Message from the Department Head

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ometime, on Monday, October 31, 2011, the world’s population exceeded seven billion people. Mr. James Eng has written an article entitled “Seven big problems for 7 billion people” (www.msnbc.msn.com/id/44990504/ns/us_news-life/seven-big-problems-billion-people/). The problems identified by Mr. Eng through interviews with world experts include the following:

- food shortage, damage to environment
- access to information technology, education
- women’s rights and gender inequality
- climate change
- aging
- energy
- water
- consumer innovation

Environment, bioprocessing, and control and sensors for biological systems are core research focus areas of the department of biological and agricultural engineering (BAE) at Kansas State University. BAE engineering faculty are actively engaged in research related to the following six of the eight problems identified in Eng’s article:

- environmental issues
- information technology
- climate change
- energy
- water
- product innovation

In 2011, BAE engineers were actively involved in addressing global issues as the Earth’s population surpassed seven billion people this past year. Our 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 is committed to partnering with others to bring solutions to life. Our desire, as you review the following pages, is that you catch a glimpse of the depth and breadth of our commitment to address six of the “seven big problems for 7 billion people” identified by Mr. James Eng. Collaboratively with other engineers and scientists, the BAE faculty are committed to fulfilling the department motto of “We Bring Solutions to Life.”

Joseph P. Harner III
Professor and Head
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The 2011 annual report highlights our ongoing research efforts in addressing global issues as the Earth’s population surpassed seven billion people this past year. Our 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.

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Faculty

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

Mahbub Alam
- Ph.D., Irrigation, Colorado State University, 1985
- M.S., Irrigation Engineering, American University of Beirut, Lebanon, 1979
- B.S., Agricultural Engineering, American University of Beirut, Lebanon, 1976
- Research: Water requirement of field crops, climatic data application to water use and agriculture
- Extension: Irrigation and water management education program, irrigation technology field research, irrigation system evaluation and demonstration, environmental issues related to water quality and wastewater use

Philip L. Barnes
- Ph.D., Civil Engineering, Kansas State University, 2001
- M.S., Agricultural Engineering, Texas A&M University, 1977
- B.S., Agricultural Engineering, University of Wyoming, 1974
- Research: Monitoring Kansas watersheds to identify non-point 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

Kyle Douglas-Mankin
- Ph.D., Agricultural Engineering, The Ohio State University, 1994
- M.S., Agricultural Engineering, The Pennsylvania State University, 1987
- B.S., Agricultural Engineering, The Pennsylvania State University, 1985
- Research: Watershed modeling, climate change, environmental impacts of biofuels, sustainable agro-environmental management, ecosystem services
- Teaching: BAE/ATM first semester orientation, introductory engineering design, agricultural resources and environmental management, watershed management, watershed modeling, natural treatment systems

Stacy L. Hutchinson
- 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 stormwater management
- Teaching: Natural resources engineering, ecological engineering, sustainable development, engineering design

Ronald 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: Particle technology, air pollution engineering, structures and environment engineering, agricultural building systems

J. Pat Murphy
- M.S., 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

Randy Price
- Ph.D., Agricultural Engineering-Precision Farming Technologies, University of Illinois, 2000
- M.S., Agricultural Engineering-Precision Farming Technologies, Purdue University, 1997
- B.S., Agricultural Engineering-Machinery Systems, Oklahoma State University, 1989
- Research: Precision farming sensors, electronic controls, GPS units
- Teaching: Precision farming techniques, machinery systems

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

John Slocumbe
- 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
Bioprocessing and Biofuel Group

