.edu
U.S. Department of Agriculture, National Research Initiative Competitive Grants Program

Tile-drained watersheds contain much of the productive agricultural land in the north central United States, yet the hydrology of these watersheds is not well understood. This study will initiate a new dimension for watershed management to improve water quality in tile-drained watersheds. Once the techniques and relationships are validated, an estimate of total maximum daily load (TMDL) to a surface water source will be available through simple and accurate means. Overall, the results of this study will be utilized for better management of agricultural practices in east central Illinois and similar areas with tile-drained watersheds.

Vegetative Treatment System Technology
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pkalita@uiuc.edu, funkt@uiuc.edu, xwang2@uiuc.edu
U.S. Department of Agriculture; Iowa Cattleman’s Association, Iowa

The performance evaluation of a vegetative treatment area (VTA) for beef feedlot runoff management is being investigated. This is probably the southermost site among all the other experimental sites in a multistate effort with significantly different climate, hydrologic, and soil conditions. The overall objective of this investigation is to evaluate through field monitoring the performance of nonbasin (noncontainment) technologies for the treatment of open feedlot runoff in several beef operations in different midwestern states. Two nonbasin technologies under consideration are infiltration basin followed by vegetative treatment area, and vegetative treatment area only.

An Innovative System for Bioremediation of Agricultural Chemicals for Environmental Sustainability
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pkalita@uiuc.edu, rcooke@uiuc.edu
U.S. Environmental Protection Agency

The overall objective of this research project is to design, implement, and evaluate a renewable, naturally available biofilter to minimize the transport of chemicals from agricultural fields into surface water sources. A cost-effective design for minimizing the chemical leaching from agricultural fields would be preferred to any reduction in pesticide and nutrient application. In addition, this design will allow for sustainable agricultural production and technology, while being environmentally beneficial to surrounding areas.

International Water Management Program
pkalita@uiuc.edu, vsingh@uiuc.edu
U.S. Department of Agriculture-Foreign Agriculture Service; National Association of State Universities and Land-Grant Colleges; Government of India - AKI (Agricultural Knowledge Initiative) Program

The project builds expertise and human capacity and involves both priority areas of the U.S.-India Agricultural Knowledge Initiative (AKI) Competitive Grants Program: capacity building and water management. The short-term and long-term goals of this proposal are threefold: to develop a consortium of U.S. and Indian Universities/Research Institutes/NGOs; to develop MS and PhD sandwich degree programs in “International Water Management;” and to develop collaborative research programs on the use of biodrainage for salinity control and water harvesting techniques for groundwater recharge.

Control of Cryptosporidium and Rotavirus Contamination
M. K. Kuhlenschmidt,* P. K. Kalita
pkalita@uiuc.edu
U.S. Department of Agriculture, National Research Initiative

The goal of this research is to prevent microbial contamination of water resources and provide a safe and sustainable environment for animal production facilities. In order to design and implement field-applicable technology for prevention of microbial contamination, the processes of microbial transport in surface and near-surface runoff need to be understood and quantified. Furthermore, the critical factors that affect microbe transport rates and viability, for example, soil composition, vegetation, rainfall, and land slope, must be identified and characterized. This current study seeks to identify these critical factors.

* Denotes principal investigator.
Journal Articles

Agricultural Infotronic Systems


Agricultural Safety


Bioenvironmental Engineering


Food and Bioprocess Engineering


**Life Support Systems Engineering**


**Mechatronics**


**Off-Road Equipment Engineering**


Water Quality


Books

Bioenvironmental Engineering


Book Chapters

System Informatics and Analysis


Papers Presented at Conferences and Symposia

Agricultural Infotronic Systems


Bioenvironmental Engineering


Biological Nanotechnology


Decision Support


Food and Bioprocess Engineering


**Grain Qualities and Properties**


**Mechatronics**


**Off-Road Equipment Engineering**


**Precision Agriculture**


System Informatics and Analysis


Water Quality


Theses

Bioenvironmental Engineering


Food and Bioprocess Engineering


Grain Qualities and Properties

Off-Road Equipment Engineering


Soil and Water Resources


Water Quality


Awards and Honors

Robert A. Aherin
Maynard Coe National Agriculture Safety Award, National Institute for Farm Safety, 1980
Outstanding Young Men of America Award, National Jaycees, 1981
Honorary State Farmer Degree, Minnesota Future Farmers of America Association, 1983
Outstanding Service Award, American Lung Association, 1983
Agriculture Safety Professional-of-the-Year Award, Minnesota Safety Council, 1983

