College of Engineering

2013 Annual Report

Biological and Agricultural Engineering
Kansas State University was founded in 1863 when 52 students enrolled in the first classes. 2013 was a memorable year as K-State celebrated its sesquicentennial. Faculty, students, alumni and friends took time in 2013 to celebrate Kansas State University’s proud heritage and look toward the future. The department of biological and agricultural engineering joined in the sesquicentennial festivities and celebrated our centennial as an agricultural engineering program.

The first agricultural engineering curriculum was approved in 1914 with an emphasis on farm machinery, flour milling and irrigation. The agricultural engineering curriculum today has expanded and the Bachelor of Science degree program is known as biological systems engineering. The department also celebrated the 50th anniversary of the agricultural mechanics program which began in the early 1960s. Today the program is known as agricultural technology management.

One hundred years later the department of biological and agricultural engineering is continuing the land-grant university tradition of excellence with emphasis on machinery systems, bio-processing and environmental/ ecological engineering. The department today has faculty engaged in the three pillars of a land-grant university, which include teaching, research and extension.

The core emphasis of the department 100 years ago was utilization of energy and natural resources for food production and processing wheat for human food consumption. During the early years, there was an abundance of energy and natural resources such as water. So utilization, rather effective utilization, appears to have been the focus based on early theses and dissertations by BAE graduate students. Today, there is a renewed vigor with the projected increases in global populations and limited natural resources, to focus on effective utilization of inputs necessary for food and fiber production systems, as well as adding value to each step in the feed-to-food processing chain.

The department of biological and agricultural engineering annual report is a reflection of our commitment to enable Kansas State University to reach its Vision 2025 goal of becoming a “Top 50 public research institution.” New BAE faculty hired in 2013 collectively have the responsibility of developing solutions to global challenges while insuring the next generation has adequate natural resources to maintain a quality of life. Dan Flippo (machinery systems), Trisha Moore (environmental ecology), Isaya Kisekka (irrigation and water management) and Ajay Sharda (precision technologies and agriculture) each have unique strengths in advancing the department and providing young people with the skills necessary to meet the challenges of developing sustainable systems to meet global demands.

The 2013 annual report highlights our ongoing research efforts where faculty continually ask questions in search of answers in addressing global challenges. The faculty and graduate students continue to focus research on developing biological systems to address environmental issues and bio-based product development for energy and consumer products, which have long-term sustainability and are economically viable.

BAE faculty students, alumni, friends and professional staff are committed to continuing the tradition of excellence within the land-grant university mission including excellence in academic, research and extension programming. We are collaboratively partnering with others to explore, evaluate and execute as we bring solutions to life. Our desire, as you review the following pages, is that you catch a glimpse of this commitment ensuring the future success of biological and agricultural engineering. Collaboratively, the department of biological and agricultural engineering is committed to fulfilling the department motto of “We bring solutions to life.”