The bioprocessing and biofuel group conducts both fundamental and applied research in the area of biofuels and biobased products with focuses on biomass production; biomass logistics; biomass characterization; biochemical conversion such as pretreatment, enzymatic hydrolysis and fermentation; thermochemical conversion such as gasification, hydrothermal pyrolysis and fast pyrolysis; and biodegradable adhesives. During the past five years, the group has conducted more than 20 research projects related to biofuels and biobased products. Total funding for these projects is more than $6 million with more than $3 million to the group. The group has received funding from federal, state agencies and industries such as the National Science Foundation, USDA-National Research Initiative, USDA-Critical Biomaterials Program, DOE/USDA Biomass Research Program, DOD, U.S. Army Natick, DOT Sun Grant Initiative, United Sorghum Checkoff Program, state of Kansas, Kansas Bioscience Authority, USDA-Agriculture Research Services and industry. Researchers in the group have contributed to more than 60 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-composition-conversion” and biofuel production through sugar and thermal platforms; 2) pelleting forages to increase cellulosic ethanol production with focus on biomass densification and pretreatment; 3) syntheses of acid-functionalized nanoparticles for catalytic hydrothermal pyrolysis of biomass for bio-oil and bio-char production. The key project in the area of biofuels is development of affordable and durable biobased adhesives and resins for wood applications. In biofuel research, the group focuses on animal vaccines, bioplastics development and protein-based adhesives.

Dr. Donghai Wang
Dr. Wenqiao Yuan
Dr. Xiaorong Wu

Environmental Quality Group

The environmental quality group has five subgroups: 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

Large beef cattle feedlots in the Great Plains are faced with air quality challenges, including emissions of particulate matter, ammonia, odor, volatile organic compounds and greenhouse gases. For the past several years, the K-State air quality team has been conducting field, laboratory and numerical research on air emissions from large cattle feedlots in Kansas to develop science-based information on air emissions and cost-effective abatement measures for mitigating those emissions. Research has been funded by the USDA NIFA.

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 the frequency of extreme precipitation events to 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 downscale global climate model projections while incorporating site-specific climate variability. Hydrological impacts of the A2 climate-change scenario 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 critical ecosystem goods and services.
Military training lands sustainability

Military commanders and Department of Defense (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 meaning- ful 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 when 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 urban- izing communities.

Watershed restoration

A recent national symposium has identified sediment accumulation in reservoirs and streams as perhaps the most urgent water resource con- cern in the U.S. due to the resulting breadth and magnitude of lost economic and ecologic goods and services. K-State researchers, using funding from USDA, EPA, USGS and NSF, are develop- ing novel modeling tools to facilitate water resource restoration and management.

K-State researchers are leading national efforts to quantify location and size of cropland ephemeral gullies, a critical source of stream sediments. Data from hundreds of gullies are being used to test methods that simulate where ephemeral gullies form and how much soil is eroded for a given set of storm, site, soil and surface conditions.

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 spatiotemporal 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.

Novel methods are being developed to disaggregate three sources (overland, ephemeral gullies and stream bank) of sediment in watershed hydrologic modeling. Results have substantially improved model performance. Application of this research will improve targeting and effectiveness of watershed restoration efforts.

Dr. Ronaldo Maghirang
Dr. Kyle Douglas-Mankin
Dr. Stacy Hutchinson
Dr. Phil Barnes
Dr. James Steichen
Dr. Alexey Sheshukov

Nanotechnology Group:

Biofuel Production

Nanoparticles or nanometer particles are particles that are generally smaller than 50 nm. Aggregates of these particles have large surface- to-volume ratio, unique morphology, additional functional group on the surface, large porosity and altered electronic state, making them very reactive and/or catalytic. To exploit these unique proper- ties, we have been collaborating with scientists in chemical engineering, chemistry, physics and other departments at K-State to develop nano- structured particles for biomass pretreatment, cellulose hydrolysis and biofuel production.

In biofuel production, acid catalysis have been successfully used for the pretreatment of cellulolic biomass to improve the sugar recovery and its later conversion to ethanol. However, use of acid requires considerable equipment investment as well as disposing of the residues. With funding from NSF IGERT and NSF EPSCoR and collaboration with other departments, we are conducting research to develop functionalized nanoparticles for hydrolysis of lignocellulosic feedstocks for bioethanol and biodiesel production. The advantages of using functionalized metal nanoparticles are not only the catalyst properties for biomass hydrolysis and chemical reaction, but also being easily separable from hydrolysis residues and chemical reaction solutions using a strong magnetic field.

