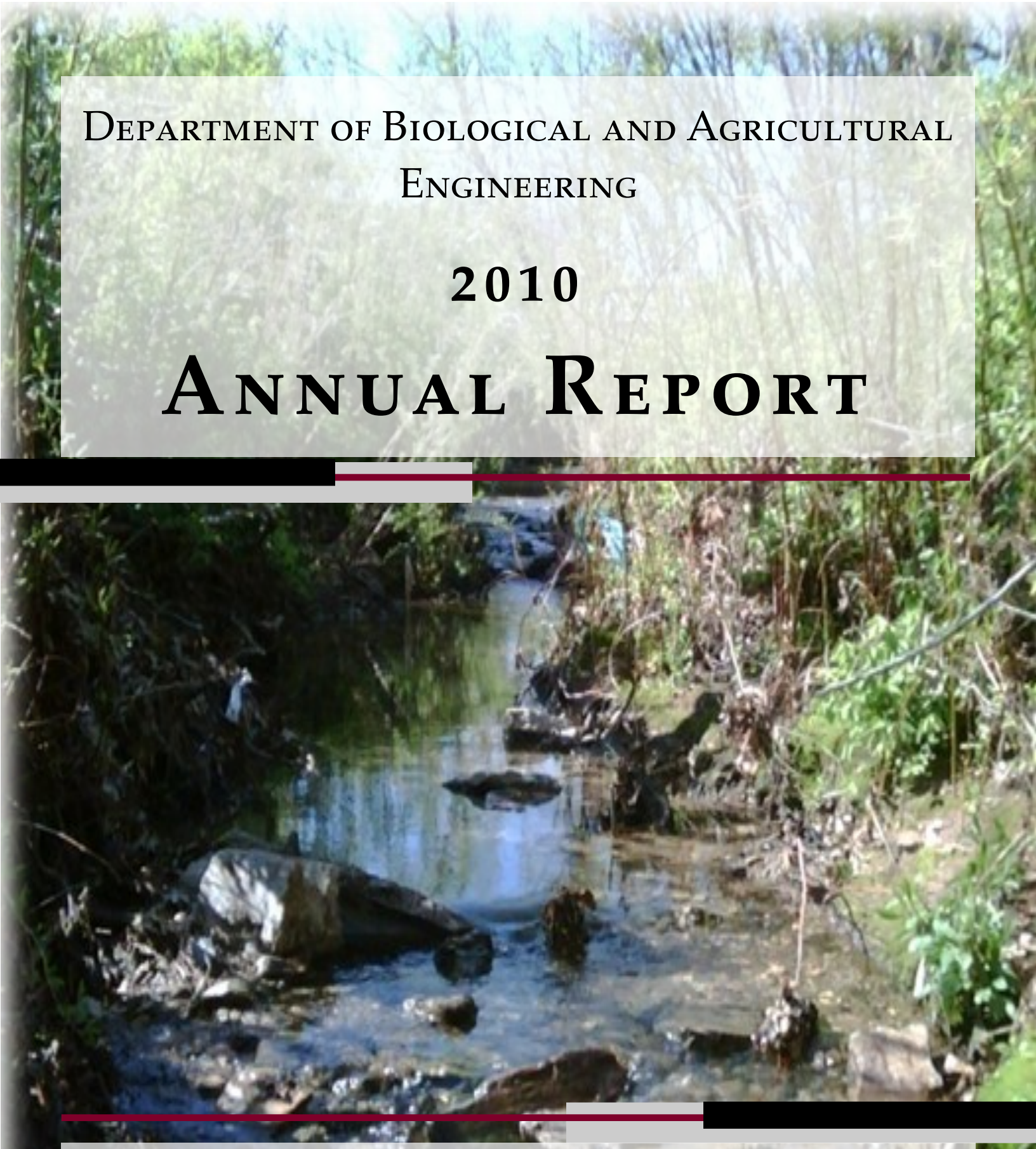
Department of Biological and Agricultural Engineering

2010

Annual Report



UofA
UNIVERSITY OF ARKANSAS
DIVISION OF AGRICULTURE

UNIVERSITY OF ARKANSAS

2010 Annual Report

Department of Biological and Agricultural Engineering

Lalit R. Verma
Department Head

University of Arkansas
Division of Agriculture
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Vice President for Agriculture

Arkansas Agricultural Experiment Station
Richard Roeder
Interim Associate Vice President for Agriculture Research

Cooperative Extension Service
Tony Windham
Associate Vice President for Agriculture Extension

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Dean

College of Engineering
Ashok Saxena
Dean

University of Arkansas
G. David Gearhart
Chancellor

Sharon Gaber
Vice Chancellor and Provost

Department of Biological & Agricultural Engineering

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Table of Contents

Foreword 1

Significant Accomplishments 3

Departmental Resources

Faculty 5
Professional and Administrative Staff 7
Teaching Faculty for Biomedical Engineering Program 8
Boards and Committees 9
Academy Members and Inductees 10
Financial Information 11
History, UA and BAEG Department 13
History, City of Fayetteville 14

Teaching Program

Undergraduate Program 15
Graduate Programs 19
Courses 25

Research Projects

Biomedical Engineering 30
Biotechnology Engineering 31
Ecological Engineering 36
Extension and Outreach Programs 40

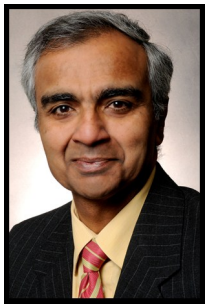
Grants 42

Publications

Books 48
Book Chapters 49
Refereed Articles 50
Invited Lectures 53
Other Lectures, Papers, and Oral Presentations 55
Patents 59

FOREWORD

FROM THE DEPARTMENT HEAD



It is wonderful to be back in the department after being in the role of Interim Dean of the Dale Bumpers College of Agricultural, Food and Life Sciences for the past two years. We have a very healthy group of students with our highest enrollments in some of our undergraduate and graduate classes. We have 100 undergraduates spread among sophomore to senior standings. There are 53 undergraduates enrolled this Fall in our Sophomore "Design Studio" class taught by Dr. Tom Costello, and 40 in the junior level "Properties" course of Dr. Julie Carrier. Our Department of Biological and Agricultural Engineering is truly unique as it resides in the UA Division of Agriculture and UA College of Engineering and Dale Bumpers College of Agricultural, Food and Life Sciences. Research and teaching faculty are on campus while our extension colleagues are in the state office of the UA Division of Agriculture's Cooperative Extension Service. We have experienced steady growth both in the quality and numbers of our students, and scholarly productivity of our dedicated faculty. Two of our senior student design teams were recognized nationally in June at the ASABE Annual Meeting in Pittsburgh.

Our research and extension programs address problems relevant to our stakeholders, not only dealing with food and agriculture, but also in sustaining ecological prosperity for a healthy planet. The ABET accredited undergraduate degree of Biological Engineering prepares students to design engineering solutions for real-world problems in Biological (living) Systems. Engineers trained to apply their expertise to various biological systems have exciting career paths and job opportunities in areas such as ecological stewardship, sustainability, food and agriculture, biotechnology, healthcare, bio-energy and bio-security.

Spring 2011 started with record enrolments in our classes, challenging us to accommodate students in lectures and multiple lab sections. We have five senior design teams engaged in challenging real-world problems under the guidance of their coordinator Dr. Tom Costello and other faculty mentors. Teams are also preparing for national competitions while completing the projects. Some of our students will participate in study-abroad in Belize. Students also participated in the recent Annual Conference of the Institute of Biological Engineering in Atlanta. Dr. Tom Costello was recognized in January with the John W. White Outstanding Faculty Teaching Award at the UA Division of Agriculture and Bumpers College Awards Ceremony.

Three outstanding alumni were inducted in the Arkansas Academy of Biological and Agricultural Engineering, and one of our alums was honored as a Distinguished Engineering Alumnus by UA College of Engineering. The Biological Engineering Senior Design Expo will be held on May 4 and we invite you to participate in the showcase of our seniors' year-long design efforts. We are pleased to learn of the promotion of Drs. Jin-Woo Kim and Brian Haggard to the rank of "Professor" effective July 1 for their outstanding and sustained contributions. The faculty will be engaged in a retreat on May 16-17 to refine our Biological Engineering curriculum with the impending plans for the start of a separate Biomedical Engineering undergraduate degree program in fall 2012. Dr. Carl Griffis has decided to retire this summer after 43 years of dedicated service to the University of Arkansas and this department. We all wish him and his family the very best. Please let us know how you can help us and do not hesitate to call (479-575-2351), e-mail (lverma@uark.edu) or if you are in the area, drop in for a visit. I would be delighted to meet with you.

Lalit R. Verma
Professor and Department Head

Significant Accomplishments in 2010

- Two University of Arkansas biological engineering senior design teams have placed in the top three in the ASABE Gunlogson National Student Design Competition. This is the third time in the last five years that UA teams have taken two of the top three spots in this national competition.

- Danielle Frechette, a senior in biological engineering, took third place in the same category for her poster, "Modification of Pathways with Pseudonomas for the Extraction and Subsequent Conversion of Algae to Butanol."

- Haibo Huang, M.S. Student in Biological Engineering (graduated in August 2009) under Dr. Yanbin Li, won the 1st place of ASABE 2010 Boyd-Scott Graduate Research Award - M.S. Competition, June 20-23, 2010, Pittsburgh, PA. His paper title is "Magnetic nanoparticles based magnetophoresis for efficient separation of foodborne pathogens". He also won the 1st place of AOCABFE 2010 Graduate Research Papers Competition, during ASABE International Annual meeting.

- Biomedical Engineering professor David Zaharoff was awarded a Transition Career Development Award by the National Cancer Institute to further his research on Interleukin-12, a powerful cytokine that shows great promise for therapeutic treatment of numerous types of cancer.

- Dr. Sreekala Bajwa was the mentor to a 2010 Honors grant recipient.

- Dr. Julie Carrier received a teaching grant, "Biobased Products and Bioenergy Multi University Graduate Program," from the USDA Higher Education Challenge (HEC) Grants Program.

- Scott Osborn won the BAE Outstanding Faculty Award for Teaching, 2010.

- Dr. Tom Costello won the BAE Outstanding Faculty Award for Service to Students, 2010

- Dr. Kaiming Ye won the BAE Outstanding Faculty Award for Research, 2010.

- Damira Kanayeva, Ph.D. student under Dr. Yanbin Li, won the Corporate Activities Program Student Travel Grant of ASM (American Society for Microbiology) 2010 Annual Meeting, May 23-27, 2010, San Diego, CA. Her presentation title is "Detection of Listeria monocytogenes using microfluidics and interdigitated microelectrode based impedance immunosensor coupled with magnetic nanoparticle-antibody conjugates". She also received the Certificate of Merit of Graduate Students Poster Competition at the AAFP 2010 Annual Meeting for the same poster presentation title.

- Jacob Lum, Master's student under Dr. Yanbin Li, won the 1st place of Graduate Students Poster Competition at AAFP 2010 Annual Meeting, September 28-29, Springdale, AR. His presentation title is "A more specific and sensitive detection method for avian influenza H5N1 using antibodies against N1 subtype and red blood cell amplification in an impedance biosensor."

- Dr. Otto Loewer received international recognition through a workshop he gave at the Science in Society Conference in Spain in November of 2010.

- Dr. Marty Matlock won the 2010 American Institute of Architecture (AIA) Education Honors Award and the 2010 Residential Architect Design Merit Award for his research "Porchscapes: An Affordable LEED for Neighborhood Development."

SIGNIFICANT ACCOMPLISHMENTS IN 2010

- Naresh Pai, graduate student under Dr. Dharmendra Saraswat, was chosen as the recipient of the 2010 Francis E. "Gene" Lortz Memorial Scholarship. This award is given to only one person in the "Post-graduate and Graduate Student" category by the Central Region of American Society for Photogrammetry and Remote Sensing. Naresh also won three awards for posters based on his dissertation and assigned research works. He won second place at the 47th Annual Meeting of Arkansas Section of the ASABE in Little Rock, first place at Cyberinfrastructure Days in Fayetteville, and first place at the 3rd Annual Graduate Student Symposium & Career Networking Event in Fayetteville. Naresh also was the Commnications Councilor for the American Society for Photogrammetry and Remote Sensing (ASPRS). During the year, his services included, moderating a technical session at 2010 ASPRS annual conference, maintaining and using blogs and web groups for disseminating student-specific news and opportunities , and organizing the first annual ASPRS student competition which encourages undergraduate and graduate students to provide solutions to a specific real-life problem using geographical information systems (GIS).

- Dr. David Zaharoff organized the first local chapter of the Biomedical Engineering Society (BMES). Over 40 students, both undergraduate and graduate, joined the chapter citing a desire to improve career opportunities and recognition for BME at the University. As an initial service project, Dr. Zaharoff, along with 6 BMES members sponsored ($1,000) and supported three Springdale elementary and middle school teams in the First Lego League robotics competition focusing on biomedical engineering. The teams successfully competed in a statewide competition in Mountain Home.

- Jingjing Zhao, a Master's student of Dr. Yanbin Li, received the Certificate of Merit of Graduate Students Poster Competition at AAFP 2010 Annual Meeting, September 28-29, Springdale, AR. Her presentation title is "Aptamer selection and aptamer-based SPR biosensor for detection of avian influenza virus."

Department Faculty

Sreekala G. Bajwa

Associate Professor
B.S. Ag.E. (1991) Kerala Agricultural University, India
M.S. Ag.E. (1993) Indian Institute of Technology, India
Ph.D.(2000) University of Illinois at Urbana-Champaign
Research Areas: Precision agricultural machinery and equipment, sensors, and controls, remote sensing for crop monitoring and soil characterization, GIS, GPS, and decision support systems.

D. Julie Carrier

Professor
B.S.(1984) McGill University, Canada
M.S. (1986) McGill University, Canada
Ph.D. (1992) McGill University, Canada
Research Areas: Effect of agricultural production systems on phytonutrient or "health beneficial compounds" with emphasis on drying and extraction of vegetable and medicinal plant crops.

Thomas A. Costello, P.E.

Associate Professor
B.S. Ag.E. (1980) University of Missouri
M.S. Ag.E. (1982) University of Missouri
Ph.D. (1986) Louisiana State University
Research Areas: Plot and field scale studies to quantify impacts of land application of animal manure on surface water quality; broiler litter management and its effects on air quality (for birds and workers), building energy consumption, bird performance and the final value of the litter as a fertilizer, energy conservation and environmental control in poultry houses.

Carl L. Griffis, P.E.