Joseph P. Harner III
Professor and Department Head
Biological and Agricultural Engineering
Teaching: Engine power transfer, vehicle dynamics
Daniel Flippo
Teaching: Fermentation engineering, metabolic engineering, advanced topics in biotechnology and bioprocess
Research: Rationally design organisms to produce value-added fine chemicals by metabolic engineering, synthetic biology, fermentation engineering
Yu Deng
Extension: Grain and livestock systems
Joseph P. Harner III
Ph.D., Environmental Science and Engineering, Virginia Polytechnic Institute and State University, 1983
M.S., Agricultural Engineering, Virginia Polytechnic Institute and State University, 1981
B.S., Agricultural Engineering, Virginia Polytechnic Institute and State University, 1979
A.S., Engineering, Virginia Western Community College, 1977
Extension: Grain and livestock systems
Jonathan Aguilar
Ph.D., Kansas State University, 2009
M.Sc., University of the Philippines-Los Baños, 2005
B.Sc., University of the Philippines-Los Baños, 1996
Research: Technology development and management related to irrigated agriculture primarily in western Kansas
Educational programs: Groundwater quality, crop water allocation, ET-based irrigation scheduling, subsurface drip irrigation (SDI)
Phil L. Barnes
Ph.D., Civil Engineering, Kansas State University, 2001
M.S., Civil Engineering, Texas A&M University, 1977
B.S., Agricultural Engineering, University of Wyoming, 1974
Research: Monitoring Kansas watersheds to identify nonpoint pollution sources polluting our rivers and lakes
Extension: Develop best management practices and programs to transfer this technology to the farmers and ranchers of Kansas to reduce non-point pollution
Edwin Brokesh
M.S., Business Administration, Kansas State University, 2006
B.S., Agricultural Engineering, Kansas State University, 1983
Teaching: Engineering design concepts, machine design, power and energy concepts, agricultural machinery systems, project management, engineering ethics
Extension: Bioenergy education, transportation of ag machinery and products
Research: Monitoring Kansas watersheds to identify nonpoint pollution sources polluting our rivers and lakes
Extension: Develop best management practices and programs to transfer this technology to the farmers and ranchers of Kansas to reduce non-point pollution
Yu Deng
Ph.D., Chemical and Life Science Engineering, Virginia Commonwealth University, 2011
M.S., Engineering, Jiangnan University, Wuxi, China, 2007
B.S., Engineering, Jiangnan University, Wuxi, China, 2005
Research: Rationally design organisms to produce value-added fine chemicals by metabolic engineering, synthetic biology, fermentation engineering
Teaching: Fermentation engineering, metabolic engineering, advanced topics in biotechnology and bioprocessing, industrial microbiology, biotechnology
Research: Rationally design organisms to produce value-added fine chemicals by metabolic engineering, synthetic biology, fermentation engineering
Teaching: Fermentation engineering, metabolic engineering, advanced topics in biotechnology and bioprocessing, industrial microbiology, biotechnology
Daniel Flippo
Ph.D., Mechanical Engineering, University of Oklahoma, 2009
M.S., Mechanical Engineering, Wichita State University, 2004
B.S., Mechanical Engineering, Kansas State University, 1994
Research: Mechanical and soil dynamics of off-road vehicles, design and validation of autonomous vehicles for agricultural and off-road use, machine-to-soil interaction modeling and behavior
Teaching: Engine power transfer, vehicle dynamics
Research: Mechanical and soil dynamics of off-road vehicles, design and validation of autonomous vehicles for agricultural and off-road use, machine-to-soil interaction modeling and behavior
Teaching: Engine power transfer, vehicle dynamics
Teaching: No teaching assignments in 2013
Research: Integration of green infrastructure systems within the built environment to enhance resiliency to climatic extremes while providing water quality benefits
Trisha Moore
Ph.D., Biological and Agricultural Engineering, North Carolina State University, 2011
M.S., Biological and Agricultural Engineering, Kansas State University, 2008
B.S., Biological and Agricultural Engineering, Kansas State University, 2006
Research: Air quality monitoring and modeling, fate and transport of air emissions from agricultural sources, cost-effective mitigation strategies
Teaching: Particle technology, air pollution engineering, structures and environment engineering, agricultural building systems
Trisha Moore
Ph.D., Biological and Agricultural Engineering, North Carolina State University, 2011
M.S., Biological and Agricultural Engineering, Kansas State University, 2008
B.S., Biological and Agricultural Engineering, Kansas State University, 2006
Research: Air quality monitoring and modeling, fate and transport of air emissions from agricultural sources, cost-effective mitigation strategies
Teaching: Particle technology, air pollution engineering, structures and environment engineering, agricultural building systems
Isaya Kisekka
Ph.D., University of Florida, 2013
M.Sc., University of Florida, 2009
B.Sc., Makerere University, 2002
Research: Development of water management strategies and technologies for sustaining irrigated crop production with limited water through field experiments, simulation modeling, and adaptation of water conservation technologies such as plant-based thermal infrared and soil water sensors
Educational programs: Demonstrate conjunctive use of thermal infrared sensors, soil water sensors and climatic data for site-specific irrigation water management, application of simulation models in evaluating alternative limited irrigation management strategies design
Zifei Liu
Ph.D., Civil Engineering, Kansas State University, 1998
M.S., Civil Engineering, Kansas State University, 1996
B.S., Civil Engineering, Montana State University, 1990
Research: Ecological engineering, sustainable landscape management, nonpoint source pollution control, urban storm water management
Teaching: Natural resources engineering, ecological engineering, sustainable development, engineering
Ronaldo Maghirang
Ph.D., Agricultural Engineering, The Pennsylvania State University, 1992
M.S., Agronomy, University of the Philippines at Los Baños, 1986
B.S., Agricultural Engineering, University of the Philippines at Los Baños, 1982
Research: Air quality—measurement, control, modeling, environmental applications of nanotechnology, grain handling and identity preservation
Teaching: Particulate technology, air pollution engineering, structures and environment engineering, agricultural building systems
Mei He
Ph.D., Chemistry, University of Alberta, Canada, 2008
M.S., Pharmaceutical Chemistry, Chenggong University, China, 2003
B.E., Chemical Engineering, Chongqing University, China, 2000
Research: Bioengineering, nano-microfluidic technology integration and design with particular interest in disease diagnostics, personalized cancer medicine, and biologically inspired devices
Teaching: Biotechnology and disease diagnosis, biomolecular techniques, transport phenomena in biological engineering, biomedical engineering
J. Pat Murphy
M.S., Agricultural Engineering, Kansas State University, 1970
B.S., Business Administration, Kansas State University, 1968
B.S., Agricultural Engineering, Kansas State University, 1968
Extension: Livestock systems and environmental quality

Danny H. Rogers
Ph.D., Agricultural Engineering, Oklahoma State University, 1988
M.S., Civil Engineering, Kansas State University, 1977
B.S., Agricultural Engineering, Kansas State University, 1976
Extension: Education and demonstration program related to irrigated agriculture in Kansas including water conservation, water use productivity, best management practices, system selection and improvements, pumping plant efficiency, water policy and water quality protection

Ajay Sharda
Ph.D., Biosystems Engineering, Auburn University, 2011
M.Tech., Farm Power and Machinery, Punjab Agricultural University, India, 2001
B.Tech., Agricultural Engineering, Punjab Agricultural University, India, 1998
Research: Control and data acquisition, precision planting and liquid application technologies, unmanned aerial systems for precision ag and farm data management
Teaching: Precision agricultural technologies, machine systems

Aleksey Sheshukov
Ph.D., Fluid Mechanics, Kazan State University, Russia, 1996
M.S., Theoretical Mechanics/Applied Mathematics, Kazan State University, Russia, 1991
Extension: Environmental quality, watershed restoration and protection, best management practices, environmental impacts of climate change
Research: Hydrologic modeling, nonpoint source pollution control, soil erosion, climate change, GIS and computer modeling

John Slocombe
Ph.D., Agricultural Education, Iowa State University, 1983
M.S., Agricultural Education, Kansas State University, 1979
B.S., Agricultural Education, Kansas State University, 1977
Research: Chemical application systems, forage machinery systems, variable-rate technology, agricultural safety and health
Teaching: Chemical application systems, machinery systems, variable-rate technology

James Steichen
Ph.D., Agricultural Engineering, Oklahoma State University, 1974
B.S., Agricultural Engineering, Oklahoma State University, 1970
Research: Hydrology, water quality, military training lands management, soil erosion control, stream crossings
Teaching: Soil erosion and sediment pollution control, irrigation systems and water management, applied hydrology, natural resources and environmental science team projects

Donghai Wang
Ph.D., Biological and Agricultural Engineering, Texas A&M University, 1997
M.S., Biological and Agricultural Engineering, University of Illinois at Urbana, 1994
B.S., Biological and Agricultural Engineering, Northeast Agricultural University, China, 1982
Research: Fermentation, thermochemical and biochemical conversion of biomass for biofuels, biobased products, grain processing
Teaching: Physical properties of biomaterials, biological processing engineering, biomaterial processing, processing and storage of grains