Packer Engineering Safety Award, American Society of Agricultural Engineering, 1987
Teaching Award, Program, American Society of Agricultural Engineers, 1989
Young Faculty Award for Excellence in Extension, University of Illinois College of Agriculture, 1993
Outstanding Alumni Award, College of Applied Sciences and Technology, Illinois State University, 2002

Loren E. Bode
Paper Award, Honorable Mention, American Society of Agricultural Engineers, 1982
Young Extension Worker Award, American Society of Agricultural Engineers, 1983
Senior Faculty Award for Excellence in Extension, University of Illinois College of Agriculture, 1990
Midwest Agricultural Chemical Association Educator's Award, 1991
Fellow, American Society of Agricultural Engineers, 1992
Paul A. Funk Achievement Award, University of Illinois College of Agriculture, 1993
President's Citation, American Society of Agricultural Engineers, 2000, 2002
Hall of Fame Award, Illinois Extension Agricultural Association, 2004
Honorary Knight of St. Patrick, College of Engineering, 2005

Philip Buriak
Teaching Award of Merit, National Association of College Teachers of Agriculture, 1986
Honorary American Farmer Degree, National Future Farmers of America Organization, 1987
Paper Award, Outstanding Research Presentation, National Agricultural Education Research Meeting, 1988
Teaching Excellence Award, University of Illinois Department of Agricultural Engineering, 1989, 1992, 1994
Karl E. Gardener Outstanding Undergraduate Advising Award, University of Illinois College of Agriculture, 1993
Author of the Year, 1st Runner Up, Journal of Agriculture Education, 1994
Author of the Year, 2nd Runner Up, Journal of Agricultural Education, 1997
Honorary Illinois Farmer Degree, Illinois Association of Future Farmers of America, 1997
Teaching Academy of Excellence, University of Illinois College of Agricultural, Consumer and Environmental Sciences, 1997-2002
Teaching Award of Excellence, University of Illinois College of Agricultural, Consumer and Environmental Sciences, 1997
Senior Teaching Award of Excellence, University of Illinois College of Agricultural, Consumer and Environmental Sciences, 1999
Campus Award for Excellence in Undergraduate Teaching, University of Illinois, 1999
National Award for Excellence in College and University Teaching, U.S. Department of Agriculture, 1999
Distinguished Teacher/Scholar, University of Illinois, 2000
Paul A. Funk Recognition Award, University of Illinois College of Agricultural, Consumer and Environmental Sciences, 2001
J. Kent Mitchell Teaching Excellence Award, University of Illinois Department of Agricultural and Biological Engineering, 2001
Team Award for Excellence, College of Agricultural, Consumer, and Environmental Sciences Teaching Course Team, University of Illinois College of Agricultural, Consumer and Environmental Sciences, 2001
E. B. Knight Journal Award, North American Colleges and Teachers of Agriculture, 2003
Teaching Fellow Award, North American Colleges and Teachers of Agriculture, 2003

Leslie L. Christianson
Teaching Excellence Award, University of Illinois Department of Agricultural Engineering, 1987, 1991
Stanley H. Pierce Award, University of Illinois College of Engineering, 1989
Paper Award, American Society of Agricultural Engineers, 1994
Paper Award, American Society of Heating, Refrigeration and Air-Conditioning Engineers, 2003
Fellow, Academic for Entrepreneurship, University of Illinois, 2005

Richard C. Coddington, Emeritus
Teaching Excellence Award, University of Illinois Department of Agricultural Engineering, 1988, 1992
Amoco Award for Innovative Teaching, 1991

Richard A. Cooke
Dissertation Research Award, Virginia Polytechnic Institute and State University Chapter of Sigma Xi, 1995
J. Kent Mitchell Teaching Excellence Award, University of Illinois Department of Agricultural and Biological Engineering, 2005

Steven R. Eckhoff
Dow Outstanding Young Educator Award in the Midwest Region, American Society for Engineering Education, 1986
Kansas State University Presidential Lecturer, 1986, 1987
Outstanding Paper in Cereal Chemistry Award, Corn Refiners Association, 1989
Research Fellowship, Corn Refiners Association, 1990, 1991
Teaching Excellence Award, University of Illinois Department of Agricultural Engineering, 1993
Excellence in Teaching Award, American Association of Cereal Chemists, 1999