Professor
B.S. Ch.E. (1963) University of Arkansas
M.S. Ch.E. (1965) University of Arkansas
Ph.D. Engineering (1968) University of Arkansas
Research Areas: Applications of computers and microcircuitry for monitoring and control of biological processes in food processing, quality, and safety.

Brian E. Haggard

Associate Professor
B.S. Life Sciences (1994) University of Missouri
M.S. Environmental Soil & Water Science (1997) University of Arkansas
Ph.D. Biosystems Eng. (2000) Oklahoma State University
Research Areas: Ecological engineering including the evaluation of nitrogen, phosphorus, carbon and antibiotics transport and transformation through aquatic systems; the sorption and release of dissolved phosphorus to or from soils and sediments; the determination of factors limiting the growth of periphyton and phytoplankton in streams and reservoirs; and the use of aquatic and terrestrial ecosystems to provide wastewater treatment and nutrient retention.

Sha Jin

Assistant Professor
B.S. (1985) East China University of Science and Technology
M.S. (1988) East China University of Science and Technology
Ph.D. (1996) Kyushu Institute of Technology, Japan
Research Area: Molecular genetics and cell biology in disease prevention, control, and drug discovery; Nanosensor development; Vaccine development; Gene therapy

Jin-Woo Kim

Associate Professor
B.S. Ch.E. (1986) Seoul National University, Korea
B.S. Microbiology (1991) University of Iowa
M.S. Biology (1994) University of Wisconsin
Ph.D. Ag.E. (1998) Texas A&M University
Research Areas: Biotechnological/biochemical engineering, including process analysis and optimization, bioreactor design, biological remediation of environmental toxins, conversion of renewable biological wastes to high value products, and bio-catalytic potential microbes.

Yanbin Li, P.E.

Professor
B.S. Ag.E. (1978) Shenyang Agricultural University, China
M.S. Ag.E. (1985) University of Nebraska
Ph.D. Ag.E. (1989) Pennsylvania State University
Research Areas: Developing biosensors and engineering methods for food safety and sanitation, specifically, description of bacteria in poultry meat and processing water, and rapid detection of bacteria in food products.

Yi Liang

Assistant Professor, Extension
B.S. Ag. E. (1990) China Agricultural University, China
M.S. Ag. E. (1995) China Agricultural University, China
Ph.D. (2000). University of Alberta, Canada
Research Areas: Air quality and energy efficiency with confined animal feeding operations, quantification of emission and transportation of air pollutants, development and evaluation of emission prevention and control technologies.

Otto J. Loewer, P.E.

Professor
Director, University of Arkansas Economic Development Institute
ASABE Fellow
B.S. Ag.E. (1968) Louisiana State University
M.S. Ag.E. (1970) Louisiana State University
M.S. Ag. Econ (1980) Michigan State University
Ph.D. Ag.E. (1973) Purdue University
Research Areas: Computer simulation of biological systems; grain drying, handling, and storage systems.

Marty D. Matlock, P.E.

Professor
B.S. Soil Chemistry (1984) Oklahoma State University
M.S. Plant Physiology (1989) Oklahoma State University
Ph.D. Biosystems Engineering (1996) Oklahoma State University
Research Areas: Nonpoint source nutrient loading effects on water bodies and developing engineering design parameters for using constructed ecosystems as treatment systems.

G. Scott Osbron, P.E.

Associate Professor
B.S. Ag.E. (1984) University of Kentucky
M.S. Ag.E. (1987) University of Kentucky
Ph.D. Bio & Ag.E. (1994) North Carolina State University
Research Areas: Heat and mass transfer coupled with kinetics of biological systems and modeling of biological processes.
Application Areas: Control of rice fissuring through genetic manipulation, ecological engineering, oxygenation of wastewater and natural water bodies, biomechanics, food engineering, and biomedical engineering.

Departmental Resources

Faculty

Dharmendra Saraswat

Assistant Professor, Extension
B.S. Ag.E. (1988) Allahabad University, India
M.S. Ag.E. (1990) Indian Agricultural Research Institute, India
Ph.D.(2007) Ohio State University
Research Areas: GeoSpatial technologies (Geographic Positioning Systems, Geographic Information Systems, remote sensing and sensor technology) in agricultural settings, and simulation modeling for watershed management and production agriculture.

Samy Sadaka, P.E.

Assistant Professor, Extension
B.S. (1982) Alexandria University, Egypt
M.S. (1988) Alexandria University, Egypt
Ph.D. (1995) Dalhousie University, Nova Scotia, Canada and Alexandria University, Egypt
Research Areas: Gasification and fast pyrolysis of biomass; biorenewables resources; biofuels and biopower; fluidized beds; energy conservation.

Karl VanDevender, P.E.

Professor, Extension
B.S. Ag.E. (1985) Mississippi State University
M.S. Ag.E. (1987) Mississippi State University
Ph.D. Engineering (1992) University of Arkansas
Research Areas: Development and implementation of statewide Extension programs in livestock and poultry waste management, liquid and dry; develop curricula and training materials for educational programs in collection, storage, and land application of waste to prevent contamination of surface and groundwater; work with other UA personnel to develop and demonstrate manure storage, treatment, and utilization practices that address environmental, production, and economic considerations; develop and maintain positive working relationships with other government agencies and industries.

Lalit R. Verma, P.E., Department Head

Professor
Department Heat
B.Tech Ag.E. (1972) Agricultural University, India
M.S. Ag.E. (1973) Montana State University
Ph.D. Engineering (1976) University of Nebraska
Research Areas: Dr. Verma conducts the administration of the Department of Biological and Agricultural Engineering department, overseeing all components of the department including curriculum design, teaching, research, and extension.

Kaiming Ye

Associate Professor
B.S. Ch.E. (1985) East China University of Science and Technology
M.S. Ch.E. (1988) East China University of Science and Technology
Ph.D. Ch.E. (1991) East China University of Science and Technology
Research Areas: Stem cell engineering, high throughput screening platform for screening for breast cancer specific genes using siRNA library, Biosensing, and Bioimaging.

David A. Zaharoff

Assistant Professor
B.S. M.E. (1997) University of Illinois-Urbana/Champaign
Ph.D. B.M.E. (2002) Duke University
Research Areas: Development of novel, translatable vaccine and immunotherapy delivery platforms; cancer vaccines; bionanotechnology; controlled-release of antigens and cytokines; microparticle-based vaccines and immunotherapeutics; pathogen-mimicking nanoparticles; biomaterials; biopolymers; chitosan; translational research; drug delivery; bladder cancer; prostate cancer; breast cancer; tumor immunology; electromechanical manipulation of tumor microenvironments; mouse modeling of cancer; mammalian cell culture techniques; microscopy; and flow cytometry.

Departmental Resources

Professional and Administrative Staff

Julian Abram
Program Tech Lab Coordinator

Paul Algee
Technology Support Specialist

Holly Beason
Secretary II, Extension

Eric Cummings
Program Associate

Steve Green
Program Associate

Jeonshwan Kim
Post Doctoral Associate

Subodh Kulkarni
Program Associate, Extension

Linda Pate
Administrative Manager

Ju Seok Lee
Post Doctoral Associate

Jianhan Lin
Post Doctoral Associate

Betty Martin
Technical Assistant

Leslie Massey
Program Associate

John Murdoch
Program Technician

Will Nash
Administrative Specialist III

Lee Schrader
Program Technician

Jeffie thomas
Department Fiscal Manager

Amy Walker
Fiscal Support Specialist

Karen Withers
Administrative Office Supervisor, Extension

Ronghui Wang
Post Doctoral Associate

Departmental Resources

Teaching Faculty for the Biological Engineering Program

Professors:

Dr. Danielle Julie Carrier, Biological & Agricultural Engineering

Dr. Carl Griffis, Biological & Agricultural Engineering

Dr. Yanbin Li, Biological & Agricultural Engineering

Dr. Marty Matlock, Biological & Agricultural Engineering

Dr. Karl VanDevender, Biological &Agricultural Engineering

Dr. Lalit Verma, Biological & Agricultural Engineering

Associate Professors:

Dr. Sreekala Bajwa, Biological & Agricultural Engineering

Dr. Tom Costello, Biological & Agricultural Engineering

Dr. Brian Haggard, Biological & Agricultural Engineering

Dr. Jin-Woo Kim, Biological & Agricultural Engineering

Dr. Scott Osborn, Biological & Agricultural Engineering

Dr. Kaiming Ye, Biological & Agricultural Engineering

Assistant Professors:

Dr. Sha Jin, Biological & Agricultural Engineering

Dr. Samy Sadaka, Biological & Agricultural Engineering

Dr. Dharmendra Saraswat, Biological & Agricultural Engineering

Dr. David Zaharoff, Biological & Agricultural Engineering

Dr. Yi Liang, Biological & Agricultural Engineering

Teaching and Supporting Faculty for the M.S. Biomedical Engineering Program

Distinguished Professors:

Dr. Vasu Varadan, Electrical Engineering, Billingsly Chair

Dr. Vijay Varadan, Electrical Engineering

Professors:

Dr. Simon Ang, Electrical Engineering

Dr. Robert Beitle, Chemical Engineering

Dr. Edgar Clausen, Chemical Engineering

Dr. Russell Deaton, Computer Science Computer Engineering

Dr. Jeannine Durdik, College of Arts and Sciences

Dr. Magda El-Shenawee, Electrical Engineering

Dr. Ingrid Fritsch, Chemistry and Biochemistry

Dr. Panneer Selvam, Civil Engineering

Associate Professors:

Dr. Rick Couvillion, Mechanical Engineering

Dr. Ernie Heymsfield, Civil Engineering

Dr. Keith Roper, Chemical Engineering

Dr. Gal Shafirstein, UAMS

Dr. Steve Tung, Mechanical Engienering

Dr. Kaiming Ye, Biological Engineering

Dr. Vladimir Zharov, UAMS

Assistant Professors:

Dr. Christa Hestekin, Chemical Engineering

Dr. Sha Jin, Biological & Agricultural Engineering

Dr. Shannon Servoss, Chemical Engineering

Dr. David Zaharoff, Biological Engineering

BAEG Advisory Board

2009-2010 Members

Thomas M. Badger
UAMS

Virendra K. Bhumbla
Tyson Foods, Inc.

Lawrence E. Cornett
Department of Physiology and Biophysics

Fred G. Fowlkes
Entergy, Inc. (Retired)

Michael Freer
Tyson Foods, Inc.

Jeff Madden
Riceland Foods, Inc.

Ralph Mashburn

Stanley Mathis
USDA

Kyle McCann
Washington Regional Medical Center

J.L. Mehta
UAMS

James F. Moore
Riceland Foods, Inc.

Wesley Ritter
Halliburton

Gene Sullivan

Randy Young
Arkansas Soil and Water Conservation

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NRCS

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Drake McGruder
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Bob Morgan
Beaver Water District

Toni Peacock
BAEG Alumna

Christopher Pixley
BAEG Alumnus

Active Academy Members

David Anderson
B.S. ('70)

Stanley B. Andrews
B.S. ('90), M.S. ('93)
COE Young Alumni 2007

Pat Bass
B.S. ('76)

John L. Bocksnick
B.S. ('76), M.S. ('78)

David Beasley
B.S. ('71), M.S. ('73), Ph.D. ('77)

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M.S. ('51)
COE Distinguished Alumni 2005

Dennis K. Carman
B.S. ('73)

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B.S. ('71)

John J. Classen
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William L. Cooksey
B.S. ('79)

David "Gail" Cowart
B.S. ('60)

Steven D. Danforth
B.S. ('80)

Joe D. Faddis
B.S. ('67)

Michael W. Freer
B.S. ('85), M.S. ('88)

Alan D. Fortenberry
B.S. ('72), M.S. ('77)
COE Distinguished Alumni 2007

Fred G. Fowlkes
B.S. ('68), M.S. ('77)

Dennis R. Gardisser
B.S. ('79), M.S. ('81), Ph.D. ('92)

Carl L. Griffis
B.S. ('63), M.S. ('65), Ph.D. ('68)

Floyd R. Gunsaulis
B.S. (88), M.S. (90)
COE Young Alumni 2006

Kevin Henry
B.S. ('99)

Darrell Holmes
B.S. ('81)

John P. Hoskyn
B.S. ('60), M.S. ('64)

Michael D. Jones
B.S. ('67), M.S. ('68)

Dayna King-Cook
B.S. ('85), M.S. ('88)

John L. Langston
B.S. ('71), M.S. ('73)

Otto J. Loewer
B.S. ('68), M.S. ('70), Ph.D. ('73)

Jeffery D. Madden
B.S. ('88)

Ralph A. Mashburn
B.S. ('58)

Stanley A. Mathis
B.S. ('84)

Bruce Netherton
B.S. ('60)

Robert W. Newell
B.S. ('54)

Richard Penn
B.S. ('82), M.S. ('92)

Carl Peters
B.S. ('68), M.S. ('61)

Jonathan W. Pote
B.S. ('75), M.S. ('75), PhD ('79)

Stanley E. Reed
B.S. ('73)

Bill R. Ridgway
B.S. ('88)

David Wesley Ritter
B.S. ('79), M.S. ('81)

Richard M. Rorex
B.S. ('78), M.S. ('81)

Terry Siebenmorgen
B.S. ('79), M.S. ('81), Ph.D. ('84)

Michael D. Shook
B.S. ('82)

Eugene H. Snawder
B.S. ('69)

Freddie C. Stringer
B.S. ('70)

Albert E. "Gene" Sullivan
B.S. ('59)
COE Distinguished Alumni 200'7

Phil Tacker
B.S. ('79), M.S. ('82)

Karl VanDevender
B.S. ('87), M.S. ('87), PhD ('92)

Paul N. Walker
B.S. ('70), M.S. ('71), Ph.D. ('74)

William K. Warnock
B.S. ('72), M.S. ('75), Ph.D. ('77)

Bruce E. Westerman
B.S. ('90)
COE Young Alumni 2005

Robert W. White
B.S. ('72), M.S. ('76)

J. Randy Young
B.S. ('71), M.S. ('75)
COE Distinguished Alumni 2006

Honorary Academy Members

Harold S. Stanton
B.S. ('50), M.S. (53)