Lisa R. Wilken
Ph.D., Biological and Agricultural Engineering, Texas A&M University, 2009
B.S., Biological and Agricultural Engineering, Kansas State University, 2003
Teaching: Introductory design for biological and agricultural engineers, principles of biological engineering, properties of biomaterials, bioseparation processes in biotechnology
Research: Trees and forages, energy and carbon sequestration, air quality, soil health

Naiqian Zhang
Ph.D., Agricultural Engineering, Virginia Polytechnic Institute and State University, 1987
M.S., Agricultural Engineering, Purdue University, 1984
B.S., Agricultural Mechanics, China Agricultural University, 1970
Research: Sensors and controls, wireless sensor network
Teaching: Instrumentation and control for biological systems, sensors and controls for agricultural and biological systems, measurement systems
Research highlights

Bioprocessing and Biofuel Group

The bioprocessing and biofuel group conducts both fundamental and applied research in the area of biomass and bio-based products with focuses on biomass production, biomass logistics, biomass characterization, biochemical conversion such as pre-treatment, enzymatic hydrolysis and fermentation, thermochemical conversion such as gasification, hydrothermal pyrolysis and fast pyrolysis, biodegradable adhesives, and downstream processing and separations. During the past five years, the group received more than $6 million in extramural funding from the National Science Foundation, USDA-National Research Initiative, USDA-Critical Biodiversity Program, DOE/USDA Biomass Research Program, DOD, U.S. Army Natick, DOT San Grant Initiative, United Sorghum Checkoff Program, State of Kansas, Kansas Bioscience Authority, USDA-Agriculture Research Services and industries. Research in the group has contributed to more than 70 peer-reviewed publications in the last five years. Key projects in the biofuel area include 1) grain sorghum, sorghum biomass and sweet sorghum as a viable renewable resource for biofuels with focus on analysis of the relationship among "genetic-structure-function-phenomenon-conversion" and biofuel production through sugar and thermal platforms; 2) synthesis of acid-functionalized nanoparticles for hydrolysis and pretreatment of lignocellulosic biomass; 3) development of pretreatment methods to increase biomass conversion efficiency; 4) biomass storage and biomass delivery; 5) catalytic hydrothermal pyrolysis of biomass for bio-oil and bio-char production; 6) development of fractionation, extraction and purification processes for efficient biomass utilization and value-added co-products; and 7) conversion of biomass to value-added chemicals with minimal treatment by cellulolytic bacteria; 8) systematical analysis of microorganisms to understand the complex metabolic and physiological mechanisms under different fermentation conditions by systems biology tools; and 9) development of metabolic engineering and synthetic biology tools to engineer less-studied microorganisms to increase yield of the value-added products on biomass.

Dr. Donghai Wang
Dr. Lisa Wilken
Dr. Yu Deng
Dr. Mei He

Environmental Quality Group

The environmental quality group has five sub-groups: air quality, water sustainability and climate change, military training lands sustainability, urban green design and watershed restoration.

K-State researchers are leading research and development into issues central to environmental sustainability. More than $2 million in annual extramural funding from NSF, DOD, EPA, USDA, DOE and others allow researchers in the biological and agricultural engineering department to collaborate with scientists, economists and others to address critical issues in air quality, climate change, military training lands sustainability, urban green design and watershed restoration.

Air quality

Agricultural operations, including concentrated animal feeding operations, prescribed range burning and off-road military vehicle training activities, emit various air pollutants such as particulate matter, which can have adverse impacts on both human health and the environment, and greenhouse gases, which contribute to global climate change. Limited data are available on air pollutant emissions from these activities. Current research includes: (1) measurement, control, and modeling of air pollutant emissions from animal feeding operations, including beef cattle feedlots and swine operations; (2) measurement of the effects of soil texture and intensity of training with off-road vehicles on fugitive dust emission potential due to wind erosion at military training installations; and (3) investigation of the impact of smoke from prescribed burning of rangelands.

Water sustainability and climate change

Hydrologic factors are major drivers of terrestrial and aquatic ecosystem response to climate change. With human-induced global climate change, we expect warming, hydroclimatic variability and frequency of extreme precipitation events will continue to increase. These changes will lead to increased stream intermittency, shifts in flood and drought timing and severity, and changes in vegetative phenological cycles.

K-State researchers developed a tool to temporally down-scale global climate model projections while incorporating site-specific climate variability. Hydrological impacts of climate change scenarios in northeastern Kansas, for example, include reduced low-flow duration, increased drought occurrence, and decreased flood frequency and duration. Future work will refine statistical procedures and test impacts on habitat, critical ecosystem goods and services in Smoky Hill watershed in western Kansas.

Military training lands sustainability

Military commanders and DOD resource managers face the difficult challenge of maximizing accessibility of ranges and training lands to meet mission requirements while ensuring their sustainable use for the operational demands of the future. Current research at K-State focuses on data collection and analysis methods, visualization tools, and data delivery mechanisms for assessing training land condition and trends, and providing timely and meaningful information to guide decisions at the military installations. Data for a suite of environmental/sustainability indicators across four monitoring themes are collected, assessed and synthesized to help identify where and where sustainable use of training lands is not being achieved, with results presented in near-real time via a web-mapping application.

Urban Water Institute

The Urban Water Institute was established at Kansas State University–Olathe in 2011. Faculty in biological and agricultural engineering are working with more than 30 water experts from across K-State to promote treatment technologies, management approaches and public policy that support sustainable water use in urban and urbanizing communities.

Dr. Ronald Maghirang
Dr. Zifei Liu
Dr. Stacy Hutchinson
Dr. Phil Barnes
Dr. James Steichen
Dr. Aleksey Sheshukov

Mechatronics/Precision Agriculture Group

The mechatronics/precision agriculture group has been conducting research on several fronts, including sensors, wireless sensor network and optical processing. During the past few years, the group received more than $2 million in extramural funding from DOD, USDA, the Sun Grant Initiatives and industries to support these projects. The group has also worked with the CIS and ECE departments within the College of Engineering to develop educational programs on sensors and embedded systems at the graduate, undergraduate and secondary education levels on four NSF-sponsored projects.