Bruce Elliott-Litchfield
Andersen Consulting Award for Excellence in Advising, University of Illinois College of Engineering, 1989, 1993
Teaching Excellence Award, University of Illinois Department of Agricultural Engineering, 1990
Everitt Award for Teaching Excellence, University of Illinois College of Engineering, 1991
Research Fellowship, Corn Refiners Association, 1991
Young Faculty Award for Excellence in Teaching, University of Illinois College of Agriculture, 1992
A. W. Farrall Young Educator Award, American Society of Agricultural Engineers, 1993
University Scholar, University of Illinois, 1994
Engineering Council Advisors List for Outstanding Advising, University of Illinois, 1995
Faculty Award for Excellence in Research, University of Illinois College of Agricultural, Consumer and Environmental Sciences, 1996
Collins Award for Innovative Teaching, University of Illinois College of Engineering, 1997
Harriet and Charles Luckman Undergraduate Distinguished Teaching Award, University of Illinois, 1997
Team Award for Excellence, University of Illinois College of Agricultural, Consumer and Environmental Sciences, 2001
Distinguished Teacher/Scholar Award, University of Illinois, 2003
Ted L. Funk
Outstanding Program Team Award in Extension,
University of Illinois College of Agriculture, Consumer
and Environmental Sciences, 1999
Sustained Excellence in Extension Programming,
University of Illinois College of Agriculture, Consumer
and Environmental Sciences, 1999
Professional Staff Award for Excellence, Innovation and
Creativity, University of Illinois College of
Agricultural, Consumer and Environmental Sciences,
2003
Campus Award for Excellence in Public Engagement,
University of Illinois, 2004

Carroll E. Goering, Emeritus
Fellow, American Society of Agricultural Engineers
Outstanding Technical Paper Awards, American Society
of Agricultural Engineers; honorable mention, 1985,
1990, 1992
Outstanding Technical Paper Awards, American Society
of Agricultural Engineers, 1985, 1990, 1992
Everitt Award for Teaching Excellence, University of
Illinois College of Engineering, 1986
Senior Faculty Award for Teaching Excellence, University
of Illinois College of Agriculture, 1994
Paul A. Funk Recognition Award, University of Illinois
College of Agricultural, Consumer and Environmental
Sciences, 1996
Massey-Ferguson Award, American Society of
Agricultural Engineers, 2001
Cyrus Hall McCormick Jerome Increase Case Gold Medal
Award, American Society of Agricultural and
Biological Engineers, 2005

Tony E. Grift
Superior Paper Award, American Society of Agricultural
Engineers, 2002, 2003
Information and Electrical Technologies Division
Outstanding Paper Award, American Society of
Agricultural Engineers, 2003
Japanese Society for the Promotion of Sciences
Fellowship, 2005

Alan C. Hansen
Paper Award, Outstanding Technical, American Society of
Agricultural Engineers, 1990
Silver Medal for Academic Achievement, South African
Institute of Agricultural Engineers, 1990
Silver Medal for Best Publication of the Year, South
African Institution of Mechanical Engineers, 1992
Silver Medal for Best Paper Published, South African
Institute of Agricultural Engineers, 1992
Faculty Award for Excellence in Teaching, University of
Natal, Faculty of Engineering, South Africa, 1994, 1996
Teaching Excellence Award, American Society of
Agricultural Engineers Student Branch, University of
Illinois, 2002
Outstanding Advisor Award, Accenture Consulting,
University of Illinois College of Engineering, 2003,
2005
Outstanding Paper Award, Information and Electrical
Technologies Division, American Society of
Agricultural Engineers, 2003
Everitt Award for Teaching Excellence, University of
Illinois College of Engineering, 2004
Faculty Award for Excellence in Teaching, University of
Illinois College of Agricultural, Consumer and
Environmental Sciences, 2005
Superior Paper Award, American Society of Agricultural
and Biological Engineers, 2006