H. Franklin Waters
B.S. ('55) Posthumously

Albert H. Miller
Posthumously

2010 Academy Inductees

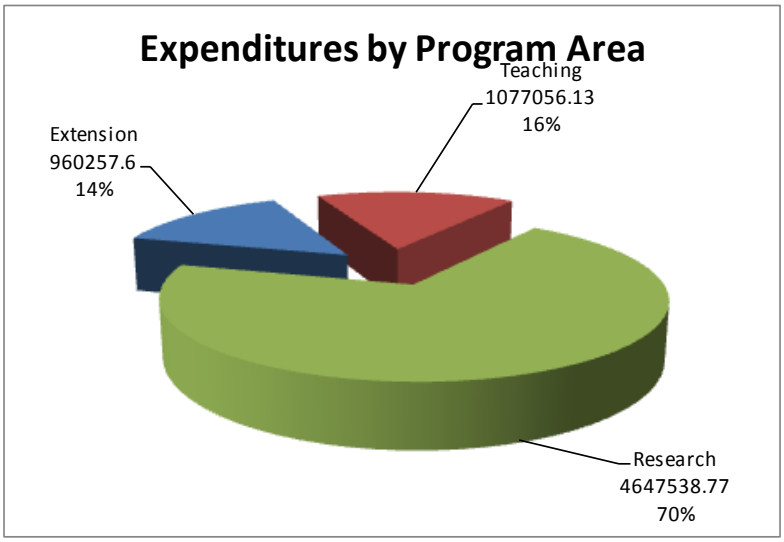
Randy Childress

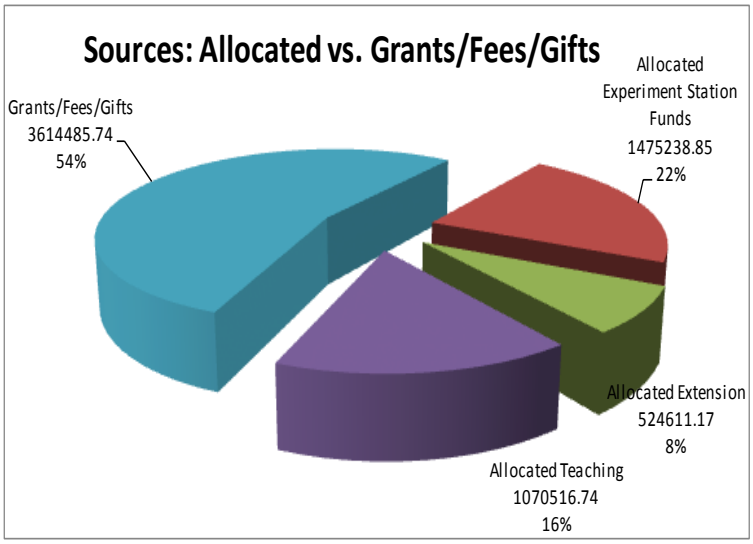
Howard.B. Austin

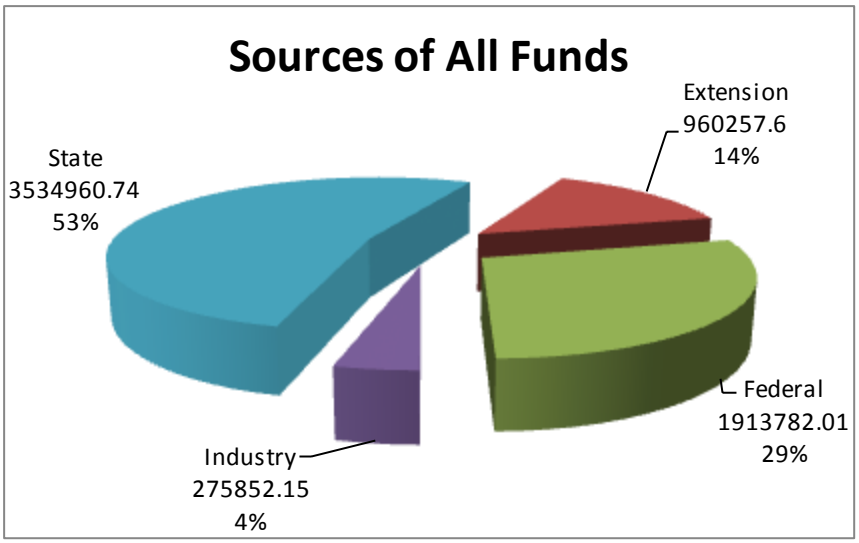
Departmental Resources

Financial Report

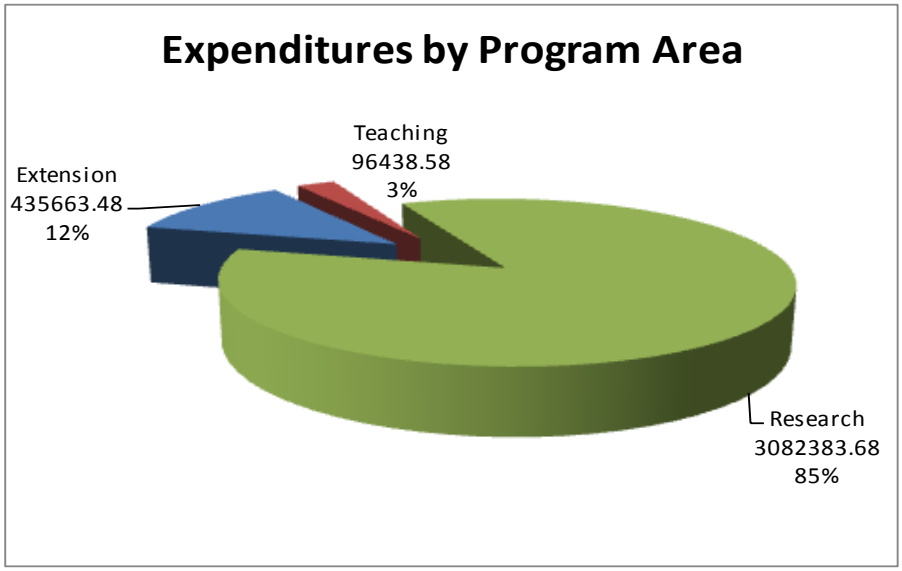
Total Expenditures, July 1, 2009 to June 30, 2010 - $6,684,853

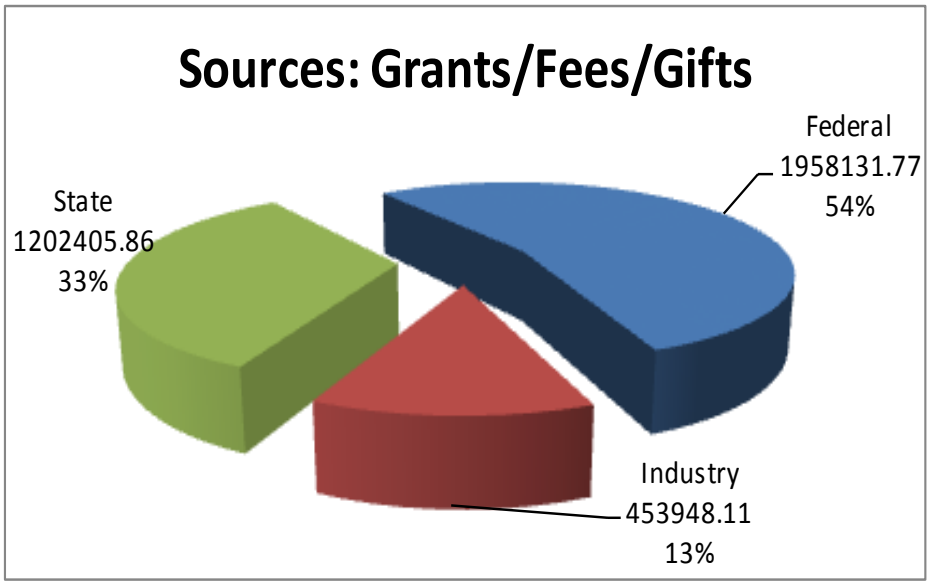






Grants/Fees/Gifts - $3,614,486





University of Arkansas

The University of Arkansas was founded in 1871 under the Morrill Land-Grant Colleges Act of 1862. Originally named Arkansas Industrial University, classes began in February of 1872.

Old Main was completed in 1875, and was the primary instructional and administrative building. The first class to graduate etched their names in the sidewalk in front of Old Main, starting Senior Walk and a tradition that is still going today.

The University of Arkansas became the first major Southern public university to admit African-American student without litigation when Silas Hunt of Texarkana, an African-American veteran of World War II, was admitted to the university's School of Law in 1948. Vitamin E was co-discovered by UA Agricultural Chemistry Professor Barnett Sure (1920-51). Sure, along with fellow professor Marinus C. Kik (1927-67), made major advances in nutrition science during their tenures at the university. Along with this discovery, Sure extended knowledge of how vitamin E, amino acids, and B-vitamins function on reproduction and lactation. Kik developed the process for parboiling rice to increase retention of vitamins and shorten cooking time. Kik also documented benefits of adding fish and chicken to rice and grain diets to provide adequate protein for a growing world population.

The university has many great traditions like Senior Walk. The *UA Alma Mater* was written in 1909 by Brodie Payne and was recognized in 1931 as one of the twenty-five best college songs by the University College Song Association in New York, and at the end of the song, students and alumni always point toward Old Main. The *Arkansas Fight Song* was written in the late 1920's and is still sung at every football game. The university received the Razorback mascot in 1909 during a speech by the current football coach, Hugo Bezdek, when he referred to the team as "a wild bang of Razorback hogs," and in 1910, the student body voted to change the mascot from the Cardinals to the Razorbacks. The "calling of the Hogs" began in the 1920's, when several local farmers attending a football game decided to try to help a lagging team and yelled "Woo, Pig Sooie!" The school colors are cardinal red and white.

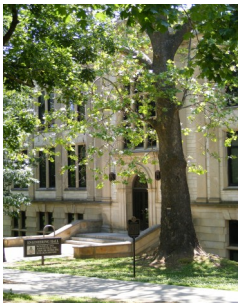
Department of Biological and Agricultural Engineering

In 1921, the University of Arkansas activated the Department of Agricultural Engineering to teach service courses and conduct applied research. The department was housed in Gray Hall, located where Mullins Library now stands. The department moved to the old campus infirmary, nicknamed "the old agriculture building" and now called the Agriculture Annex, in 1966, and finally to its current location in Engineering Hall in 1990 after a renovation of the building originally built in the early 1900's.

The first Bachelor of Science on Agricultural Engineering was conferred in 1950, with the first Master of Science in Agricultural Engineering following in 1952. The first Ph.D. degree was conferred in 1984.

To reflect the change in the Engineering field of study, the department's name was changed to Biological and Agricultural Engineering in 1988. In 1990, the B.S. and M.S. degrees were renamed to reflect the change in the curriculum and the new name of the department, and in 2002, were renamed again to Biological Engineering.

In 2003, the department received approval from the Arkansas Department of Higher Education to begin the M.S. in Biomedical Engineering program. This showed the department's continued goal of keeping up with the changes in the biological engineering research fields. The first M.S. in Biomedical Engineering was conferred in 2006.



The Biological and Agricultural Engineering Department is housed on the second floor of Engineering Hall. The main department office and all the faculty offices are located on the second floor. The department has use of two classrooms, two conference rooms, one computer lab, one student lab, and a study lounge. The department also has offices and labs at the Biological and Agricultural Lab, located on North Garland Avenue, and at the Engineering Research Center, located off South School Street.

Departmental Resources

History

City of Fayetteville and Northwest Arkansas

The City of Fayetteville recently ranked eighth in the Best Metro on Forbes Magazines "Best Places for Business and Careers," boasting a ranking of 12 and 16 for cost of doing business and job growth for 2007. Kiplinger's 2008 "Best Cities to Work, Live and Play" list featured Fayetteville as its number seven choice.

According to the 2010 census, Fayetteville has a population of 73,580 and is the third most populous city in Arkansas. It boasts a proud history, with several notable residents including authors Ellen Gilchrist (*In the Land of Dreamy Dreams*, 1981) and Donald Harrington (*The Cherry Pit*, 1965), Arkansas U.S. Senators J. William Fulbright and David Pryor, poet Miller Williams and his Grammy Award-winning songwriter daughter Lucinda, and noted architect E. Fay Jones.

The city of Fayetteville has many highlights, including the town square, where a farmer's market is held from April through November. Dickson Street is a main thoroughfare leading to the University of

Arkansas and is lined with shops and restaurants. The Walton Arts Center is a professional performing arts center and hosts many national and international fine art events throughout the year.

Many industry giants consider Northwest Arkansas home. Bentonville based Wal-Mart, is the world's largest public corporation by revenue, according to the 2008 Fortune Global 500. Founded by Sam M. Walton in 1962, it is the largest private employer in the world and the fourth largest utility or commercial employer. Lowell is the home for J.B. Hunt Transport Services, Inc., one of the largest truckload transportation companies in the United States, with annual revenues of over $2 billion. Tyson Foods, Inc. is based out of Springdale and is the world's largest processor and marketer of chicken, beef, and pork. With 2005 sales of $26 billion, Tyson Foods is the second-largest food production company in the Fortune 500, the largest meat producer in the world, and according to Forbes one of the 100 largest companies in the United States.

FOREWORD

Biological Engineers improve people's lives today and help assure a sustainable quality of life for tomorrow. They create solutions to problems by coupling living systems (human, plant, animal, environmental, food, and microbial) with the tools of engineering and biotechnology. Biological engineers improve human health through biomedical engineering; ensure a safe, nutritious food supply and create critical new medications through biotechnology engineering; secure a health, safe environment through ecological engineering. A bachelor or science in biological engineering is excellent preparation for medical school.

Biological engineering is an ABET accredited program leading to a B.S. degree, M.S. degree, or Ph.D. degree offered through the department. The curriculum is under joint supervision of the dean of the College of Engineering and the dean of the Dale Bumpers College of Agricultural, Food and Life Sciences. The Bachelor of Science in Biological Engineering degree is conferred by the College of Engineering and is granted after the successful completion of 128 hours of approved course work.

The educational objectives of the Biological Engineering program are to produce graduates who:

- *Effectively apply engineering to biological systems and phenomena (plant, animal, human, microbial, and ecosystem) with demonstrated proficiency in basic professional and personal skills.*

- *Are well prepared for diverse careers in biological engineering, life-long learning, and professional and ethical contributions to society through sustained accomplishments in biomedical engineering, ecological and biotechnology.*

AREAS OF TECHNICAL EMPHASIS

The three areas of technical emphasis in biological engineering are as follows:

BIOMEDICAL ENGINEERING

This emphasis focuses on nanomedicine, tissue engineering, organ regeneration and its clinical application, bioinstrumentation, biosensing/medical imaging, medical electronics, physiological modeling, biomechanics, and rehabilitation engineering. This area provides exceptional preparation for medical, veterinary, or dental school as well as for graduate programs in biomedical engineering.