Dr. Donghai Wang
Dr. Xiaorong Wu

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 five years, the group received more than $2 million in extramural funding from DoD, USDA, the Sun Grant Initiatives, Kansas Water Resource Institute and industries to support these projects. Since 2000, the group has 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 three NSF-sponsored projects.

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 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. Recently, the group has started to test the sensor in air quality measurement.

The group also developed a low-cost, optical sensor that is capable of simultaneously measuring sediment concentration and flow velocity in streams. By combining these measurements, sediment flux and sediment load can be estimated.

In 2009, 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 “nodes” 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 e-mails. In 2011, more work was done to improve the velocity sensor through fluid dynamics modeling and modification of signal conditioning, and processing hardware and software.

With many new precision farming technologies becoming available, large gaps exist between these technologies and farmers, and between the investment and profit. Much effort has been made by the group to simplify and streamline the tasks for the farmers to manage the technologies. Wireless technologies are being investigated as a means to expedite the collection, delivery and integration of farm data.

Dr. Naiqian Zhang
Dr. Randy Price
Publications

Publications

Patents

Referred Journal Publications
Publications


Invited Publications


Invited Speakers


  - Watershed Hydrologic Processes (3 hours)
  - Hydrologic Impacts of Climate Change (1.5 hours)
  - Overview of Gulf of Mexico Hypoxia (1.5 hours)


Cooperative Extension Publication (new)


Newly funded projects:
- "Measuring Success of Targeted BMP Implementation and Getting Smarter about Ephemeral Gully Sediment and Nutrient Source and BMPs," USDA, 2011-2014, $570,000
- "Marion Lake WRAPS," EPA 319, KDHE, Marion County, 2011, $56,000
- "Little Arkansas River WRAPS," EPA 319, KDHE, City of Marion, 2011, $150,000
- "Big Creek and Middle Smoky Hill River WRAPS," EOA 319, KDHE, and City of Hays, 2011, $128,000
- "Scientifically Targeted Locations, Social Strategies, and Market-Based Incentives to Reduce Sediment Transport from Agricultural Lands," USDA NRCS Conservation Innovation Grant, 2009-2011, $450,000

Edwin Brokesh
Newly funded proposals:
- "Cadaver Lift," University of Kansas Medical School, Fall semester 2011, $1,000

Kyle Douglas-Mankin
Newly funded projects:
- "Measuring Success of Targeted BMP Implementation, and Getting Smarter about Ephemeral Gully Sediment and Nutrient Sources and BMPs," USDA-CSREES Integrated Research, Education and Extension Water Quality Program, CRIS Project No. 2011-09160, 2011, $570,000(3-year period)

Stacy L. Hutchinson
Newly funded projects:
- "Fort Riley Range and Training Land Assessment," Great Plains Cooperative Ecosystems Studies Unit (CESU) Agreement No. W912X7-11-2-0016, 04/15/2011-12/31/2012, $100,000

Value of continuing funded projects: $916,431

Ronaldo Maghirang
Newly funded projects:
- "Mechanistic Modeling of Wind Barriers and Grain Commingling Using CFD and DEM – Amendment #01," USDA ARS, 09/15/10-09/14/15, $52,000 (amendment #1; $49,952 total to date)
- "Mechanistic Modeling of Wind Barriers and Grain Commingling Using CFD and DEM – Amendment #02," USDA ARS, 09/15/10-09/14/15, $10,000 (amendment #2; $59,952 total to date)
- "Measurement and Modeling of Fugitive Dust Emissions from OE-Road DoD Activities," DoD-SERDP (through USDA), 07/15/11-09/30/12, $38,390

Value of continuing funded projects: $1,103,503

J. Pat Murphy
Value of continuing funded projects: $5,333,500

Randy Price
Newly funded projects:
- "Development of New Technologies to Estimate Sugarcane Yields and Improve Planting Systems," American Sugar Cane League, 2011, $15,500

Danny Rogers
Newly funded projects:

Aleksy Sheshukov
Newly funded projects:

John Stoccombe
Value of continuing funded projects: $360,000

James Steichen
Value of continuing funded projects: $435,702

Donghai Wang
Newly funded projects:
- "Development and Utilization of Sorghum as Feedstock for Biofuel Production," Kansas Sorghum Commission, 3/01/2011-9/30/2013, $25,000
- "Bio-Industrial Uses of Sorghum Proteins," USDA, 9/1/2008 to 8/31 2013, $45,000
- "Sorghum Biomass Genomics and Phenomics," USDA-NIFA, 9/1/2011 to 8/31 2014, $800,000
- "Utilization of Sorghum as Feedstock for Biofuel Production," K-State Center for Sorghum Improvement, 10/1/2011-9/30/2012, $28,176

Value of continuing funded projects: $791,877

Xiaorong Wu
Value of continuing funded projects: $42,810

Wenqiao Yuan
Newly funded projects:
- "Evaluation of the Potential of Big Bluestem for Biofuel Production," COT (South Central Sun Grant), 7/1/2011-6/30/2013, $75,000
- "Support for Research and Education Collaboration on Microalgae-Based Biofuels and Bioproducts in Thailand," KSU Office of International Programs, 8/15/2011-5/31/2012, $3,000

Naqian Zhang
Newly funded projects:
- "CG-Team Demonstration Project: Training the Next Generation Workforce To Use Real-Time Data and Simulation Technologies," National Science Foundation, 9/1/2011-8/31/2013, $249,920

Value of continuing funded projects: $791,877
Philip L. Barnes
Council for Agricultural Science and Technology (CAST), member
American Society of Agricultural and Biological Engineers, member
SW-01 Soil and Water Executive Committee, chair (nationally)
SW-06 Soil and Water Erosion Control Group, past chair
AW-22 Soil and Water Erosion Control Group, past chair
SW-112 Soil and Water Erosion Control Group, past chair

Kyle Douglas-Mankin
Professional

Edwin Brokesh
Professional

Kyle Douglas-Mankin
Professional

John Slocumbe
Professional

James Steichen
Professional

Donghai Wang
Professional

Wenqiao Yuan
Professional

List of Abbreviations

ASABE – American Society of Agricultural and Biological Engineers
SW – Soil and Water Division
SE – Structures and Environment Division
FPE – Food Processing and Engineering Division
IET – Information and Electrical Technologies Division
PM – Power and Machinery Division
M – Membership Development Council
BE – Biological Engineering Division
ESH – Ergonomics, Safety and Health Division
ED – Education Division
ASEE – American Society of Engineering Education
BAE Air Quality Laboratory
This laboratory supports research and teaching missions of the BAE department in agricultural air quality and related areas. Current research includes characterization, control and modeling of air emissions from large cattle feedlots; environmental applications of nanotechnology; fugitive dust emissions from military activities; and grain handling and storage. The lab is equipped with conventional and specialized instruments for sampling and/or measuring particulate matter concentrations, particle size distribution, gas concentration, 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, Aerodynamic Particle Size™ spectrometer, Scanning Mobility Particle Size™ spectrometer, micro-orifice uniform deposit impactors, optical particle spectrometer, FTIR spectrometer, Chemiluminescence ammonia analyzer, Chemi-Cuncert ammonia detector, gas chromatographs, aerosol generator, multiplynzymeter, microbalances and weather stations.

BAE 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 the 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 $15,000 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 biofueling for biofuel and bioproduct development and biomedical applications; (2) biomass gasification: 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 production/transport utilization; (3) biomass hydrothermal conversion: convert agricultural residues, animal manure, microalgae and other lignocellulosic biomass into bio-oils through novel catalyzed hydrothermal pyrolysis, and bio-oil separation and upgrading; (4) biodiesel quality control: develop 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) floor-standing, stirred-tank pressure reactor for biomass liquefaction/pyrolysis; (2) unique downdraft gasifier designed to gasify low-bulk-density biomass materials such as corn stover, switchgrass and poultry litter, and (3) various shakers and incubators, Bead-Beaters (Biospec), Soudlet extractors (Pyrex), a digital phase-contrast microscope with built-in camera (FisherSci), pH meters, algar photospectroscopy and temperature-controlled growth chambers for algae research.