The team joined a USDA-Agronomy group in developing high-throughput phenotyping technologies to accelerate wheat breeding. The team helps develop both vehicle-carried and hand-held phenotyping systems to be used in the field.

A unique, frequency response-based permittivity sensor developed by the group is capable of simultaneously measuring multiple properties of dielectric materials. The sensor has been novel methods are being developed to disaggregate three sources (overland, ephemeral gully and stream bank) of sediment in watershed restoration. Conservation efforts in the past have dealt mainly with overland transport, while recent research would suggest that as much as 60% of the sediment transport may be coming from the other two sources. Many Kansas lakes and ponds are experiencing rapid growth of blue-green algae (cyanobacteria). Recent research has shown that climate change has caused wide swings in temperature and rainfall. Many of these lakes and ponds experience long periods of limited inflow. These water bodies become stagnant, which cause the nutrient levels to rise which favor the growth of cyanobacteria over common algae. Once the cyanobacteria die toxics are produced, they are harmful to livestock and humans. Current research is looking for mechanisms to control the cyanobacteria before they produce the toxics.

Watershed hydrologic and water quality simulation models are being used to develop a GIS-based water quality trading web interface. Engineering research is quantifying the spatial-temporal pollutant load variability, uncertainty and in-stream delivery to define an "environmental trading ratio" to facilitate point source (e.g., wastewater treatment plants) to nonpoint source (e.g., farm fields) pollutant effluent trades to economically achieve watershed water quality improvement.

Dr. Stan Cline
Dr. Zifei Liu
Dr. Amy Mayuga

Research in the group has contributed to more than 70 peer-reviewed publications in the last five years.
tested extensively in soil to measure water content and salinity, in water to detect nutrients and pesticides, and in biofuel-biodiesel and ethanol to measure blend ratio and impurities. The group has tested the sensor for air quality monitoring.

The group also developed a low-cost, optical sensor capable of simultaneously measuring sediment concentration and flow velocity in streams. By combining these measurements, sediment flux and sediment load can be estimated. Since 2007, 12 such sensors were deployed in three military installations in Maryland, Georgia and Kansas, respectively, to monitor soil loss related to military training. Sensor signals are transmitted via a “three-tier wireless sensor network.” Measured data are transmitted by “motes” to the gateway of each local wireless sensor network, where packets of data from multiple sensors are transmitted directly, or through repeaters, to a central station via mid-range radio. Data from the central stations are then transmitted to a data server through commercial cellular systems and posted to the internet by a web server. A software package has been developed to enable real-time display, queries, statistics and delivery of daily reports via email. More work was done to improve the velocity sensor through fluid dynamics modeling and modification of the signal conditioning, and processing hardware and software.

KSU BAE STORM2050

The following is a summary of the current projects underway at Kansas State University’s department of biological agricultural engineering. Each project fits under our Sustainable Terrain and Off Road Machinery 2050 (STORM2050) departmental vision, as well as align with recent Kansas State University’s 2025 vision for research, education and engagement.

AgDrone

AgDrone is a small ground vehicle concept that research the feasibility of numerous smaller robotic vehicles working together in a field. Size and weight of these vehicles eliminates soil damage and erosion due to large-vehicle soil compaction. Their low-cost, efficient small unmanned aircraft systems (SUAS), which can be flown at or below 400 ft, by producers, can be equipped with an appropriate sensing suite to ascertain in-season irrigation needs to study large fields efficiently during critical stages of crop growth. This project will develop a sensing suite aboard a SUAS to safely fly and measure in-season crop water stress for precision application of irrigation water, thereby improving water-use efficiency by producers, and enhancing water availability in crop production and other purposes.

DIEGO

Given a set of initial soil conditions (field roughness, residue cover, soil shear, etc.) and desired final conditions, what are the parameters of an optimized tillage implement? Designing implements with experimental genetic optimization uses a neural network and genetic algorithm to model and “evolve” a disk tiller from targeted experiments on a large gantry test apparatus.

By tactically varying implement parameters and soil properties, the neural network can then be used as a black box to predict the behavior of any variation of the implement in any soil condition. The genetic algorithm then goes through thousands of iterations of implement offsetting to find the set of implement parameters that have the highest performance for a certain application. All of the optimized implements will be cataloged in a KSU implement database for farmer and industry use. DIEGO will also be used to evolve new implement designs based upon special applications, as well as used for other implement concepts.

KORE

Also under the STORM2050 initiative is the Kansas Off-Road Equipment (KORE) Lab. Analogous to JD Powers or Consumer Reports, the KORE Lab will evaluate and test off-road equipment and issue a report to producers to help in their decision making as well as manufacturers to aid in their design. The KORE Lab will also be a lab space for student development and mentoring as they assist in test apparatus design and evaluation of products. The lab is a joint effort with a private consulting industry that will collaborate in this vision.

Dr. Naqian Zhang
Dr. Ajay Sharda
Dr. Daniel Filippo
Mr. Edwin Brokesh

Refereed Journal Publications


Zifei Liu

Newly funded projects:

- “Mitigation of air emissions from swine buildings through the photocatalytic technology using UV/TiO2,” National Pork Board; Liu, Z. (PI), R.G. Maghirang, J. DeRouchey, and J. Murphy; May 1, 2013-May 1, 2014, $37,368
- “Effectiveness of vegetative environmental buffers to reduce swine facility emissions,” National Pork Board; Zifei Liu, J. DeRouchey, R. Maghirang, and P. Murphy; May 1, 2013-May 1, 2014, $36,262

Ronaldo Maghirang

Newly funded projects:

- “Measurement and modeling of fugitive dust emissions from off-road DoD activities – Budget Amendment,” SERDP through USDA ARS; R.G. Maghirang (PI), and J. Steichen; July 2011 – September 2014, $59,992 (new) $158,942 (total to date)
- “Mechanistic modeling of wind barriers and grain comminution using CFD and DEM – Budget Amendment,” USDA ARS; R.G. Maghirang, September 2010 – September 2015, $27,750 (new), $117,702 (total to date)