BIOTECHNOLOGY ENGINEERING

This emphasis entails biotechnology at the micro and nano scale, food processing, food safety and security, development of new products from biomaterials, and biotransformation to synthesize industrial and pharmaceutical products.

ECOLOGICAL ENGINEERING

The integration of ecological principles into the design of sustainable systems for treatment, remediation, and prevention of pollution to the environment are key components of this area of emphasis. Stream restoration, watershed management, water and wastewater treatment design, ecological services management, urban greenway design, and enclosed ecosystem design are several applications used in this emphasis.

Each student is required to complete eighteen semester hours of approved electives in his or her area of concentration. Six hours must be from the biological engineering design elective courses (listed below) from a single area of concentration. The remaining twelve hours are classified as technical electives and consist mainly of upper-level courses in engineering, mathematics, and the sciences as approved by the student's advisor. The selected technical electives must include at least six hours of upper-level engineering courses, either within BENG or from other engineering departments. The department maintains a list of approved electives.

The areas of technical concentration and the recommended elective courses for each are listed beginning on page sixteen.

For more information, visit the website at http://www.baeg.uark.edu or contact the Department of Biological and Agricultural Engineering office at (479) 575-2351.

Teaching Program

Undergraduate Program

Biological Engineering Curriculum

2010-2011 Course Catalog

The following is a list of courses required for the Bachelor of Science in Biological Engineering degree and a suggested course sequence. Some courses are not offered every semester, so students who deviate from the suggested sequence must pay close attention to course offerings each semester and the required pre-requisites for courses. Students are strongly encouraged to meet with their advisors on a regular basis.

Students with a Pre-medical focus area must see a faculty advisor for alternate scheduling and elective course requirements.

Freshman Year

First Semester

ENGL 1013	Composition I
CHEM 1103	University Chemistry I
GNEG 1111	Introduction to Engineering I
MATH 2554	Calculus I
PHYS 2054	University Physics I

Total of 15 Semester Hours

Second Semester

ENGL 1023	Composition II
GNEG 1121	Introduction to Engineering II
HIST 2003, 2013 or PLSC 2003 *(choose one)*	
MATH 2564	Calculus II
Freshman Engineering Science Elective	

Total of 15 Semester Hours

Sophomore Year

First Semester

BENG 2612	Biological Engineering Design Studio II
CHEM 3603/3601L	Organic Chemistry I and Lab
GNEG 1122	Introduction to CAD
MATH 2574	Calculus III
Science Elective	

Total of 16 Semester Hours

Second Semester

BIOL 2013/2011L	General Microbiology and Lab
BENG 2622	Biological Engineering Design Studio III
CHEM 3613/3611L	Organic Chemistry II and Lab
MATH 3404	Differential Equations
MEEG 2003	Statics

Total of 17 Semester Hours

Junior Year

First Semester

BENG 3712	Engineering Properties of Biological Materials
CHEM 3813	Introduction to Biochemistry
MEEG 3013	Mechanics of Materials
3 Hour Technical Elective *(see advisor)*	
Choose One:	
CHEG 2313	Thermodynamics of Single Component Systems
MEEG 2403	Thermodynamics
Choose One:	
CHEG 2133	Fluid Mechanics
CVEG 3213	Hydraulics
MEEG 3503	Mechanics of Fluids

Total of 17 Semester Hours

Second Semester

BENG 3723	Unit Operations in Biological Engineering
BENG 3803	Mechanical Design in Biological Engineering
BENG 3104	Instrumentation in Biological Engineering

BENG Design Elective *(see advisor)*
Humanities/Social Science Elective *(see advisor)*

Total of 16 Semester Hours

Senior Year

First Semester

BENG 4813	Senior Biological Engineering Design I
BENG 3733	Transport Phenomena in Biological Systems

BENG Design Elective *(see advisor)*
3 Hour Technical Elective *(see advisor)*
6 Humanities/Social Science Elective *(see advisor)*

Total of 18 Semester Hours

Second Semester

BENG 4822	Senior Biological Engineering Design II

6 Hours of Humanities/Social Science Elective *(see advisor)*
6 Hours of Technical Elective *(see advisor)*

Total of 14 Semester Hours

128 Total Hours Required

AREAS OF TECHNICAL EMPHASIS

The Biological Engineering curriculum has a choice of three areas of technical emphasis for students. The areas of technical emphasis and the recommended elective courses for each emphasis are listed below. This list contains courses required for the Bachelor of Science in Biological Engineering degree and a suggested course sequence. Some courses are not offered every semester, so students who deviate from the suggested sequence must pay close attention to course offerings each semester and the required pre-requisites for courses. Students are strongly encouraged to meet with their advisors on a regular basis.

BIOMEDICAL ENGINEERING/PRE-MEDICAL

DESIGN ELECTIVES

BENG 3213	Biomedical Engineering: Emerging Methods & Applications*
BENG 4203	Biomedical Engineering Principles*

TECHNICAL ELECTIVES

BENG 4113	Risk Analysis for Biological Systems
BENG 4123	Biosensors and Bioinstrumentation
BENG 4233	Tissue Engineering
BENG 4243	Biomaterials
BENG 451VH	Honors Thesis
BIOL 4233	Genomics and Bioinformatics
ELEG 2904	Digital Design
HESC 3204	Nutrition for Health Professionals and Educators
KINS 3353	Mechanics of Human Movement

CHOOSE ONE:

BIOL 2404	Comparative Vertebrate Morphology*
BIOL 2443/2441L	Human Anatomy*

CHOOSE ONE:

BIOL 4234	Comparative Physiology
BIOL 2443/2441L	Human Physiology

*Students in the Pre-Medical Concentration **must** see a faculty advisor for alternate scheduling and elective course requirements. Pre-Medical students must take CHEM 3613/3611L (Organic Chemistry I) and CHEM 3603/3601L (Organic Chemistry II). This requires special scheduling of courses beginning in the first semester of the Sophomore year. Consultation with faculty advisors are greatly encouraged.*

* Elective course strongly recommended by the faculty for a particular area of emphasis.

BIOTECHNOLOGY ENGINEERING

DESIGN ELECTIVES

BENG 4123	Biosensors and Bioinstrumentation
BENG 4703	Biotechnology Engineering

TECHNICAL ELECTIVES

BENG 4113	Risk Analysis for Biological Systems
BENG 4233	Tissue Engineering
BENG 4243	Biomaterials
BENG 451VH	Honors Thesis
BIOL 4233	Microbial Genetics
BIOL 4313	Molecular Cell Biology
CHEG 3153	Non-equilibrium Mass Transfer
CHEG 4423	Automatic Process Control
CHEM 3453/3451L	Elements of Physical Chemistry
FDSC 3103	Principles of Food Processing
FDSC 4124	Food Microbiology
FDSC 4304	Food Chemistry
HESC 3204	Nutrition for Health Professionals and Educators
MEEG 4413	Heat Transfer

ECOLOGICAL ENGINEERING

DESIGN ELECTIVES

BENG 4903	Watershed Eco-Hydrology
BENG 4923	Ecological Engineering Design

TECHNICAL ELECTIVES

BENG 4113	Risk Analysis for Biological Systems
BENG 451VH	Honors Thesis
BENG 4133	Digital Remote Sensing and GIS
BENG 4803	Precision Agriculture
BIOL 3863/3861L	General Ecology
CVEG 3223	Hydrology
CVEG 3243	Environmental Engineering
CVEG 4243	Environmental Engineering Design
CSES 2203	Soil Science
CSES 4043	Environmental Impact and Fate of Pesti cides
ENSC 4043	Analysis of Environmental Contaminants

Teaching Program

Undergraduate Program

Graduates for 2010:

Bachelor of Science in Biological Engineering

Nicholas Blazic
Zach Callaway
Joseph Chidiac
Evan Childress
Tai-When Chou
Alvaro Claure
Danielle Frechette
Yamama Hafeez
Nathan Holeman
Braendon Kelly
Haley Malle
Caroline Powell
Katherine Rutledge
Will Scott
Jacob Taylor
Kaitlyn Terrell
Clark Trapp
Casey Vickerson
Jeff Welch

Biological Engineering Student Club

2010-2011 Officers

Danielle Frechette
President

Nick Blazic
Vice President

Evan Childress
Service Chair

Zach Callaway
Treasurer

Kris Bunnell
Community Service Chair

Jeff Welch
Secretary

Tanushree Thote
Student Faculty Correspondent

Advisors: Dr. Carl L. Griffis and Dr. Lalit R. Verma

Ecological Engineering Student Club

2010-2011 Officers

Katy Rutledge
President

Nathan Holeman
Vice President

Evan Childress
Secretary

Jacob Taylor
Treasurer

Clark Trapp
Program Chair

Advisors: Dr. Marty Matlock

Biomedical Engineering Student Club

2010-2011 Officers

Clark Trapp
President

Abby Washispack
Vice President

Danielle Frechette
Secretary

Jimmy Vo
Treasurer

Dr. David Zaharoff
Adviser

Scholarship Recipients for 2010

Arkansas Academy of Biological & Agricultureal Engineering Scholarship

Shiloh Aubrey Hurd
Chris Muchael McDaniel

Biological & Agricultural Engineering Departmental Scholarship

Paige Joetta Heller

Billy Bryan Scholarship

Kelly Holmes-Smith
Tai-Wen Debby Chou
Yamama Hafeez

Xzin McNeal Scholarship

Kelly Holmes-Smith
Amy Jaclynn Powless
Joseph Roland Chidiac
Tai-Wen Debby Chou
James Breandon Kelly
Nick Darren Blazic
Danielle Margot Frechette
William Meredith Ryan

J.A. Riggs Tractor Company Scholarship

Samantha Grace Puckett

Master of Science in Biological Engineering

Foreword

The Department of Biological and Agricultural Engineering desires that each graduate student receives a broad and comprehensive educational experience. This experience includes social as well as intellectual development to lead students to an increased level of maturity. Certainly, coursework is primary, but social activities—the exploration of the unknown and the exchange of ideas with fellow students and faculty—are also part of the total educational experience.

An additional part of this development process occurs through service to others. Students are encouraged to become involved in all departmental functions including teaching, research, extension, and social activities so that they may obtain the best possible education.

The core of graduate education lies in obtaining technical expertise in an area of specialization. Specifically, the objectives of the Master's and PhD engineering graduate program are for students to:

- Develop the ability to comprehend and apply engineering principles in order to solve problems in research, development and design.
- Obtain sufficient understanding of the mathematical, physical and biological sciences for comprehension of literature in these and related fields.
- Acquire the skills required to use appropriate equipment, including instruments and computers, in solving problems in their areas of interest.
- Achieve the technical competence necessary to teach college-level courses and conduct an adult education program (such as in Cooperative Extension).

In the attainment of the above objectives, graduate students will combine biological or biomedical engineering courses with other engineering fields, the physical sciences, mathematics, statistics and the biological sciences in developing their program of study. The advanced degrees are primarily research degrees awarded for significant creative research or design accomplishment, and not for the completion of a specified number of courses. Therefore, a student's program concentration is on a significant thesis or dissertation problem completed under the supervision of members of the graduate faculty. This complements a program of strong course support to properly address the thesis or dissertation problem.

Admission Requirements

Admission to the M.S.B.E. program is a three-step process. First, the prospective student must be granted admission to the University of Arkansas Graduate School. Second, the prospective student must be accepted into the department's program which depends on transcripts, recommendations, a statement of purpose, and the following additional requirements:

- A cumulative GPA in the last sixty hours of course work of 3.0.
- A cumulative GRE score of 1100 or higher (verbal and quantitative combined).
- A TOEFL score of at least 550 (paper-based), 213 (computer-based), or 80 (internet-based). This requirement is waived for applicants whose native language is English or earned a bachelor's or master's degree from a U.S. institution.
- An eligible member of the faculty (graduate status of group II or higher) must agree to serve as the major advisor to the prospective student.

Third, the prospective student will only be admitted to the M.S. program provided engineering competence can be demonstrated by satisfying one of the following criteria:

- Receipt of a B.S. degree in engineering from a program accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET) or equivalent.
- Completion of 18 hours of additional undergraduate course work (deficiency courses) in addition to the Master's program requirements (additional hours may be required for course pre-requisites).

More detail on admission requirements may be found at http://catalogofstudies.uark.edu/.

Teaching Program

Graduate Program

Master of Science in Biomedical Engineering

Foreward

The Master of Science in Biomedical Engineering is a multidisciplinary degree program designed for students from a multitude of academic areas. The objectives of the M.S.B.M.E. program are to prepare graduates for careers in biomedical engineering practice with government agencies, engineering firms, or industries and to provide a foundation for continued study at the past-masters level. This program focuses on Bioimaging and Biosensing; Bioinformatics and Computational Biology; Tissue Engineering and Biomaterials; and Bio-MEMS/ Nanotechnology.

Admission Requirements

In general, admission to the Biomedical Engineering Graduate Program is a multiple-step process. First, the prospective student must be admitted to graduate standing by the University of Arkansas Graduate School. Second, the student must be accepted into the Biomedical Engineering Program, which depends on transcripts, recommendations, a statement of purpose, and the following GPA and test scores.

Basic Requirements

Engineering Academic Background: The admission requirements for students with an ABET-accredited BS degree in engineering are: a minimum GRE of 1100 and a GPA of 3.0 or greater.

Non-Engineering Academic Background: Students with a BS or MS degree in a non-engineering background can also pursue the MS in Biomedical Engineering. The admission requirements are: a minimum GRE of 1100 and a GPA of 3.0 or greater. In addition, these students will be required to complete these courses prior to enrollment in the program or before the end of year one at UA:

Calculus I
Calculus II
Ordinary Differential Equations
General Chemistry
University Physics I

The Student's Graduate Committee will make a recommendation on the Plan of Study.

Finally, a member of the faculty who is eligible (graduate status of group II or higher) must agree to serve as a major advisor to the prospective student.

Details concerning admission for both international and domestic students are provided in the UA Graduate School Handbook.

Doctor of Philosophy In Biological Engineering

Admission Requirements

In addition to the requirements of the University of Arkansas Graduate School, admission to the departmental aspect of the PhD program depends strongly on the judgment of the individual professor who will serve as the graduate advisor. The minimal admission criteria are as follows:

- A GRE score of 1100 or above (verbal and quantitative).
- A TOEFL score of at least 550 (paper-based), 213 (computer-based), or 80 (internet-based). This requirement is waived for applicants whose native language is English or who earn a bachelor's or master's degree from a U.S. institution.
- A member of the faculty who is eligible (graduate status of group II or higher) must agree to serve as major advisor to the prospective student.
- A Master of Science degree in Engineering with a thesis.