Michael C. Hirschi
Paper Reviewers Award, American Society of Agricultural
Engineers, 1988
Blue Ribbons (6), Educational Aids Competition,
American Society of Agricultural Engineers, 1991 (3),
Early Career Award, Epsilon Sigma Phi Alpha Nu Chapter,
1992
Young Faculty Award for Excellence in Extension,
University of Illinois College of Agricultural, Consumer
and Environmental Sciences, 1995
Teaching Excellence Award, University of Illinois
Department of Agricultural Engineering, 1997
Certificate of Excellence, American Society of Agronomy
Education Materials Contest, 1998
Accenture Consulting Outstanding Advisor Award,
University of Illinois College of Engineering, 2000,
2001
Academy of Teaching Excellence, University of Illinois
College of Agricultural, Consumer and Environmental
Karl A. Gardner Outstanding Undergraduate Advising
Award, University of Illinois College of Agricultural,
Consumer and Environmental Sciences, 2003

Prasanta K. Kalita
Research Excellence Award, Iowa State University, 1992
Advisor of the Year, Kansas State University College of
Engineering, 1996
Who's Who in Science and Engineering, 1996
Most Outstanding Advisor of the Year, Kansas State
University BAE Department, 1997
Outstanding Kansas State University Instructor and Advisor K-State Mortar Board, 1997

Finalist, President's Outstanding Advisor Award, Kansas State University, 1999
Teaching Excellence Award, American Society of Agricultural Engineering Student Branch, University of Illinois, 2002
Outstanding Engineering Advisor, University of Illinois College of Engineering, 2002
J. Kent Mitchell Teaching Excellence Award, University of Illinois Department of Agricultural and Biological Engineering, 2003
Faculty Award for Excellence in Teaching, University of Illinois College of Agricultural, Consumer and Environmental Sciences, 2003
Academy of Teaching Excellence, University of Illinois College of Agricultural, Consumer and Environmental Sciences, 2003
Food and Agricultural Sciences Excellence in College and University Teaching Awards Program Nominee, U.S. Department of Agriculture, 2003
Best Paper Award, International Association of Science and Technology for Development, 2003
Outstanding Advisor Award, Accenture Consulting, University of Illinois College of Engineering, 2004
Teaching Fellow Award, North American Colleges and Teachers of Agriculture, 2004
Excellence in Teaching Award, United States Department of Agriculture Food and Agricultural Sciences, National Association of State Universities and Land-Grant Colleges, 2005
Karl E. Gardner Outstanding Undergraduate Advising Award, University of Illinois College of Agricultural, Consumer and Environmental Sciences, 2006
Accenture Outstanding Engineering Advisor, University of Illinois College of Engineering, 2006
North American Colleges and Teachers of Agriculture Regional Outstanding Teacher Award, Vancouver, Canada, 2006

J. Kent Mitchell, Emeritus
Fellow, American Society of Agricultural Engineering
Educational Aids Competition, American Society of Agricultural Engineers, 1972, 1975, 1979, 1984
Alpha Zeta Outstanding Instructor, University of Illinois College of Agriculture, 1986
Teaching Excellence Award, University of Illinois Department of Agricultural Engineering, 1986

Everitt Award for Teaching Excellence, University of Illinois College of Engineering, 1987
Faculty Award for Excellence in Teaching, University of Illinois College of Agriculture, 1989
Paul A. Funk Recognition Award, University of Illinois College of Agriculture, 1994
Honorary Badge, Warsaw Agricultural University (Warsaw, Poland), 2001
Hancor Soil and Water Engineering Award, American Society of Agricultural Engineers, 2002

Marvin R. Paulsen
Fellow, Committee on Institutional Cooperation, 2000-2001
Fellow, American Society of Agricultural Engineers, 2002
Andersons/NC-213 Grain Quality Research Award, 2002
Paul A. Funk Achievement Award, University of Illinois College of Agricultural, Consumer and Environmental Sciences, 2005

William H. Peterson, Emeritus
 Appreciation Plaque, South Dakota Rural Electric Member Services Association, 1977

Robert E. Petrea
President's Award, National Institute for Farm Safety, 2004
Special Recognition Award, National Institute for Farm Safety, 2004

Luis F. Rodriguez
Postdoctoral Research Fellowship, National Research Council, NASA, 2004

John C. Siemens, Emeritus
Blue Ribbon, Educational Aids Competition, American Society of Agricultural Engineers, 1985
Agronomic Educational Material Publication, American Society of Agricultural Engineers, 1992
Senior Faculty Award for Excellence in Extension, University of Illinois College of Agriculture, 1993
John Deere Gold Medal Award, American Society of Agricultural Engineers, 1999