Bioprocessing Laboratory
This laboratory (Seaton 33-34 A-C-D-E and Seaton 138 A-B), with a total of more than 3,500 square feet of space, is well equipped with advanced facilities for both research and teaching. The advanced equipment is available for student research projects with different capacities for biomass size reduction, high-pressure reactor apparatus and seed-bath reactor for biomass pretreatment. The lab is equipped with advanced equipment for production of biofuel and chemicals through fermentation Bioreactor (BF-3000) and water bath shaker for fermentation and incubation shakers. The lab is equipped with the following: fermentors with different capacities 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 capacities for material separation, HPLC, spectrometer (UV-VS), FTIR spectrometer (Spectrum 400), HP 5973 GC/MS coupled with CDS 7000 Printer, Francis CHNSO analyzer, Buchi Rotavapor, IKA Bomb Calorimeter, Karl Fisher ultrasonic system, freeze dryer, rheometer, CO2, supercritical carbon dioxide, 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 natural resource protection. The laboratory has a state-of-the-art Dionex DX-600 ion chromatograph for analyzing micro- and macro-nutrients from soil and water samples, a Hewlett Packard HP-5890 Series II gas chromatograph with electronic capture (ECD) and Flame ionization (FID) detectors for pesticide and hydrocarbon analysis, and a Shimadzu SCL 10 A VP high-performance liquid chromatograph with a photo diode array detector and fluorescence detector. The 900 GC wet laboratory includes a chemical fume hood, 0°C and 4°C storage, clean bench, pH and electrical conductivity probes, Brookfield viscometer, and 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 and piping testing. The facility includes a below-floor concrete channel and 50,000 L return-tank growth chamber. Storage and maintenance for extensive field research equipment includes 50+ solar-powered ISCO stream-flow monitors/water-quality samplers, two weather stations, 10+ rain gauges, soil sampling equipment and supplies, EM-38 electromagnetic induction soil conductivity sensor, and irrigation testing equipment and supplies.

Instrumentation and Control Laboratory
The instrumentation and control laboratory serves both research and teaching needs of the department. The laboratory has seven work stations fully equipped with general-purpose electronics and testing equipment. The equipment includes a variety of microcontroller boards, data-logging boards and software for student laboratory exercises and supports student team projects related to instrumentation and controls. Research equipment in the laboratory includes specialized instruments and equipment for spectral analysis, hyperspectral imaging, impedance measurement, digital and optical image processing, wireless communication and robotic design.

Watershed Monitoring Laboratory
This laboratory has six graduate-student-assigned modeling workstations, each equipped with powerful Windows-based computers, dual-screen monitors, server-based file storage and ESRI geographic information system site-license keys, a meeting table, and two student research computer workstations. Modelers routinely test and evaluate current releases and beta-versions of leading watershed modeling software (e.g., SWAT, AGNPS, RECGEM).

Machine Systems Laboratory
This laboratory is used for a variety of machinery systems activities including teaching, extension workshops and research. Space in the machinery systems laboratory is flexible allowing for research, lectures, labs and other activities requiring tabletop space workstations and hands-on learning. Areas are designated for specific training 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 electronics, tractors, utility vehicles and various precision 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.

Water Quality Laboratory
The 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 and ESRI geographic information system site-license keys, a meeting table, and two student research computer workstations. Modelers routinely test and evaluate current releases and beta-versions of leading watershed modeling software (e.g., SWAT, AGNPS, RECGEM).
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 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 life-long learning
- knowledge of contemporary issues
- ability to use the techniques, skills and modern engineering tools necessary for engineering practice

The agricultural technology management (ATM) undergraduate degree program is designed to prepare students for careers requiring the integration of science, engineering technology and business principles to manage human and natural resources and systems for producing, processing and marketing food and other biological materials. The BAE department recognizes technologically trained people must understand potential impacts of these technologies on the environment. As such, emphasis on both natural resource protection and environmental control of agricultural activities are vital parts of the ATM degree. The ATM undergraduate degree program is nationally recognized by the American Society of Agricultural and Biological Engineers and produces graduates equipped to manage people, machines and technology. This program is unique at Kansas State University and among higher education institutions in Kansas. The ATM program is annually assessed to meet criteria established by the Kansas Board of Regents. Desired student learning outcomes of the program include the following:

- ability to apply basic principles of mathematics, science, technology, management and economics to agricultural systems
- ability to plan and conduct experiments, and to analyze and interpret data
- ability to identify agricultural system problems, discover relevant information, develop and analyze possible alternatives, and formulate and implement solutions
- ability to apply economic principles, scientific principles and technologies, techniques and skills to manage agricultural systems
- ability to function within and contribute to multi-disciplinary teams
- ability to recognize and define agricultural systems problems and the impact of their proposed solutions in a global and societal context
- ability to communicate effectively
- ability to understand professional and ethical responsibilities and put them into practice
- recognition of the need for and an ability to engage in life-long learning
Graduate Report

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 are as follows:

Ph.D. students:
- Aguilar, Orlando (Panama): Measurement and Control of Greenhouse Gas Emissions from Beef Cattle Feedlots (Major Professor: Ronaldo Maghirang)
- Bonifacio, Henry (Philippines): Measurement of Air Pollutant Emission Rates from Beef Cattle Feedlots (Major Professor: Ronaldo Maghirang)
- Coronado, Marcelo (Panama): Biodiesel Quality Monitoring Using Vibrational Spectroscopy (Major Professor: Wenqiao Yuan)
- Cui, Yan (China): Cultivation and Harvesting of Microalgae for Biofuel Production (Major Professor: Wenqiao Yuan)
- Daggupati, Prasad (India): GIS Methods to Implement Sediment BMPs and Locate Ephemeral Gallies (Major Professor: Kyle Douglas-Mankin)
- Dvorak, Joseph (USA): Fluid Velocity Sensor (Major Professor: Naiqian Zhang)
- Gan, Jing (China): Hydrothermal Conversion of Lignocellulosic Biomass (Major Professor: Wenqiao Yuan)
- Gonzales, Howell (Philippines): Airflow Through and Dust Deposition on Vegetative Barriers (Major Professor: Ronaldo Maghirang)
- Guo, Li (China): Measurement and Control of Particulate Emissions from Cattle Feedlots in Kansas (Major Professor: Ronaldo Maghirang)
- Han, Wei (Canada): Three-Tier Wireless Sensor Network Infrastructure for Environmental Monitoring (Major Professor: Naiqian Zhang)
- Li, Ningbo (China): Protein-Based Adhesives from Renewable Resources (Major Professor: Donghai Wang)
- Lu, Hao (China): Glucose Synthesis via Artificial Photosynthesis (Major Professor: Wenqiao Yuan)
- Muche, Muluken (USA): Assessing the Impact of Military Maneuver Training on Watershed Hydrologic Function (Major Professor: Stacy Hutchinson)
- Peña, Leidy (Colombia): Functionalized Nanoparticles for Biomass Hydrolisis (Major Professor: Donghai Wang)
- Rahmani, Vahid (Iran): Understanding the Impact of Climate Variability in Kansas (Major Professor: Stacy Hutchinson)
- Sinnathamb, Sumathy (Sri Lanka): Ecological Impacts of Bioenergy Crop Production in the Midwest U.S. (Major Professor: Kyle Douglass-Mankin)
- Theeraratanaanon, Karnnalin (Thailand): Evaluation and Characterization of Pellleted Biomass from Selected Resources for Ethanol Production (Major Professor: Donghai Wang)
- Yan, Shuping (China): Effect of Sorghum Genotype, Germination, and Pretreatment on Bioethanol Yield and Fermentation (Major Professor: Donghai Wang)
- Zhang, Ke (China): Evaluation of the Potential of Big Bluestem for Biofuel Production (Major Professor: Donghai Wang)

Master of Science students:
- James, Arthur (Panama): The Effect of Biomass, Operating Conditions, and Gasifier Design on the Performance of an Updraft Biomass Gasifier (Major Professor: Wenqiao Yuan)
- Meeks, Jeremy (USA): Wind Erosion Potential from Off-Road Military Vehicle Activities (Major Professor: Ronaldo Maghirang)
- Sullivan, Justin (USA): Development of an Energy Gradient Profile for Irish Creek to Predict Sediment Load (Major Professor: Phil Barnes)
- Yan, Di (China): Hydrogen and Electricity from Microbial Fuel Cells (Major Professor: Wenqiao Yuan)
- Zhang, Ling (China): Organic Acids and DHA Production from Pentose (Major Professor: Wenqiao Yuan)