Prospective PhD students may decide to go directly from a bachelor's degree to the PhD program if the following criteria are met:

- A cumulative GPA in the last sixty hours of 3.5.
- A minimum GRE score of 1200.
- A Bachelor of Science in Engineering from an ABET accredited program.

Students with a non-engineering B.S. degree may be considered for conditional admissions into the Ph.D. program provided they meet the criteria outlined below. Otherwise, they need to start an M.S. program first. The Departmental Graduate Committee will make a specific recommendation to the Department Head.

Conditional admission criteria: The following are the minimum criteria for the conditional admission to PhD program for students with non-engineering B.S. degree:

- GPA: 3.50 or higher for the baccalaureate degree
- GRE Scores: 1300 (Quantitative + Verbal) with 700 or higher in Quantitative; 5 or higher in
- Writing.
- TOEFL: 580 (or equivalent) or higher (for international applicants only)
- Students must earn credit for the following 18 hours of coursework including credit for all prerequisites listed in the undergraduate catalog:

A minimum of 15 credit hours of 2000 level or above of engineering courses (with course prefix BENG, CHEG, CVEG, CENG, ELEG, INEG, or MEEG) currently allowed for credit within the BENG undergraduate program.

Teaching Program

Graduate Program

Doctor of Philosophy In Biological Engineering

Minimum of 3 credit hours of 3000 level or above of BENG engineering ***design*** courses currently allowed for credit within the BENG undergraduate program.

Specific deficit courses are to be determined in consultation with the student's major advisor and advisory committee. Additional deficiency courses may be required for students with insufficient coursework in a critical area (such as life sciences).

Upon completion of the required conditions, the conditional status will be removed and the students will be fully admitted to the BAEG PhD program.

More detail on admission requirements may be found at http://catalogofstudies.uark.edu/.

Graduate Students

The following students were part of the Graduate program during 2010. Several students cannot be listed due to limitations of the Family Educational Rights and Privacy Act (FERPA). Faculty advisors provided support and planning to the students throughout their career in the Department of Biological and Agricultural Engineering.

Master of Science in Biological Engineering

Student	*Advisor*
Prathamesh Bandekar	Dr. Sreekala Bajwa
Hua Bai	Dr. Yanbin Li
Bryan Bailey	Dr. Brian Haggard
Angele Djioleu	Dr. Julie Carrier
Jacop Post	Dr. Sreekala Bajwa
Gurdeep Singh	Dr. Dharmendra Saraswat

Master of Science in Environmental Engineering

Student	*Advisor*
Ryan Johnston	Dr. Marty Matlcok
Amber Brown	Dr. Marty Matlock

Master of Science in Biomedical Engineering

Student	*Advisor*
Luke Brockman	Dr. Sha Jin
Jonathan Earls	Dr. Kaiming Ye
Andreas Haukas	Dr. Kaiming Ye
Yarina Masniuk	Dr. Kaiming Ye
Michael May	Dr. Christa Hestekin
Sruthi Ravindranathan	Dr. Sha Jin
Pratyush Rai	Dr. Vijay Varadan
Alex Ziegler	Dr. Sreekala Bajwa

Doctor of Philosophy in Biological Engineering

Student	*Advisor*
Chris Bunnel	Dr. Julie Carrier
Kate Herzog	Dr. Marty Matlock
John Judkins	Dr. Jin-Woo Kim
Nalinikanth Kotagiri	Dr. Jin-Woo Kim
Bhanu prashanth Koppolu	Dr. David Zaharoff
Chuan Lau	Dr. Julie Carrier
Mansoor Leh	Dr. Sreekala Bajwa
Naresh Pai	Dr. Dharmendra Saraswat
Mahmoud Sharara	Dr. Samy Sadaka
Weiwei Wang	Dr. Kaiming Ye
Huantong Yao	Dr. Sha Jin
Lu Zhang	Dr. Kaiming Ye

Teaching Program

Graduate Programs

Graduate Student Advisees in Other Areas

The following students are participating in other programs across the university with a member of the department's faculty serving in an advising role. Several students cannot be listed due to limitations of the Family Educational Rights and Privacy Act (FERPA).

Student	*Program*	*Advisor*
Mica Doubledee	MSPlant Pathology	Dr. Sreekala Bajwa
JianJun Du	PhD Chemical Engineering	Dr. Julie Carrier
Andrew Warren	MS Civil Engineering	Dr. Tom Costello
Chris Rogers	MS Environmental Soil and Water Science	Dr. Brian Haggard
John Michael Fohner	MS Environmental Soil and Water Science	Dr. Brian Haggard
Colin Reinhardt	MSGeology	Dr. Brian Haggard
Erin Grantz	MS Environmental Soil and Water Science	Dr. Brian Haggard
Katherine McCoy	MS Civil Engineering	Dr. Brain Haggard
Shrijeeta Ganguly	PhD Biology	Dr. Brian Haggard
Ryan Haley	PhD Cell and Molecular Biology	Dr. Jin-Woo Kim
Hengyu Wang	PhD Mechanical Engineering	Dr. Jin-Woo Kim
Neha Tiwari	PhD Cell and Molecular Biology	Dr. Jin-Woo Kim
Jacob Hohnbaum	MS Mechanical Engineering	Dr. Jin-Woo Kim
Baliji Srinivasan	PhD Mechanical Engineering	Dr. Yanbin Li
Feng Chen	PhD Chemical Engineering	Dr. Yanbin Li
Jacob Lum	PhD Cell and Molecular Biology	Dr. Yanbin Li
Jingjing Zhao	MS Cell and Molecular Biology	Dr. Yanbin Li
Leisha Vance	PhD Environmental Dynamics	Dr. Marty Matlock
Jason Davis	MS Agriculture and Extension Education	Dr. Samy Sadaka
Eric Krueger	PhD Physics	Dr. Kaiming Ye
Brenda Flack	PhD Cell and Molecular Biology	Dr. Kaiming Ye
Siddhant Ramaswamy	PhD Electrical Engineering	Dr. Kaiming Ye
Jeong Yoon Lee	PhD Cell and Molecular Biology	Dr. Kaiming Ye
Stuart Brune	PhD Chemical Engineering	Dr. Kaiming Ye
Zhuxin Dong	PhD Mechanical Engineering	Dr. Kaiming Ye
Liang Huang	PhD Electrical Engineering	Dr. Kaiming Ye
Siva Naga Sandeep	MS Mechanical Engineering	Dr. Kaiming Ye
Ahmed Hassan	PhD Electrical Engineering	Dr. David Zaharoff
Geetika Bajpai	PhD Cell and Molecular Biology	Dr. David Zaharoff
Geoff Keeler	PhD Cell and Molecular Biology	Dr. David Zaharofff

Graduate Degrees Earned

The following students completed all requirements for their degree program and were awarded a degree from the University of Arkansas.

John Judkins
M.S.., Biomedical Engineering
Dr. Jin-Woo Kim
Dissertation:" Carbon Nanotube Diffusion Under Simulated Physiological Conditions"

Jeong-Hwan Kim
Ph.D., Biological Engineering
Dr. Jin-Woo Kim
Dissertation:" Development of Valence-Directed Nanoparticle Building Blocks on the Basis of Controlled Bio/Nano-Interfacing Chemistry"

Mahmoud Sharara
M.S. Biological Engineering
Dr. Samy Sadaka
Dissertation: "Biodrying-Gasification of Dairy Manure-Wheat Straw Mixture"

Rusty Tate
M.S. Environmental Engineering
Dr. Marty Matlock
Dissertation: "Evaluation and Comparison of Stomrwater Models for Hybridized Low-Impact Development Design"

Jithesh Veetil
Ph.D. Biological Engineering
Dr. Kaiming Ye
Dissertation: "Fluorescent Molecular Probes For Quantitative Biomolecular Detection and Cellular Imaging"

Feiya Zhao
M.S. Biological Engineering
Dr. Yi Liang
Dissertation: "Broiler House Ammonia Emission Monitoring: Spatio– Temporal Dynamics

The following courses are taught as part of the Biological and Agricultural Engineering curriculum for the Undergraduate, Master's, and Ph.D. programs.

BENG1012 Biological Engineering Design Fundamentals
Introduction to the profession of Biological Engineering including a definition, and demonstration through field trips, guest speakers, examples of job opportunities and internships. Basic engineering methodologies, including analysis and design, as applied to biological systems. Introduction to problem solving, data analysis, report writing, presentations, and engineering record keeping. Group activities and team design efforts. Lecture 1 hour, laboratory 3 hours per week. Co-requisite: Lab component.

BENG1022 Biological Engineering Design Studio I
Practice of biological engineering design in the Biological Engineering Design Studio. Design projects explore the unique problems associated with engineering applied to biological systems. Group activities to teach teamwork skills in the context of engineering practice, including reporting, project management, time management, communication and balancing individual and team accountability. Introduction and application to a computer aided graphics package. Lecture 1 hour, laboratory 3 hours per week. Prerequisite: BENG 1012 or GNEG 1103. Co-requisite: Lab component.

BENG2612 Biological Engineering Design Studio II
Applications of biology, chemistry and physics to the design of life support for enclosed biological systems involving people, animals, plants and microbes. Design process will be based upon engineering analyses such as quantifying bio-energetics and growth, energy and mass balances, solar energy and use of watershed modeling tools. Student teams will be presented multiple design modules that include literature/experimental discovery, open-ended design and prototype testing. 4 hours of design studio per week. Prerequisite: GNEG 1121. Pre- or Co-requisite: PHYS 2054, BIOL 1543/1541L.

BENG2622 Biological Engineering Design Studio III
Continuation of BENG 2612. Design Studio experience includes additional life support system design modules. Design process will include discussion of social issues and ethics, use of engineering economics as a tool to evaluate design alternatives. Use of descriptive statistics and regression to analyze experimental data. Improve written and oral communication skills through presentation of design project results. 4 hours of design studio per week. Prerequisite: BENG 2612.

BENG3104 Electronic Instrumentation for Biological Systems
Theory and advanced applications of analog circuits, digital circuits, and commercial instruments involving biological materials and systems. Lecture 3 hours, laboratory 3 hours per week. Prerequisite: PHYS 2074.

BENG3104H Honors Electronic Instrumentation for Biological Systems
Theory and advanced applications of analog circuits, digital circuits, and commercial instruments involving biological materials and systems. Lecture 3 hours, laboratory 3 hours per week. Prerequisite: PHYS 2074.

BENG3213 Biomedical Engineering: Emerging Methods and Applications
Introductory course for undergraduate biomedical engineering students. Emerging biomedical engineering topics including: tissue engineering, stem cell engineering, biomedical nanotechnology, medical imaging and biosensing, single molecule imaging, biomarker discovery and proteomics, gene therapy, drug delivery, and protein engineering. Design of components for tissue engineering processes, nanodrug delivery and nanotechnology based disease detection. Lecture 3 hours per week. Prerequisite: BIOL 2533. Pre- or Co-requisite: BENG 3723.

BENG3723 Unit Operations in Biological Engineering
Design of basic unit operations typical of biological engineering practice; unit operations include pump-pipe, fan-duct, moist air (psychrometric) processes (cool/heater/humidifier/dryer), air mixing, aeration, and refrigeration; unit operations design will account for unique constraints imposed by biological systems. Lecture 2 hours and lab 3 hours per week. Co-requisite: Lab component. Prerequisite: (MEEG 2403 or CHEG 2313) and (CVEG 3213 or CHEG 2133 or MEEG 3503).

BENG3803 Mechanical Design in Biological Engineering
Introduction to the mechanical design process applied to biological engineering, with examples of mechanical components interfacing with biological systems. Engineering properties of materials, loading, combined stress analysis, theories of failure. Systems approach in design, including safety, reliability and cost. Lecture 2 hours, laboratory 3 hours per week. Co-requisite: Lab component. Prerequisite: MEEG 3013.

BENG4113 Risk Analysis for Biological Systems
Principles of risk assessment including exposure assessment, dose response, and risk management. Methods of risk analysis modeling and simulation with computer software. Applications of risk analysis in medical, animal, food and environmental systems. Prerequisite: MATH 2564 and BIOL 2013.

BENG4123 Biosensors & Bioinstrumentation
Principles of biologically based sensing elements and interfacing techniques. Design and analysis methods of biosensing and transducing components in bioinstrumentation. Applications of biosensors and bioinstrumentation in bioprocessing, bioenvironmental, biomechanical and biomedical engineering. Lecture 2 hours, laboratory 3 hours per week. Co-requisite: Lab component. Prerequisite: BIOL 2013 and BENG 4103.

BENG4133 Digital Remote Sensing and GIS
Basic digital image processing techniques and geo-spatial analysis applied to monitoring of natural processes and resources. Course topics include introduction to electromagnetic radiation, concept of color, remote sensing systems, and light attenuation by atmosphere, objects and sensors. Advanced topics

include data models, spectral transforms, spatial transforms, correction and calibration, geo-rectification, and image classification with hyperspectral and multi-spectral images acquired with aerial and satellite sensors. Raster GIS is integrated into the course throughout the semester. Will use software such as ENVI, ArcGIS and ArcView. Lecture 2 hours, lab 3 hours per week.

BENG4203 Biomedical Engineering Principles
Engineering principles applied to the design and analysis of systems affecting human health. This is an introductory course focusing on fundamentals of physiological systems and modeling and how this relates to analysis and equipment design. Topics include: brief overview of anatomy and physiology; bioelectric phenomena, physiological modeling, cardiovascular system, biomechanics, computational biology. Requires a background in circuits, fluid dynamics, mechanics, biology, and chemistry. Lecture 3 hours per week. Prerequisite: MEEG 2013, (MEEG 2403 or CHEG 2313), ELEG 2103, (MEEG 3503 or CVEG 3213 or CHEG 2133), MEEG 3013, BIOL 1543 or equivalents.

BENG4233 Tissue Engineering
This course introduces students to biological, engineering and clinical aspects of tissue and cell engineering. The introduction to stem cells and histology are reinforced with a concomitant lab that introduces cell culture techniques and illustrates functional and structural aspects of various biological tissues. Topics include Cell Signaling, Transport and Kinetics, Scaffolds, Surface Interactions, Drug Delivery, and Clinical, Ethical and Regulatory Considerations. Two to three lecture hours per week plus three lab hours per week. Co-requisite: lab component. Prerequisite: MATH 3404 and CHEM 3813.