Vijay Singh
American Association of Cereal Chemists Outstanding Poster Award, 1998
Young Faculty Excellence Award, National Corn Refiners Association, 2003
Innovation Hall of Fame, Office of Technology Management, University of Illinois, 2004
New Holland Young Research Award, American Society of Agricultural and Biological Engineers, 2005
Archer Daniels Midland Award for Best Paper in Protein and Co-Products Published in American Oil Chemists Society Press Publications, 2006
Participant, Frontiers of Engineering Symposium, National Academy of Engineering, 2006
Excellence in Research Award, University of Illinois College of Agricultural, Consumer and Environmental Sciences, 2007
Global Scholar, University of Illinois College of Agricultural, Consumer and Environmental Sciences, 2007

Lei Tian
Novel Academic Idea Award for Young Faculty, Jilin University of Technology, 1988, 1989
Nominee, CGS Award for Most Distinguished Dissertation of the Program, Department of Biological and Agricultural Engineering, University of California at Davis, 1995
Nominee, Kinsella Memorial Prize, University of California at Davis, 1995
Nominee, University Microfilms International Distinguished Dissertation Award in Mathematics and Physics and Engineering, University of California for National Council of Graduate Schools, 1995
Outstanding Accomplishment of Training on Teaching College, University of Illinois College of Agricultural, Consumer and Environmental Sciences Academy of Teaching Excellence, 1997
Honorable Mention for the Graduate College of Outstanding Mentor Award, University of Illinois College of Graduate Studies, 1999-2000
Superior Paper Award, American Society of Agricultural Engineers, 1999-2000
Faculty Fellow, National Center for Supercomputing Applications, University of Illinois, 2000-2001

Xinlei Wang
Paper Award, American Society of Heating, Refrigeration and Air-Conditioning Engineers, 2002
Honorable Mention Paper Award, American Society of Agricultural and Biological Engineers, 2002
J. Kent Mitchell Teaching Excellence Award, University of Illinois, Department of Agricultural and Biological Engineering, 2006
Faculty Award for Excellence in Extension, University of Illinois College of Agricultural, Consumer and Environmental Sciences, 2006

Qin Zhang
Best Paper in the Decade Award, Transactions of Chinese Society of Agricultural Engineering, 1995
General Electric Scholar, University of Illinois College of Engineering, 1998
Collins Award for Innovative Teaching, University of Illinois College of Engineering, 1999
Information and Electrical Technologies (IET) Division Select Paper Award, American Society of Engineers, 2001
Best Paper Award, SCI Control Systems, World Multi-Conference on Systemics, Cybernetics and Information, 2001
Fellow, National Center for Supercomputing Applications, 2002
Adjunct Chair Professor, College of Engineering, China Agricultural University, 2003
Adjunct Professor, College of Biological Engineering and Food Sciences, Zhejiang University, China, 2003
Fellow, Japanese Society for the Promotion of Science, 2004
Adjunct Professor, College of Mechanical Engineering, Department of Mechatronics, Yanshan University, China, 2004
Select Paper Award, Information and Electrical Technologies Division, American Society of Agricultural and Biological Engineering, 2005
Faculty Research Award, University of Illinois College of Agricultural, Consumer and Environmental Sciences, 2005
Honorable Mention Paper Award, American Society of Agricultural and Biological Engineers, 2006

Yuanhui Zhang
Outstanding Paper Award, American Society of Agricultural Engineers, 1989, 2001
Honorary Professorship, Beijing University of Agricultural Engineering, China, 1994
Honorary Professorship, Shandong Institute of Technology, China, 1994
Everitt Award for Teaching Excellence, University of Illinois College of Engineering, 1997
General Electric Scholar, University of Illinois College of Engineering, 1997
Blue Ribbon Award, American Society of Agricultural Engineers, 1998
Teaching Excellence Award, University of Illinois Department of Agricultural Engineering, 1999
Superior Paper Award, American Society of Agricultural Engineers, 2001
Annual Paper Award, American Society of Heating, Refrigeration and Air-Conditioning Engineers, 2002
Fellow, National Center for Supercomputing Applications, 2004
Bliss Faculty Scholar Award, University of Illinois College of Engineering, 2005