J. Pat Murphy

Newly funded projects:

- “Mitigation of air emissions from swine buildings through the photocatalytic technology using UV/TiO2,” National Pork Board; J. DeRouchey, P. Murphy, and R. Maghirang; May 1, 2013-May 1, 2014, $37,368
- “Effectiveness of vegetative environmental buffers to reduce swine facility emissions,” National Pork Board; J. DeRouchey, P. Murphy, and R. Maghirang; May 1, 2013-May 1, 2014, $36,262

Value of continuing funded projects: $1,344,707

Danny Rogers

Newly funded projects:

- “Web-based KanSched3 and Smart Phone App,” USDA-ARS: Ogallala Aquifer Program; FY2013-2015, $33,000
- “Demonstrating the Use of Soil Water Measurement Technologies,” USDA-ARS: Ogallala Aquifer Program; Crop Year 2013-2014, $30,000

Value of continuing funded projects: $43,540

Aleksey Sheshukov

Newly funded projects:

- “Ephemeral Gully Assessment and Adoption of Preventive Measures to Reduce Erosion in Cultivated Croplands,” USDA-NRCS, A. Sheshukov, P. Barnes, R. Graber, T. Keane, and D. Devlin; 2013-2015, $100,256 (including $50,256 matching funds)

Value of continuing funded projects: $2,034,386

John Slocombe

Value of continuing funded projects: $162,000

James Steichen

Value of continuing funded projects: $59,992

Donghai Wang

Newly funded projects:

- “Development and Utilization of Sorghum as Feedstock for Biofuel Production,” Kansas Sorghum Commission; D. Wang, and T. Tesco; 10/1/2013-9/30/2014, $25,000
- “Spectroscopic measurement of biological materials,” USDA; D. Wang, 9/15/2013 to 9/14/2017, $55,000
- “Acid-functionalized nanoparticles as separable hydrolysis catalysts,” NSF-EPSCoR; D. Wang, 9/1/2013-9/8/2014, $36,668
- “Commercialization of industry-identified grain sorghum with optimized endosperm matrixes for enhanced bioethanol conversion and high-lysine DDG feed and food value,” DOW; D. Wang; 7/1/2013-6/30/2014, $37,995
- “Optimization of dihydroxyxylized soybean oil (DSO) derivatives for pressure-sensitive adhesives,” Kansas Soybean Commission; S.X. Sun and D. Wang; 7/1/2013 to 6/30/2014, $63,872

Value of continuing funded projects: $11,146,037

Lisa Wilken

Newly funded projects:

- “ADVANCE 2014 Distinguished Lecture Series Proposal (Fall 2013): Dr. Raja Ghosh,” Kansas State ADVANCE; L. Wilken, Accepted invite (visit Summer or early Fall 2014), $1,200

Value of continuing funded projects: $13,774

Naiqian Zhang

Value of continuing funded projects: $3,579,898
BACE Air Quality Laboratory

The Air Quality Laboratory supports the research, teaching and extension missions of the BAE department in agricultural air quality and related areas. Current research includes measurement, control and modeling of air emissions from animal feeding operations, including large cattle feedlots and swine operations; fugitive dust emissions from off-road military activities; investigation of the impact of smoke from prescribed burning of rangelands; and grain handling and storage. The laboratory is equipped with conventional and specialized instruments for sampling and/or measuring particulate matter concentrations, particle-size distribution, gas concentrations, flow rates and velocities, and meteorological parameters, among others. Major pieces of equipment include tapered-element oscillating microbalance particulate monitors, high-volume and mini-volume particulate samplers, Aerodyamic Particle Sizer™ spectrom- eter, Scanning Mobility Particle Sizer™ spectrometer, micro-orifice uniform deposit impactors, optical particle spectrometer, FTIR spectrometer, photo-acoustic gas monitor, Chemiluminescence ammonia analyzer, Chemcassette ammonia detector, gas chromato- graph, photoscanic multi-gas monitor, pulsed-fluorescence hydrogen sulfide analyzer, aerosol generator, multi-pycometer, microbalances and weather stations.

BACE Student Computer Center

This lab is equipped with 22 computers, three printers and a scanner, and is the heart of the study environment of the department. It is part of a student study complex adjacent to a main classroom. Adjacent to the student computer center are a design team room, student club room and student study center. The student computer center is maintained through the engineering student equipment fee, which is collected from all students who enroll in ATM or BAE courses. The department receives about $15,800 per year from these fees and uses more than two-thirds of them to maintain this center.

Bioenergy Laboratory

This laboratory is set up and equipped to conduct the following research: (1) microalgae work on microalgae cultivation methods, harvesting techniques, oil extraction processes, and bioinforming for biofuel and bioproduct development and biomedical applica- tions; (2) biomass gasification to produce high-quality syngas from biomass with special focus on value-added utilization of agricultural residues, gasification system kinetic modeling and optimization, syngas cleanup and reforming, and product and by-product utiliza- tion; (3) biomass hydrothermal conversion for converting agricul- tural residues, animal manure, microalgae and other high-moisture- content biomass into bio-oils through novel catalyzed hydrothermal pyrolysis, and bio-oil separation and upgrading; (4) biodiesel quality control for developing near- and mid-infrared spectroscopy-based models and chemometrics methods for biodiesel impurity detection, fatty acid identification and physical/chemical properties prediction. The lab is equipped with the following instruments: (1) a floor- stand, stirred-tank pressure reactor for biomass liquefaction/pyrolysis; (2) a unique downdraft gasifier designed to gasify low-bulk-den- sity biomass materials such as corn stover, switchgrass and poultry litter; and (3) various shakers and incubators, Brad-Beaure (Bio- spec), Souleht extractors (Pyrex), a digital phase-contrast microscope with built-in camera (FisherSco), pH meters, algae photo-bioreactors and temperature-controlled growth chambers for algae research.