BENG4233 Biomaterials
Study of different classes of biomaterials and their interactions with human tissues. From absorbable sutures to Ziconium alloy hip implants, biomaterials science influences nearly every aspect of medicine. Topics include: biocompatibility factors: natural and synthetic biopolymers, ceramics and metals, orthopedic, dental and cardiovascular implants; ophthalmological and dermatological materials; degradable polymers for drug delivery; nanobiomaterials; smart biomaterials and the regulation of devices and materials by the FDA. Three lectures per week. Prerequisite: (BENG 3712 or MEEG 2103) and MEEG 3013

BENG4223 Numerical Methods in Biomedical Engineering
Application of mathematical techniques and numerical methods for analyzing biological data and solving biological problems. The emphasis will be computer simulation and mathematical modeling applications in biomedical engineering. Prerequisite: MATH 3404.

BENG4283 Electronic Response of Biological Tissues
Understand the electric and magnetic response of biological tissues with particular reference to neural and cardiovascular systems. Passive and active forms of electric signals in cell communication.. We will develop the central electrical mechanisms from the membrane channel to the organ, building on those excitation, dielectric models for tissue behavior, Debye, Cole-Cole models. Role of bound and free water on tissue properties. Magnetic response of tissues. Experimental methods to measure tissue response. Applications to Electrocardiography & Electroencephalography, Microwave Medical Imaging, RF Ablation will be discussed that are common to many electrically active cells in the body. Analysis of Nernst equation, Goldman equation, linear cable theory, and Hodgkin-Huxley Model of action potential generation and propagation. High frequency response of tissues to microwave.
Prerequisites: ELEG 3703 or equivalent; MATH 3404 or equivalent;
basic biology. (Same as ELEG 4773)

BENG450V Special Problems (I-V)
Selected problems in biological engineering are pursued in detail. Prerequisite: senior standing. May be repeated for 4 hours.

BENG451VH Honors Thesis (1-6)
Prerequisite: Honors candidacy.

BENG452V Special Topics in Biological Engineering (1-6)
Special topics in biological engineering not covered in other courses. May be repeated. May be repeated for 8 hours.

BENG4703 Biotechnology Engineering
Introduction to biotechnology topics ranging from molecular biological engineering, bioprocess engineering, biopharmaceutical manufacturing and biosensors to FDA regulations, as well as engineering principles in the design of the systems in the aforementioned topic areas. Lecture 3 hour per week. Prerequisite: BIOL 2013, (CHEM 2613 or CHEM 3603) and (MEEG 2403 or CHEG 2313).

BENG4712 Engineering Properties of Biological Materials
Measuring and predicting the physical, chemical, and biological properties of biological materials necessary for the analysis and design of production and processing systems. Lecture 2 hours per week. Prerequisite: BENG 2622.

BENG4813 Senior Biological Engineering Design I
Design concepts for equipment and processes used in biological, food and agricultural industries. Initiation of comprehensive two -semester team-design projects; defining design objectives, developing functional/mechanical criteria, standards, reliability, safety, ethics and professionalism issues. Lecture 2 hours, laboratory 3 hours per week. Co-requisite: Lab component. Prerequisite: consent of instructor. Prerequisite: BENG 3723. Pre- or Co-requisite: BENG 3733.

BENG4822 Senior Biological Engineering Design II
Continuation of BENG 4813. Design concepts for equipment and processes used in biological and agricultural industries. Completion of 2-semester team design projects. Construction, testing, and evaluation of prototypes. Written and oral design reports. Discussion of manufacturing methods, safety, ergonomics, analysis/synthesis/design methods as appropriate

for particular design projects. Laboratory/design 4 hours per week. Prerequisite: BENG 4813.

BENG4903 WATERSHED ECO-HYDROLOGY
Engineering principles involved in assessment and management of surface water flow and hydrologic processes within ecosystems. Includes frequency analysis of rainfall, infiltration, runoff, evapotranspiration. Use of GIS/mathematical models to quantify hydrologic processes at the watershed landscape scale. Design/implementation of best management practices and ecological engineering principles and processes for advanced ecological services. Lecture 3 hours per week. Prerequisite: CVEG 3213.

BENG4923 ECOLOGICAL ENGINEERING DESIGN
Design of low impact development techniques to enhance ecological services, reduce peak runoff, and capture sediments, nutrients and other pollutants resulting from urban development. Techniques may include: bio-swales, retention basins, and filter strips. Design of sustainable ecological processes for the treatment and utilization of wastes/residues. Techniques may include: direct land application to soils/crops, composting systems, lagoons and constructed wetlands. Design goals include optimization of ecological services to maintain designated uses of land, water and air, including enhancement of habitat for wildlife and recreation, and the discovery of economically viable methods for coexistence of urban and agricultural land uses. Lecture 3 hours per week. Prerequisite: BENG4903.

BENG500V ADVANCED TOPICS IN BIOLOGICAL ENGINEERING (1-6)
Special problems in fundamental and applied research. Prerequisite: graduate standing. May be repeated for 6 hours.

BENG5103 ADVANCED INSTRUMENTATION IN BIOLOGICAL ENGINEERING
Applications of advanced instrumentation in biological systems. Emphasis on updated sensing and transducing technologies, data acquisition and analytical instruments. Lecture 2 hours, lab 3 hours per week. Co-requisite: Lab component. Prerequisite: BENG 4103.

BENG5113 DIGITAL REMOTE SENSING AND GIS
Basic digital image processing techniques and geo-spatial analysis applied to monitoring of natural processes and resources. Course topics include introduction to electromagnetic radiation, concept of color, remote sensing systems, and light attenuation by atmosphere, objects and sensors. Advanced topics include data models, spectral transforms, spatial transforms, correction and calibration, geo-rectification, and image classification with hyperspectral and multi-spectral images acquired with aerial and satellite sensors. Raster GIS is integrated into course throughout the semester. Will use software such as ENVI, ArcGIS and ArcView. Requires a class project in the student's area of interest. Lecture 2 hours, lab 3 hours per week. Students may not earn credit for both BENG 5113 and BENG 4133. Co-requisite: Lab component. Prerequisite: MATH 3404.

BENG5203 MATHEMATICAL MODELING OF PHYSIOLOGICAL SYSTEMS
Application of mathematical techniques to physiological systems. The emphasis will be on cellular physiology and cardiovascular system. Cellular physiology topics include models of cellular metabolism, membrane dynamics, membrane potential, excitability, wave propagation and cellular function regulation. Cardiovascular system topics include models of blood cells, oxygen transport, cardiac output, cardiac regulation, and circulation. Background in biology and physiology highly recommended. Lecture 3 hours per week. Prerequisite: MATH 3404.

BENG5213 INTRODUCTION TO BIOINFORMATICS
Application of algorithmic techniques to the analysis and solution of biological problems. Topics include an introduction to molecular biology and recombinant DNA technology, biological sequence comparison, and phylogenetics, as well as topics of current interest. (Same as CSCE 5213)

BENG5223 BIOMEDICAL ENGINEERING RESEARCH INTERNSHIP
Minimum six-week program (possibly up to several months) in a medical research environment working on an original engineering research project. Possible specialty areas include Anesthesiology, Cardiology, Informatics, Opthalmology, Orthopedic Surgery, and Radiology. Prerequisite: graduate standing and approval of coordinator.

BENG5233 TISSUE ENGINEERING
This course introduces students to biological, engineering and clinical aspects of tissue and cell engineering. The introduction to stem cells and histology are reinforced with a concomitant lab that introduces cell culture techniques and illustrates functional and structural aspects of various biological tissues. Topics include Cell Signaling, Transport and Kinetics, Scaffolds, Surface Interactions, Drug Delivery, and Clinical, Ethical and Regulatory Considerations. Two to three lecture hours per week plus three lab hours per week. Co-requisite: lab component. Prerequisite: MATH 3404 and CHEM 3813.

BENG5243 BIOMATERIALS
Study of different classes of biomaterials and their interactions with human tissues. From absorbable sutures to Ziconium alloy hip implants, biomaterials science influences nearly every aspect of medicine. Topics include: biocompatibility factors: natural and synthetic biopolymers, ceramics and metals, orthopedic, dental and cardiovascular implants; ophthalmological and dermatological materials; degradable polymers for drug delivery; nanobiomaterials; smart biomaterials and the regulation of devices and materials by the FDA. Three lectures per week. Students may not earn credit for both BENG 5243 and 4243 Prerequisite: (BENG 3712 or MEEG 2103) and MEEG 3013

BENG5253 BIO-MEMS
Topics include the fundamental principles of microfluidics, Navier-Stokes Equation, bio/abio interfacing technology, bio/abio hybrid integration of microfabrication technology, and various biomedical and biological problems that can be addressed with

microfabrication technology and the engineering challenges associated with it. Lecture 3 hour per week. Prerequisites: MEEG 3503 or CVEG 3213 or CHEG 2133. (Same as MEEG 5253)

BENG5263 Biomedical Engineering Principles
Engineering principles applied to the design and analysis of systems affecting human health. This is a course focusing on fundamentals of physiological systems and modeling. Topics include: brief overview of anatomy and physiology, bioelectric phenomena and neuronal model, compartmental modeling, cardiovascular system and blood flow, biomechanics, computational biology and signal transduction. Requires a background in circuits, fluid dynamics, mechanics, biology, and/ or biochemistry. Lecture 3 hours per week. Students may not earn credit for both BENG 5263 and BENG 4203. Prerequisites: MATH 3404 or equivalent and graduate standing.

BENG5273 Numerical Methods in Biomedical Engineering
Application of mathematical techniques and numerical methods for analyzing biological data and solving biological problems. The emphasis will be computer simulation and mathematical modeling applications in biomedical engineering. Lecture 3 hours per week. Students may not earn credit for both BENG 5273 and BENG 4223. Prerequisite: MATH 3404.

BENG5283 Electronic Response of Biological Tissues
Understand the electric and magnetic response of biological tissues with particular reference to neural and cardiovascular systems. Passive and active forms of electric signals in cell communication. We will develop the central electrical mechanisms from the membrane channel to the organ, building on those that are common to many electrically active cells in the body. Analysis of Nernst equation, Goldman equation, linear cable theory, and Hodgkin-Huxley Model of action potential generation and propagation. High frequency
response of tissues to microwave excitation, dielectric models for tissue behavior, Debye, Cole-Cole models. Role of bound and free water on tissue properties. Magnetic response of tissues. Experimental methods to measure tissue response. Applications to Electrocardiography & Electroencephalography, Microwave Medical Imaging, RF Ablation will be discussed. Students may not receive credit for both BENG 4183 BENG 5283. Prerequisites: MATH 3404, ELEG 3703 PHYS 3414, BIOL 2533 or equivalent (Same as ELEG 5773)

BENG5613 Simulation Modeling of Biological Systems
Application of computer modeling and simulation of discrete-event and continuous-time systems to solve biological and agricultural engineering problems. Philosophy and ethics of representing complex processes in simplified form. Deterministic and stochastic modeling of complex systems, algorithm development, application limits, and simulation interpretation. Emphasis on calibration, validation and testing of biological systems models for the purposes of system optimization, resource allocation, real-time control and/or conceptual understanding. Prerequisite: AGST 4023 or STAT 4003 or INEG 3333.

BENG5703 Design and Analysis of Experiments for Engineering Research
Principles of planning and design of experiments for engineering research. Propagation of experimental error. Improving precision of experiments. Analysis of experimental data for optimal design and control of engineering systems using computer techniques. Students must have an introductory background in statistics. Lecture 2 hours, laboratory 3 hours per week. Co-requisite: Lab component.

BENG5723 Food Safety Engineering
Principles of engineering methods applied to food and safety and sanitation. Principles of engineering methods applied to food safety and security. Discussion of thermal, chemical and electrical pasteurization or sterilization in food processing. Demonstration of monitoring and detecting techniques for food safety, including image analysis, biosensors and modeling. Lecture 3 hours per week. Prerequisite: BENG 4103 and FDSC 4124 (or equivalent).

BENG5733 Advanced Biotechnology Engineering
Applications of the principles of bioprocess/biochemical engineering to microbiological and biomedical problems. Topics include applied enzymology, metabolic engineering, molecular genetics and control, and bioinformatics and nanobiotechnology in addition to classical applied enzyme and cell-growth kinetics and advanced bioreactor design. Prerequisite: BENG 3733 or CHEG 5531.

BENG5743 Biotechnology Engineering
Introduction to biotechnology topics ranging from molecular biological engineering, bioprocess engineering, biopharmaceutical manufacturing and biosensors to FDA regulations, as well as engineering principles in the design of the systems in the aforementioned topic areas. Requires background in microbiology, organic chemistry and thermodynamics. Lecture 3 hour per week. Students may not earn credit for both BENG 5743 and BENG 4703

BENG5801 Graduate Seminar
Reports presented by graduate students on topics dealing with current research in agricultural engineering. Prerequisite: graduate standing.

BENG5923 Nonpoint Source Pollution Control and Modeling
Control of hydrologic, meteorologic, and land use factors on nonpoint source (NPS) pollution in urban and agricultural watersheds. Discussion of water quality models to develop NPS pollution control plans and total maximum daily loads (TMDLs), with consideration of model calibration, validation, and uncertainty analysis. Prerequisite: BENG 4903 or CVEG 3223.

BENG5933 Environmental and Ecological Risk Assessment
Process and methodologies associated with human-environmental and ecological risk assessments. Environmental risk assessments based on human receptors as endpoints, addressing predominantly abiotic processes. Ecological risk

assessments based on non-human receptors as endpoints. Approach using hazard definition, effects assessment, risk estimation, and risk management. Application of methods to student projects to gain experience in defining and quantifying uncertainty associated with human perturbation, management and restoration of environmental and ecological processes.

BENG5943 WATERSHED ECO-HYDROLOGY
Engineering principles involved in assessment and management of surface water flow and hydrologic processes within ecosystems. Includes frequency analysis of rainfall, infiltration, runoff, evapotranspiration. Use of GIS/mathematical models to quantify hydrologic processes at the watershed landscape scale. Design/implementation of best management practices and ecological engineering principles and processes for advanced ecological services. Lecture 3 hours per week. Students may not earn credit for both BENG 5943 and BENG 4903. Prerequisites: CVEG 3213 or equivalent.

BENG5953 ECOLOGICAL ENGINEERING DESIGN
Design of low impact development techniques to enhance ecological services, reduce peak runoff, and capture sediments, nutrients and other pollutants resulting from urban development. Techniques may include: bio-swales, retention basins, filter strips. Design of sustainable ecological processes for the treatment and utilization of wastes/residues. Techniques may include: direct land application to soils/crops, composting systems, lagoons and constructed wetlands. Design goals include optimization of ecological services to maintain designated uses of land, water and air; including enhancement of habitat for wildlife and recreation, and the discovery of economically viable methods for co-existence of urban and agricultural land uses. Lecture 3 hours per week. Students may not earn credit for both BENG 5953 and BENG 4923. Prerequisite: BENG 4903 or equivalent.