B.S./M.S. students:
- Archer, Allie (USA): The Need for Effective Engineering: A Look at the Factors Contributing to Globally Successful and Sustainable Solutions (Major Professor: Stacy Hutchinson)
- Bigham, Daniel (USA): Calibration and Testing of a Wireless Suspended Sediment Sensor (Major Professor: Naiqian Zhang)
- Borjes, Kelly (USA): Evaluation of Physicochemical Properties of Modified Algae Protein Adhesives (Major Professor: Donghai Wang)
- Hale, Kristen (USA): Adhesion Properties of Canola Protein (Major Professor: Donghai Wang)
- Handley, Katie (USA): Assessment and Prediction of Gully Erosion on Military Training Lands (Major Professor: Stacy Hutchinson)
- Kepley, Spencer (USA): Developing Niche Mobile Applications (Major Professor: Naiqian Zhang)
- Perkins, Seth (USA): Modeling Sweet Sorghum Bioenergy Crop Yields in the Southern Great Plains (Co-Major Professors: Kyle Douglass-Mankin [BAE], Richard Nelson [Chem Eng])
- Pugh, Ginger (USA): Developing Runoff Curve Numbers for Military Training Impacts (Major Professor: Stacy Hutchinson)
- Tolley, M. Katie (USA): Assessing the Performance of a Constructed Wetland System for Flu Gas Desulfurization Wastewater (Major Professor: Stacy Hutchinson)
- Ware, Brenton (USA): Permittivity Sensors for Measuring Air Contaminants (Major Professor: Naiqian Zhang)
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 workplace. Annually, approximately 20 percent of the students enrolled in BAE participate in these extracurricular design teams.

Robotic Team Competition

The Kansas State University BAE robotics team won its fifth consecutive national championship at the American Society of Agricultural and Biological Engineers (ASABE) international annual meeting August 7-10, 2011, in Louisville, Ky. This was their ninth top-three placing in the last 10 years of competition.

This competition encourages university student teams to create robotic solutions for a “Challenge with an Agricultural Flavor.” The 2011 challenge required the robots to accurately deposit a simulated herbicide around the edge of an irregular shaped field.

Fountain Wars Competition

The Kansas State University BAE fountain wars team won first place at the ASABE international meeting held in Louisville, Ky. This was their ninth top-three placing in the last 10 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 sophomore 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 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 2011. The team has won this competition eight out of the 14 years of the competition’s existence, and has finished within the top three in 12 out of 14 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. Annually, 15 to 20 students representing three degree programs and two colleges make up the BAE quarter-scale tractor team.

ASABE 2011 Annual International Meeting – Student Awards

- G.B. Gunlogson G. B. Gunlogson Student Environmental Design Competition: Fountain Wars Contest
  - Kansas State Fountain Wars Team – first place
- ASABE Robotics Competition
  - K-State EM&W (Every Machine A Wildcat) Team – first place
- Quarter-Scale Tractor Competition – first place
- Pharo of Alexandria Global Learning Award
  - Allie Archer, BAE BS/MS student from McPherson, Kan., was the first recipient of the Pharo of Alexandria Global Learning Award which recognized her academic achievements, research contributions and work experiences ahead. This award recognizes a student who has increased his or her understanding of other cultures’ needs in the quest to find sustainable solutions for improving the quality of life worldwide.

- 2011 AEM Trophy Awards:
  - Student Mechanization Branch Participation
    - K-State Agricultural Technology Management – first place
  - Student Engineering Branch Participation
    - K-State Student Branch – first place
  - Superior Paper Award
    - Karnnalin Theeraratmanoon (BAE Ph.D. student), Xiaorong Wu (BAE research assistant professor), and Donghai Wang (BAE professor), received a superior paper award. Other K-State co-authors were R. Madl, S. Steggenborg and J. Propher.
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.

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