Bioprocessing Laboratory

This laboratory, with total of more than 3,500 square feet of space, is well-equipped with advanced instruments for both research and teaching. Advanced instruments and equipment include nulls with different capacities for biomass size reduction, high-pressure reactor apparatus and sand bath reactor for biomass pretreatment, 5-L sterilizers with different capacities for production biofuel and chemicals through fermentation Bio reactor (BF-3000) and water bath shakers for fermentation, incubator shakers for biomass hydrolysis, lamina flow for bacteria inoculation, polymer chain-reaction machine and French press for biomaterial research, small-scale fast pyrolysis reactor for bio-oil production, centrifuges with different capaci- ties for material separation, HPLCs, spectrometer (UV-VS), FTIR spectrometer (Spectrum 400), 5890 GC/5975 MS coupled with CDS 7000 Purge and Trap, CHNSO analyzer, Buchi Rotavapor, IKA Bomb Calorimeter, Karl Fisher, ultrasound system, freeze dryer, rheometer, CO₂, sulfuric acid ascorbic acid, and rotavapor for biomass characterization and chemical analysis.

Environmental Analytical Laboratory

This laboratory is used for assessment of agricultural wastes, water quality and development of best management practices for natu- ral resource protection. It has a state-of-the art Dionex DX-500 ion chromatograph for analyzing micro- and macronutrients from soil and water samples, a Hewlett Packard HP-5890 Series II gas chromatograph with electron-capture (ECD) and Flame- ionization (FID) detectors for pesticide and hydrocarbon analysis, and a Shi- madzu SCL 30 A VP high-performance liquid chromatograph with a photo diode array detector and a fluorescence detector. The wet laboratory includes a chemical fume hood, IPC and PRC storage, a clean bench, pH and electrical conductivity probes, a Brookfield vis- cometer, and a 300°C oven for sample preparation and bench-scale research. An analytical laboratory is available for sample analysis.

Hydraulics Laboratory

This laboratory has flexible-use space for hydraulic, pump, pipe and irrigation testing. The facility includes a below-floor concrete channel and 50,000 L return tank growth chamber, and storage and maintenance for extensive field research equipment including 50+ solar-powered ISCO stream-flow monitors/water-quality samplers, with sound natural resources management. Assessments of vegetation, soil and water resources are performed in four areas: rangeland condition, soil erosion potential, water quantity and water quality. Principle laboratory equipment includes global positioning systems, low-altitude blimp, terrestrial imaging sensor, and various soil sam- pling and stream monitoring instruments.

Machine Systems Laboratory

This laboratory is used for a variety of machinery systems activi- ties including teaching, extension workshops and research. Space in the machinery systems laboratory is flexible allowing for research, lectures, labs and other activities requiring tabletop shop worksta- tions and hands-on learning. Areas are designated for specific train- ing tools used for group demonstrations and/or student lab activities. Training tools and equipment include fluid power/hydraulic trainers; multiple chemical application/spray system units; and components including electronic, tractors, utility vehicles and various preci- sion agricultural systems including global positioning systems and variable-rate-application electronics. Space is designated for conducting laboratory-based research in the chemical application area. These research activities include sprayer calibration, nozzle-flow checks, spray-pattern analysis and spray-droplet analysis. Laboratory space is also utilized for student projects.

Lab descriptions
downstream processing operations (extraction, fractionation and purification) and complementary tools for quantification and analysis of biological materials. It is equipped for grading of and extraction from biological materials including a Silverson high-speed homogenizer, Waring blender and stir plates. Protein analytical tools include a Molecular Devices SpectraMax® Plus384 Absorbance Microplate Reader, Life Technologies iBlot® Dry Western Blot System and NuPAGE® SDS-PAGE Gel System. Fractionation and purification tools include a Spectrum Labs KrosFlo® Research IIi Tangential Flow Filtration System (KRFi) and equipment needed for chromatography adsorption studies.

Water Quality Laboratory

This laboratory is equipped for sediment, nutrient, pesticide and bacterial analyses. Equipment includes analytical balances, membrane filtration apparatus, clean hoods, spectrophotometer, deionized-distilled water, centrifuges, drying ovens, refrigerators and freezers.

Watershed Modeling Laboratory

This laboratory has six graduate-student-assigned modeling workstations, each equipped with powerful Windows-based computers, dual-screen monitors, server-based file storage, MATLAB and Visual Studio modeling environments, and ESRI geographic information system site-license keys; a meeting table; and two student research computer workstations. Modelers continuously develop new computer modeling tools, and routinely test and evaluate current releases and beta versions of leading watershed modeling software (e.g., SWAT, WEPP, HSPF).

The Kansas State University department of biological and agricultural engineering (BAE) is committed to generating and disseminating knowledge in agricultural and biological systems. The program mission is to advance the knowledge and application of engineering and technology to living systems including plants, animals, microorganisms, agriculture and the environment. Engineering graduates apply engineering, physical and biological principles to living systems in a diverse world of opportunities.

Kansas State University is the only higher education institute in Kansas offering a biological systems engineering (BSE) degree. The BSE undergraduate degree program is a versatile program that offers environmental, machine systems and biological engineering options. The B.S. BSE degree is accredited by the Accreditation Board for Engineering and Technology (ABET). Through the program, students acquire the ability to provide engineering input to produce and process useful products such as food, fiber, energy, chemical feedstock and pharmaceuticals. Students also acquire an understanding of efficient use of soil and water resources and environmental protection to improve water quality, control air pollution and clean up contaminated soils. Students learn the importance of bringing solutions to life through integrating engineering knowledge with diverse and interdisciplinary teams collectively working together. Student learning outcomes of this program include the following:

- ability to apply knowledge of math, science and engineering
- ability to design and conduct experiments, as well as to analyze and interpret data
- ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability
- ability to function on multi-disciplinary teams
- ability to identify, formulate and solve engineering problems
- understanding of professional and ethical responsibility
- ability to communicate effectively
- broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context
- recognition of the need for and an ability to engage in lifelong learning
- knowledge of contemporary issues
- ability to use the techniques, skills and modern engineering tools necessary for engineering practice
The department of biological and agricultural engineering (BAE) offers Ph.D., M.S. and concurrent B.S./M.S. programs. Current graduate students and their research area of emphasis include the following:

**Ph.D. Students/Candidates:**
- *Aguilar, Orlando* (Panama): Measurement and Control of Greenhouse Gas Emissions from Beef Cattle Feedlots (Major Professor: Ronaldo Maghirang)
- *Appiah-Nkansah, Nana Baah* (Ghana): Full Utilization of Sweet Sorghum for Biofuel Production (Major Professor: Donghai Wang)
- *Bonifacio, Henry* (Philippines): Estimating Particulate Emission Rates from Large Beef Cattle Feedlots (Major Professor: Ronaldo Maghirang)
- *Brookes, Edwin* (USA): Farm Field to Biorefinery Gate Logistics of Biomass Collection (Major Professor: Donghai Wang)
- *Cong, Danni* (China): Management of Microcrystals in Fresh Water (Major Professor: Phil Barnes)
- *Gonzales, Howell* (Philippines): Wind Erosion Control and Particle Collection by Vegetative Barriers (Major Professor: Ronaldo Maghirang)
- *Hamekhazi, Maryam* (Iran): (Major Professor: Stacy Hutchinson)
- *Karimov, Vladimir* (Russia): Runoff Fluxes Impact on Ephemeral Gully Development (Major Professor: Aleksey Sheshukov)
- *Li, Ningbo* (China): Isolation, Characterization and Adhesion Performance of Sorghum, Canola and Camelina Proteins (Major Professor: Donghai Wang)
- *Linnebur, Kyle* (USA): Analysis of Torrefaction of Big Bluestem Canopy Temperature Profiles for Variable-Rate Irrigation (Major Professor: Naiqian Zhang)
- *Kepley, Spencer* (USA): Rapid Development of Mobile Apps Using APP Inventor and AGCO API (Major Professor: Aleksey Sheshukov)
- *Mollenkamp, Lorinda Bejot* (USA): Biofuel Modeling in SWAT 2009 for Kanopolis Watershed in Kansas River Basin (Major Professor: Aleksey Sheshukov)

**Master of Science Students:**
- *Ahmadi Fard, Ali* (Iran): (Major Professor: Lisa Wilken)
- *Barker, Jared* (USA): Field-Based Mobile Sensor Platform for Phenotyping (Major Professor: Naiqian Zhang)
- *Denker, Phillip* (USA): Tracking Military Maneuver Training Disturbance with Low-Cost GPS Devices (Major Professor: Stacy Hutchinson)
- *Hale, Kristen* (USA): The Potential of Canola Protein for Bio-Based Wood Adhesives (Major Professor: Donghai Wang)
- *Hillstock, Lisa* (USA): Quantification of Ecosystem Services in the Soldier Creek Watershed Using SWAT (Major Professor: Aleksey Sheshukov)
- *Kepley, Spencer* (USA): Visualized, Hypothesis-Driven Approaches to Field-Based Mobile Sensor Platforms (Major Professor: Stacy Hutchinson)

**Graduate report**

**Sinnathamy, Sumathy** (Sri Lanka): Toward Quantifying Ecosystem Services Using Multi-Scale Calibrated Watershed Model and GIS (Major Professor: Stacy Hutchinson)


**Wei, Yong** (China): Field-Based Phenomics for Plant Genetics Research (Major Professor: Naiqian Zhang)

**Zhang, Ke** (China): The Effect of Ectotype and Planting Location on Properties and Biofuels Yield of Big Bluestem (Major Professor: Donghai Wang)
Mudd, Shannon (USA): Disinfection of Biological Agents in the Field Using a Mobile Advanced Oxidation Process (Major Professor: Stacy Hutchinson, Co-Major Professor: Trisha Moore)

Pugh, Ginger (USA): Assessing the Hydrologic Impacts of Military Maneuvers (Major Professor: Stacy Hutchinson)

Sanchez Gil, Yaritza (Colombia): Characterization and Rheological Properties of Camelina Sativa Gum: Interactions with Xanthan Gum, Guar Gum, and Locust Bean Gum (Major Professor: Donghai Wang)

Stout, Breanna (USA): Cover Crops: An Important Tool in Contemporary Sustainable Agriculture (Major Professor: Phil Barnes)

Sullivan, Justine (USA): Analysis of Energy Gradients and Sediment Loads Occurring in the Irish Creek Watershed Located in Northeast Kansas (Major Professor: Phil Barnes)

Wang, Junqin (China): Toxicity, Biodegradation and Fate of N-Methyl-4-Nitroaniline (MNA) (Major Professor: Zifei Liu)

Wiederolt, Andrew (USA): Autonomous Harvester Development for Wheat Breeding Program (Major Professor: Naiqian Zhang)

Xu, Youjie (China): Soil Erosion: Fugitive Dust Emissions Due to Off-Road Military Vehicle Activities (Major Professor: Ronaldo Maghirang)

Student design teams

The department of biological and agricultural engineering (BAE) encourages undergraduate students to develop their engineering skills and promote creativity through participation in nationally competitive design teams. Overall goals are to provide students professional engineering experience and opportunities to develop skills in communication, leadership, teamwork, fundraising, and testing and development. These foundational skills enable students to transition into research programs and the work place. Annually, approximately 20 percent of the students enrolled in BAE participate in these extracurricular design teams.

Robotic Team Competition

BAE’s student robotics team has consistently established itself as one of the nation’s best. The team has never lost the American Society of Biological and Agricultural Engineers’ student robotics competition, routinely prevailing against teams from across the U.S., Canada and Taiwan.

At the 2013 ASABE Annual International Meeting in Kansas City, Mo., the K-State team successfully defended its title once again, clinching its seventh consecutive win.

The society’s student robotics competition is aimed at designing solutions to common agricultural issues. Challenge activities are typically themed around the meeting’s host city, i.e. Kansas City in 2013.

This year’s competition theme focused on the hay industry, of which Missouri and Kansas play a big part. The challenge was to automate the process of sorting and stacking round hay bales in a barn. Teams had to design and build a robot that could find, pick up, transport, sort and stack colored (red, green and blue) toilet paper rolls (representing round bales). There were four bales for each color.