BENG600V MASTER'S THESIS (1-6)
Prerequisite: graduate standing.

BENG700V DOCTORAL DISSERTATION (1- 18)
Prerequisite: candidacy.

Research Projects

Biomedical Engineering

Portable Impedance Biosensor for In-Field Detection of Avian Influenza

Yanbin Li, Proffesor

Issue

Avian influenza (AI) virus H5N1 was discovered in the late 1990s, and it has been reported by WHO in more than 46 countries for animal cases and in 15 countries for human cases with 517 people infected and 306 died since 2003. In the US, a recent outbreak of low pathogenic AI in 2001 and 2002 resulted in the depopulation of over 4.5 million chickens and turkeys and had cost the poultry industry approximately $125 million. World Bank estimated that more than 140 million birds had died or been destroyed due to AI H5N1 and losses to the poultry industry are in excess of $10 billion worldwide. A key in controlling the spread of AI is to rapidly detect the disease, and then eradicate infected animals, quarantine and vaccinate animals. The technology for detection of AI H5N1 is mature, but many tests are complex, some are liable to error, and some can be performed safely only in BSL3 facilities. A simple, rapid, robust and reliable AI test, suitable for use in the field, is urgently needed.

Action

A portable biosensor has been developed for in-field sensitive and specific detection of AI virus H5N1 in poultry swab samples. Magnetic nanobeads are coated with specific antibodies to target virus and used in the sampler to separate and concentrate target virus from a poultry swab sample. Red blood cells, as biolabels, are mixed with the captured target virus to form the bio-nanobead-virus-red blood cell complex. A microfluidic biochip is designed and fabricated as a flow-through device to deliver the complex to an embedded interdigitated array microelectrode for impedance measurement. The change in impedance of the bionanobead-virus-red blood cell complex is correlated to the concentration of AI virus H5N1 in the original swab sample. Our results showed that a positive signal was clearly obtained when the concentration of AI virus H5N1 in cloacal swabs was equal to or more than 100 EID50/mL. The test on live H5N2 virus in infected chickens indicated the biosensor presented the same results as that by RT-PCR. A US patent has been filed. A research prototype of this biosensor has been designed and fabricated and is being evaluated with viable AI H5N1 in a BSL-3 lab and field tests.

Impact

Since currently there is no any in-field AI test instrument available, this biosensor would provide the poultry industry with a very needed technology for rapid, sensitive and specific screening of AI H5N1 in poultry. This will help the poultry industry be better prepared for AI H5N1, ensure poultry product safety and security, and minimize the testing cost. Further, this will help our society in surveillance and control of avian influenza infections with animal and human. The biosensor technology developed in this research can also be applied to the detection of other poultry and animal diseases.

Contact

Yanbin Li, Professor, Department of Biological & Agricultural Engineering, Center of Excellence for Poultry Science, yanbinli@uark.edu / 479-575-2424
Cooperators: Billy Hargis (Poultry Science Dept), Steve Tung (Mechanical Engineering Dept), Luc Berghman (Texas A&M University), Walter Bottje (Poultry Science Dept), Suryakant Waghela (Texas A&M University), Huaguang Lu (Penn State University), Tony Huang (Penn State University), Maohua Wang (China Agricultural University), and Ming Liao (South China Agricultural University)

Funding

USDA/NIFA, Arkansas Biosciences Institute, U of A Division of

Aptamers for Rapid Detection of Avian Influenza Virus

Yanbin Li, Proffesor

Issue:

Avian influenza (AI) virus H5N1 has been reported by WHO in more than 46 countries for animal cases and in 15 countries for human cases with 517 people infected and 306 died since 2003. Outbreask of low pathogenic AI in 2001 and 2002 in US resulted in the depopulation of over 4.5 million chickens and turkeys and cost the poultry industry more than $125 million. World Bank estimated that more than 140 million birds had died or been destroyed due to AI H5N1 and losses to the poultry industry are in excess of $10 billion worldwide. Immunoassays are commonly applied for rapid screening of avian influenza virus, but are limited by the temperature sensitive and high cost antibodies that are used in the tests.

Action

Aptamers showed great potential to provide higher affinity for target virus and better thermal stability than antibodies. Aptamers to specifically bind avian influenza H5N1 virus were selected using SELEX method, and their affinity and specificity were evaluated using Dot ELISA and Dot Blot and compared with polyclonal and monoclonal antibodies against AI H5N1. Three DNA-apatmer sequences were obtained and those aptamers have better specificity and stronger binding affinity to AI subtype H5N1 than monoclonal antibodies. The selected aptamers are also being tested for the detection of AI subtype H5N1 at low concentrations in poultry swab samples using a biosensor method such as SPR, impedance or magnetoelastic biosensors.

Impact

Since the applications of immunoassays for in-field screening of avian influenza virus are limited by the use of temperature sensitive antibodies, the aptamer sensing material would provide a better option to the biosensor technology as well as diagnostic kits for in-field rapid, sensitive and specific screening of avian influenza H5N1 in poultry swab samples. This will help the poultry industry more effectively monitoring avian influenza H5N1, different subtypes and other poultry diseases with lower testing cost.

Contact

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Cooperators: Young Min Kwon (Poultry Science Dept.), Chuanmin Ruan (SenMater Technology, LLC)

Funding

ABI, NSF/STTR

Magnetic Nanoparticle Microfluidics for Highly Efficient Capture, Separation and Concentration of Foodborne Pathogens

YANBIN LI, *Professor*

Issue

Contaminated food, mainly by pathogenic microorganisms, is estimated to cause 76 million illnesses, 325,000 serious illnesses resulting in hospitalization, and 5,000 deaths in the US each year. USDA/ERS estimates the medical costs and productivity losses associated with E. coli O157, Salmonella, Listeria monocytogenes and Campylobacter alone amount to at least $6.9 billion annually. Current methods for detection of bacteria rely upon culture plating, ELISA and PCR. However, these methods are time consuming, expensive, or not specific, and require trained operators with laboratory facilities. There is an urgent need for rapid method in detection of major foodborne pathogens. At the same time, food sample preparation is critical to ensure the specificity and sensitivity of a rapid detection method for foodborne pathogens.

Action

The objective of this project is to develop a magnetic nanoparticle-based sample preparation method for rapid capture, separation and concentration of target pathogenic bacteria in foods. A single channel magnetic microfluidic device was designed and fabricated, and it demonstrated the rapid and high efficient separation of the food and water borne pathogens, including E. coli O157:H7, S. Typhimurium, and L. monocytogenes. The key tasks were accomplished, and they are (1) Theoretical estimation of forces exerted on the magnetic nanoparticles in a fluidic solution under the magnetic field, and simulation of movement track of magnetic nanoparticles in a fluidic system under the magnetic field and the corresponding magnetic gradient; (2) Design and fabricate a continuous fluidic magnetic separation device based on theoretical consideration and simulation results, a high magnetic field gradient was created by introducing a stainless steel rod situated tightly on one side of separation channel; (3) Proof of the concept that bacterial cells bound with a few magnetic nanoparticles (MNPs) through non-specific binding can be separated and removed from the target cells bound with a large number of MNPs, in contrast, the non-specific bacterial cells bound with a few magnetic microbeads cannot be separated and removed from the sample; and (4) Separation of magnetic nanoparticle-labeled target pathogen from a mixture of magnetic and non-magnetic pathogens using the fabricated fluidic device. The target pathogens with the concentration of ~ 103 CFU/mL can be isolated and collected from a mixture solution containing the same concentration of competing bacterium using 30 nm MNPs and the fluidic device. There is 83.6 % of target magnetic cells has been isolated and collected from bulk solution considering the number of magnetic cells flowed from upside outlet and the flushed ones, and 81.6% of competing bacterium flowed out from waster outlet and removed from the mixture.

Impact

The results of this project could provide the food industry with new technology to prepare the food sample for rapid detection of foodbonre pathogens. Food samples from poultry, meat, dairy, vegetables and fruits can be treated effectively to capture, separate, and concentrate the target pathogens in less than 30 min. The food industry could save millions of dollars annually by avoiding product recalls since this effective sample preparation method in couple with any rapid detection method could reduce the microbial detection time from more than 8-24 hours down to 1-2 hours. Consumers could benefit from reduced foodborne sickness and associated medical costs. This technology will also help our society reduce foodborne diseases and strengthen the safety and security of our food supply system.

Contact

Yanbin Li, Professor, Department of Biological & Agricultural Engineering, Center of Excellence for Poultry Science, yanbinli@uark.edu / 479-575-2424

Cooperators: Andrew Wang (Ocean NanoTech, LLC)

Funding

NSF/STTR

DDGS Fiber Filled Thermoplastic Composites

SREEKALA BAJWA, *Associate Professor*

Issue

DDGS is the waste stream from ethanol production. DDGS fiber is a one component of the DDGS waste stream. DDGS fibers are also produced during elucitration of poultry feed to remove the fibers. These fibers do not have a significant nutrient value although some of it is used in animal feeds. Although it can be used for biodiesel production, the technology currently is not commercially feasible. This project explores the use of DDGS fibers in thermoplastic composites as filler for thermal and dimensional stability.

Action

To evaluate DDGS fiber as a filler in thermoplastic composites, an experiment was conducted with different proportions of wood and DDGS in the composite matrix. The different fiber proportions included (a) 100% oak, (b) 25% DDGS + 75% oak, (c) 50% DDGS+50% oak, and (e) 75% DDGS+25% oak. All samples were replicated 3 times and the samples were run as a completely randomized block design. The samples were extruded and currently being tested for physical and mechanical properties.

Impact

If the properties of the composite made with DDGS fiber is found to be comparable to the commercially available wood plastic composites, it will open another avenue for inexpensive raw material for the composite industry while generating value for DDGS and extra income for the farmers. This research will not only evaluate the potential of DDGS as a filler in thermoplastic, it will also generate information on the appropriate loading rate for obtaining a specific set of properties, and also will characterize the composite for properties that are important for building applications of thermoplastic composites.

Contacts

PI: Sreekala Bajwa, Associate Professor, BAEG, sgbajwa@uark.edu, 575-2878

Collaborators:

Dilpreet Bajwa, Greenland Composites, Fayetteville, AR

Radhakrishnan Srinivasan, Mississippi State University

Funding Source: None

Research Projects

Biotechnology Engineering

Environmental Resource Management to Develop Watershed Technologies and Management Tools

Sreekala Bajwa, *Professor*

Issue

Water is a natural resource that is seriously impacted by anthropogenic factors such as urbanization and agriculture, and natural processes such as soil erosion, among other things. Although there has been significant research into the processes that affect water quality, a lot of it is still unknown. A true evaluation of the effect of natural processes and anthropogenic factors on water quality will require monitoring and modeling of these processes and the changes they cause in the landscape.

Action

This research focuses on combining remote sensing techniques with transport models to capture the dynamic soil erosion processes that affect water quality. One of the major research focuses is on identifying the source of the sediments in the deteriorated West Fork of White River (WFWR) Watershed. We have developed a method using aerial remote sensing combined with photogrammetric analysis to characterize stream bank erosion in selected reaches of WFWR Watershed. We have quantified land use land cover changes in the last 20 years using remote sensing. Currently, we are analyzing the impact of change in land use land cover on upland contribution of sediments to the river using two models, AnnAGNPS and SWAT.

Impact

It is important to protect our natural resources for future generations. The new remote sensing based method for quantifying stream bank erosion has the potential to look at whole stretches of the river instead of individual cross-sections. A clear understanding of the various sources of pollution of surface waters, and the mode of action of these pollution sources is critical to develop remediation techniques or best management practices that would either control the sediments based on the source of the sediments (stream bank vs upland).

Contacts

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Cooperators:
Indrajeet Chaubey, The Purdue University
Marty Matlock, BAEG, UAF
Students: Mansoor Leh (Ph.D. thesis), Nathan Jones (Honors thesis)

Funding Source

EPA Region 6
Honors College Grant (for undergraduate research)

Biological Engineering Students Design Simple Prosthetics for Manufacture and Use in the Developing World

Tom Costello, *Professor*

Issue:

In developing countries, there are many people who have suffered amputation of limbs due to trauma (from war, natural disasters and motor vehicle accidents) along with complications from diabetes and other vascular diseases. Physicians in many countries are less able to save threatened limbs due to poor emergency health care and limited follow-up care in the home. The earthquake in 2010 in Haiti has led to amputation of limbs for many thousands of people. Prosthetic limbs typically used in the U.S. are much too expensive for amputees in developing countries. Most patients either suffer without an artificial limb, or they rely on donated prosthetics (e.g., discarded by patients in the U.S.) imported to the country by international medical missions. In order for the medical systems in developing countries to meet needs of their patients in a sustainable way, there is a need for prosthetic components which can be manufactured locally in developing countries.

Action

Since 2006, UA biological engineering senior design teams have focused on the design of low-cost prosthetic devices for use in developing countries. One team designed a single-axis prosthetic knee. Another team designed and implemented a testing machine capable of applying repetitive loading to prosthetic components to verify fatigue strength. Four successive teams have worked on simple designs for a low-cost prosthetic foot. The latest version uses spring steel. Students did the research, considered multiple alternatives, and used engineering methods to optimize the best solutions. The two-semester course sequence allowed students to build and test prototypes of their designs. Students and faculty have twice presented ideas to a prosthetic clinic in the Dominican Republic. The students also get feedback and suggestions from a local prosthetist and are working with the international medical group Physicians for Peace. Students held a Limb Drive in 2010 to collect used prosthetic devices for donation to amputees in Haiti. They collected over 16 prostheses, 21 sets of crutches, 11 walkers and 3 wheel chairs.

Impact

Biological engineering students are learning to incorporate biology and engineering to solve problems in the medical field. Prototypes designed, fabricated and tested by student design teams in their senior design course provide evidence that graduates of the program will make contributions to improve medicine, health and quality of life as professional engineers. Students in Arkansas--who have an interest in engineering, biology, and serving people--have an accredited engineering program at the UA that will help them to develop into important players in the world-wide health care system. Graduates can go on to medical school, do graduate work in biomedical engineering or seek industry jobs at the bachelor's level.