The bales were randomly placed on an 8 x 8 foot board. The bales had to be stacked by color and points were awarded based on the number of bales stacked and the height of the stack.

Beginning in January and finishing in July, the K-State team developed a single robot solution that could efficiently search the board and quickly pick up and stack four bales at a time. The team also developed a three-robot solution that featured wireless communication between identical robots to accomplish the same task in less time.

Team membership is voluntary and is open to all K-State students. Being part of the team is a great opportunity for students to develop and hone their skills in mechanical design, programming, testing, troubleshooting and teamwork.

*BAE doctoral and master’s graduates
Fountain Wars Competition
The Kansas State University BAE fountain wars team won second place at the 2013 ASABE international meeting in Kansas City. This was its 11th top-three placing in the last 12 years of competition.

The ASABE Fountain Wars Competition applies understanding of the fundamental principles of hydraulics and fluid flow towards designing solutions to a defined set of tasks. The competition consists of two technical tasks, an aesthetic display, and an oral presentation completed by sophomores and juniors. As part of this engineering competition, students are introduced to marketing-style promotion and designing for aesthetics, incorporating biomaterial in the design or display to earn bonus points. The students are introduced to the pre-manufacturing of components due to the limited time to construct on site during the competition. They bring their four fountain components in disassembled condition in five containers of specified dimension and weight. Teams construct the fountain in 90 minutes and pass the safety test to participate in the international competition.

Quarter-Scale Tractor Competition
The Kansas State University BAE quarter-scale tractor design team won first place in the International Quarter-Scale Design Competition in 2013. The team has won this nine years out of the 16 years of the competition’s existence, and has finished within the top three teams in 15 out of 16 years.

The Quarter-Scale Tractor Student Design Competition challenges students to harness the power and torque of a specified stock engine in order to maximize performance in the tractor pull. Through involvement in the quarter-scale tractor design team, students gain practical experience in the design of drive-train systems; tractor performance; manufacturing processes; and analysis of traction vs. forces, weight transfer and strength of materials. Teams construct the fountain in 90 minutes and pass the safety test to participate in the international competition.

ASABE 2013 Annual International Meeting Awards
- G.B. Gunlogson Student Environmental Design Competition Fountain Wars Contest Kansas State fountain wars team – second place
- ASABE Robotics Competition K-State EMAW (Every Machine A Wildcat) team – first place (seventh consecutive year in placing first)
- Quarter-Scale Tractor Competition BAE quarter-scale tractor team – first place finish at competition in June in Peoria, Ill.; “X” team won first place in its competition
- Biological Systems Engineering Student Professional Club – second place in the Association of Equipment Manufacturers (AEM) Student Engineering Branch, Group A Award

- DereAnn Turpin (BSE SP2013) received the 2013 Phoens of Alexandria Global Learning Award for her exemplary leadership skills, humanitarian service, and dedication to the promotion of sustainable and environmentally sound engineering practices.
- Danny H. Rogers, BAE professor, was elected ASABE Fellow and selected as 2013 ASABE Kansas Section Member of the Year.
- Rumeli Bhadra, BAE research associate, was selected 2013 ASABE Kansas Section Young Member of the Year.
- Donghai Wang, BAE professor, along with BAE co-authors Karmalin Theerarattananoon and Feng Xu (former doctoral students of Wang) were recognized for an ASABE Superior Paper Award: Impact of pelleting and acid pretreatment on biomass structure and thermal properties of wheat straw, corn stover, big bluestem and sorghum stalk. Transaction of the ASABE 55(5):1845-1858.

- Derek Roth, CMRP Horizon Milling
- Miles Keaton, P.E. Product Engineering Manager WW Balers John Deere
- Craig Cowley Senior Process Engineer Hills Pet Nutrition
- Donald Baker, P.E., D.WRE, CPESC Principal and Owner Water Resources Solutions, LLC
- Dale Turner, P.E. Manufacturing Engineer Kuhn Krause
- Mike O’Halloran Engineering Manager Current Products Agco Corporation
- Casee M. Eisele Project Manager ECAP Project Manager John Deere Ag Marketing Center
- Kevin Stamm, P.E. Hydraulic Engineer U.S. Army Corps of Engineers Hydrology Engineering Branch
- Jeff Grimm Field Engineer Capstan Ag Systems, Inc.

- Justing Atwood LandMark Implement, Inc.
- Alex Evans
- Grant Good Product Proving Supervisor, Combines AGCO
- Chad Germyer Manager Prairieland Partners
- Mike Celley, CMRP Horizon Milling
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The purpose of the BAE Advisory Council shall be:
- to provide advice from the perspective of alumni, successful engineering practitioners, industry and business leaders, and other external entities regarding the relevance of our programs and the efficiency of our internal operations;
- to provide a connection between our faculty and students on campus, and the various industries they represent; and
- to provide leadership to the many K-State engineering alumni—this leadership comes in the form of service and financial support.

The purpose of the ATM Advisory Council shall be:
- to provide advice from the perspective of alumni, successful engineering practitioners, industry and business leaders, and other external entities regarding the relevance of our programs and the efficiency of our internal operations;
- to provide a connection between our faculty and students on campus, and the various industries they represent; and
- to provide leadership to the many K-State engineering alumni—this leadership comes in the form of service and financial support.

- Justing Atwood/LandMark Implement, Inc.
- Alex Evans
- Grant Good/Combines AGCO
- Chad Germyer/Prairieland Partners
- Mike Celley/Horizon Milling
- Miles Keaton/WW Balers John Deere
- Jeffrey Miller/Hills Pet Nutrition
- Donald Baker/Water Resources Solutions, LLC
- Jeff Grimm/Capstan Ag Systems, Inc.
- Mike O’Halloran/Current Products Agco Corporation
- Casee M. Eisele/ECAP Project Manager John Deere Ag Marketing Center
- Kevin Stamm/Hydraulic Engineer U.S. Army Corps of Engineers
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