Contact:

Tom Costello and other faculty, Department of Biological and Agricultural Engineering
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Funding:

Division of Agriculture, Dale Bumpers College of Agricultural, Food and Life Sciences
College of Engineering

LEADERSHIP AND SUSTAINABILITY IN THE EMERGING CHAOS: UNDERSTANDING THE LINKAGES AMONG TECHNOLOGY, ECONOMICS AND SOCIETAL VALUES

OTTO LOEWER, *Professor*

Issue

Sustainable prosperity and wellbeing are threatened in the foreseeable future for many reasons, the most important being that change is occurring at an increasing rate. Solving progressively more complex problems in the face of relentless and increasingly rapid change will become ever more difficult. Developing and implementing feasible solutions will require that those of differing expertise, experiences and perspectives have the ability to effectively communicate. This will necessitate the emergence of enlightened leaders whose skills include (1) a basic understanding of the linkages among technology, economics and societal values; (2) an ability to communicate effectively and knowledgably about how change is being driven by these linkages and (3) a fundamental awareness of the indicators of the emerging chaos and the associated challenges facing humankind.

Action

Leaders of all types need to be enlightened as to how and why macro -level change occurs if the future is to be a time of sustainable prosperity and wellbeing. With this need in mind, three important aspects for understanding the nature of change have been developed: (a) a conceptual model; (b) a historical perspective; and (c) a statistical overview. These three aspects have been incorporated into seminars, workshops and speeches before a wide range of local, state, national and international audiences. Furthermore, the material has been developed into a 3-hour special topics graduate/undergraduate course intended for all disciplines. In all these settings, attendees learn:

- The basic principles that define how macro-level change is driven by the linkages among technology, economics and societal values.
- A simple vocabulary that can be used to promote effective communication about change among those with different expertise, experiences and perspectives.
- Some of the alarming trends that point to the critical need for enlightened leadership that focuses on sustainable prosperity and wellbeing.

Impact

The payoff is that leaders at all levels become more informed about the nature of change and better equipped to promote sustainable prosperity and well being. The target audiences are those public- and private-sector leaders at all levels with an interest in one or more of the following:

- Involvement in sustainability initiatives.
- Fostering more effective communication among various clientele groups.
- Enhancing personal awareness about important trends that will greatly impact humankind in the foreseeable future.

Contacts

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Cooperating Scientists or Institutions: None

Funding Sources: None external

BIO/NANO TECHNOLOGY– PROGRAMMABLE MICRO/NANOSCALE BIO/ABIO INTERFACING

JIN-WOO KIM, *Professor*

Issue

The biomaterials, including DNA, proteins, and cells, are well optimized through evolution, exhibiting unique recognition, transport, catalytic, and replication properties. In stead of reinventing the wheels, the integration of such pre-engineered biomaterials into nano systems would lead to the realization of the next generation bio/ abio hybrid engineered systems for applications raging from MEMS/ NEMS-based micro/nano fluidic systems to bioelectronic and biosensing systems. However, the major challenges for making this merger feasible are integration and interfacing of the micro- and nano -scale biological and abiological materials at similar scales. The successful development of interfacing techniques for their integration is imperative to overcome the challenges.

Action

Currently, we are in the process of developing a series of nano hybrid materials and devices through stable and "controllable" interfaces between bio and abio materials at the nanoscale. Currently, particular emphases are given to the aqueous-phase self-organization of nanomaterials and their composites, which comply with a specific design, with multifunctional, multiplex, multicolor, and multimodal properties that are "programmable and customizable" on the basis of target applications, in particular biological, biomedical and electronic applications. One of the applications includes the development of a photoacoustic and photothermal diagnostic and therapeutic system using unique plasmonic nanoparticles and their complexes.

Impact

This research is an important step towards realization of the bio/nano technology that bridges the sciences of biology, medicine, nano-materials, and MEMS/NEMS by pairing their advantages. The project has high potential to transform many fields of research including biology, chemistry, physics, medicine, and materials science and engineering.

Contact

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Funding

Arkansas Bioscience Institute

Research Projects

Biotechnology Engineering

Producing Sugar Streams with Mimimal Inhibitor Concentration from Herbaceous and Woody Feedstock

Julie Carrier, *Professor*

Issue:

This research program is centered on the production of sugar streams that have minimal five and six carbon sugar-derived inhibition products so that the enzymatic hydrolysis step is conducted with minimal amounts of enzymes and that the fermentation step produces maximum yields. The tested feedstocks are herbaceous, switchgrass, and woody, poplar and sweetgum. The objectives of this research program are to: 1) determine conditions in which the tested biomass can be pretreated such that minimum concentrations of furfural, formic acid, and acetic acid are released; and, 2) to delineate the formation of furfural, formic acid and acetic acid during pretreatment such that processing conditions that minimize their production can be determined. These steps are critical because they will ensure that cellulosic feedstocks are used in an optimal fashion.

Action

In the biochemical conversion platform, the production of bio-based products implies the release of cellulose and hemicellulose from the feedstock cell wall by a combination of pretreatment and enzymatic steps. This research program is focused on understanding how the hemicellulose breaks down to single sugars, without the production of inhibition products. Unfortunately, hemicellulose depolymerization is not simple because it breaks down into pieces of sugars that later lead to the formation of undesirable degradation products, such as furfural, formic acid and acetic acid which inhibit the enzymatic hydrolysis step. We are working at determining processing conditions that minimize the production of furfural, formic acid and acetic acid.

Contacts

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Funding

NSF Project #0828875, DOE Project # FG36-08GO88036, SunGrant

Detection of Charcoal Rot in Soybean with Remote Sensing

Sreekala Bajwa, *Associate Professor*

Issue

Charcoal rot is soybean disease that causes significant economic losses. It often strikes the plant when the plant is already stressed due to lack of water and nutrients, or during reproduction. Hence it is difficult to detect. Some of the cultivars of soybean have shown some resistance to this disease. If the onset of disease can be detected with remote sensing in multiple cultivars with different degree of resistance, that would save a lot of time and effort on the part of the grower.

Action

The part of this multistate project that I focus on is to identify whether remote sensing is an effective tool to monitor the disease, especially early during the infestation. We (I in collaboration with John Rupe) have conducted two years of microplot experiment with 4 different cultivars (with different degree of resistance), two levels of disease treatment, and two levels of water stress. The plants were monitored for canopy reflectance, stomatal conductance, canopy temperature, disease rating, etc. Unfortunately, the excessively wet 2008 season was not favorable for active disease proliferation. We are still analyzing the data from 2009.

Impact

If the disease can be detected with remote sensing, it will be a powerful tool to map and identify diseases in large scale. This will allow the farmers and crop consultants to understand the yield impact (damage) caused by this disease, and to establish remedial measures in a site-specific fashion.

Contacts

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PI: John Rupe, Professor, Plant Pathology

Funding Source

United Soybean Board

Research Projects

Ecological Engineering

Residual Oil in Gulf of Mexico Marshes and Estuaries

Scott Osborn, *Associate Professor*

Issue

The remaining oil from the Horizon Spill over the summer of 2010 is very difficult to remove from marsh and estuary areas because the presence of vegetation does not allow skimming to be used. Aside from toxicity problems from the oil itself, the oil is also food for bacteria that results in bacterial overgrowth and depletion of the dissolved oxygen in the water. Lack of dissolved oxygen is highly detrimental to aquatic species in the area, particularly oysters that require higher oxygen levels than other aquatic life. Oysters are a major source of fishing income in the Gulf areas.

Action

The SDOX technology, co-invented by Osborn with the patent being held by University of Arkansas System adds dissolved oxygen to shallow, warm water far more effectively than traditional technology. The SDOX is being deployed in shallow warm water areas in the Gulf to determine if sufficient oxygen can be added to support natural bioremediation of oil residual while supporting oxygen levels required for proper reproductive cycles of oysters to occur. Dissolved oxygen plume will be injected into Gulf waters and allow natural tides to feed the plumes into the difficult to reach areas where oysters grow. The movement of the dissolved oxygen plumes will be monitored so full-scale SDOX systems can be implemented to solve the problem broadly over a longer period of time.

Impact

If successful, the SDOX system will allow the oyster fishing industry to recover from the spill much more quickly than would otherwise be possible. Enrichment of the dissolved oxygen environment in the marsh and estuary areas will help the entire ecosystem to recover long term from the impacts of the Horizon Spill.

Contacts

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Funding Sources

National Science Foundation

Removing Drug Residuals from Reservoir Sources of Drinking Water

Scott Osborn, *Associate Professor*

Issue

Recent water quality surveys of both environmental and drinking water have shown measurable concentrations of drugs, endocrine disruptors and industrial chemicals. One of the major likely sources of these chemicals is treated wastewater that enters the environment from municipal treatment plants. These chemical are very difficult to remove from the environment and typical wastewater treatment processes do not remove these chemicals. These chemicals can be removed from drinking water before it is consumed by humans, but the impacts of the chemicals while in the environment are of concern.

Action

The HyDOZ system is a commercial system that was co-invented by Osborn and the patent is held by the University of Arkansas System. The HyDOZ adds dissolved ozone to water much more effectively and at less cost than traditional ozone systems. Ozone is a powerful oxidizer than can effectively remove the drug residuals, endocrine disruptors, and industrial chemical of concern at the tail end of the wastewater treatment process prior to release of the wastewater into the environment. Ozone systems are rarely used in current wastewater treatment designs because of the high cost. The HyDOZ system has the potential to significantly reduce the cost of treatment while increasing the effectiveness of ozonation. A commercial scale prototype of the HyDOZ was constructed and tested on a side stream of water at the Springdale, AR Wastewater Treatment Facility. Results showed that the HyDOZ was capable of meeting current disinfection standards for the plant at a lower cost than traditional ozone. Significant amounts of chemical of concern were also removed. Further testing and scale-up is being conducted.

Impact

Should the HyDOZ prove economically feasible, municipal wastewater treatment plants could replace existing chlorination and/or ultraviolet systems (that do not remove the drug residuals, endocrine disruptors, nor industrial chemicals) to perform standard disinfection (removal of fecal coliforms) of wastewater while also preventing chemicals of concern from entering the environment and travelling through the watershed to drinking water reservoirs.

Contacts

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Funding Sources

National Institutes of Health

An Ammonia Emission Mitigation System for Commercial Broiler Houses

Sreekala Bajwa, *Associate Professor*

Issue

Air quality impacts from confined animal feeding operations (CAFO) is an emerging issue. Potential regulations could affect the economic viability of animal agriculture all over the US. As a top poultry state, and home to several poultry integrators, there is an opportunity for Arkansas to become a benchmark state for conducting research on air quality issues from poultry operations. Ammonia and particulate matter are the two pollutants of concern emitted from poultry houses. Mitigation of ammonia emission from broiler houses would be important for future viability of broiler operations and for protecting the environment and community health.

Action

This project aims at developing a simple and effective at-source mitigation system for reducing ammonia emission from commercial broiler houses. Preliminary analysis of a two-component mitigation system that combined a water scrubber with a biofilter to treat the exhaust air from a broiler house showed poor effectiveness. Currently, we are modeling a biofilter and also testing it with various filter media at laboratory scale. This proposed mitigation system is expected to be non-hazardous, easily disposable and will have minimal impact on water and air quality at disposal.

Impact: As a top poultry state in the US, Arkansas could be seriously impacted by evolving air quality issues, if they are not addressed immediately. As most biofilters have shown to remove 90-95% of the ammonia from the treated air, we expect that the bag biofilter system will have high effectiveness while being more compact in size and easy/inexpensive to construct and implement. As the treated air is circulated back to the house, this system is expected to provide significant bird and human health benefits while reducing the ventilation requirements. The immobilization of ammonia in the filter bed would provide major environmental quality benefits. The spent filter media rich in immobilized N could be land applied as a bio-fertilizer for uptake to crops, thereby avoiding re-release of ammonia to the airshed.

Contacts

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Collaborators:

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Yi Liang, BAEG, UAF

Susan Watkins, Poultry Sciences, UAF

Dharmendra Saraswat, BAEG, UAF

Funding Source

USDA-NRI

Application of Cotton Gin Waste and Recycled Cotton Bale Wrap in Ligno-Cellulosic Composites (LCC)

Sreekala Bajwa, *Associate Professor*

Issue

Two of the major waste streams of cotton cultivation include the gin waste that comes from cotton gins, and the plastic film used for wrapping the cotton bales in the new John Deere cotton module builder. Both of these waste streams do not have any significant application at present. On the other hand, they pose serious environmental issues such as the fire hazard of gin waste piles, if merely discarded. Therefore, it is necessary to find alternate uses or disposal strategies for these waste materials without adding additional cost to the producers.

Action

The focus of this research project is to generate value added products from the two waste streams coming from cotton agriculture, the gin waste and bale wraps. Cotton gin waste is rich in natural ligno-cellulosic fibers, which may be used to replace the more expensive wood fiber in composite boards. Similarly, cotton bale wraps may be able to replace part of the high-density polyethylene in composite boards, without compromising the mechanical and physical properties of the end products. Therefore, we evaluated the two waste materials for potential application in fiber-reinforced thermoplastic composite boards. Formulations for the composites selected based on lab studies were tested at a commercial scale in 2009 at Greenland Composites Inc. We have also characterized the burr and linter fraction of the cotton gin trash for chemical and physical properties. Testing of these composite boards for physical and mechanical properties showed that they have comparable properties and good potential to be used in building applications.

Impact

It is important to protect our environment for future generations, and to help rural communities by making agriculture more profitable. The new composites made with cotton gin waste and recycled bale wrap will add value to two of the waste streams from cotton agriculture, and reduce their environmental impact by removing them from the environment. The new composite material made from these materials will have lower costs as the raw materials are inexpensive. The cotton farmers will benefit from this product by selling the cotton gin waste for a price instead of paying for its disposal. The many wood-plastic composite industries situated in the cotton belt will benefit from this product by substituting the scarce and expensive raw materials with inexpensive and abundant raw materials that are locally available.

Contacts

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Dilpreet Bajwa, Greenland Composites, Fayetteville, AR

Greg Holt, USDA-ARS, Lubbock, TX

Funding Source:

Cotton Inc.

Research Projects

Ecological Engineering

Implementation of Low Impact Development Best Management Practices to Remediate Sediment from Urban Development

Marty D. Matlock, *Professor*

Issue

Northwest Arkansas is the sixth fastest growing Metropolitan Statistical Area in the US (Figure 1). The cities of Northwest Arkansas include Bentonville, Rogers, Springdale, Fayetteville, and Siloam Springs. These cities are located in both the Illinois and White River Watersheds. These watersheds receive wastewater discharge from most of the metropolitan communities in Northwest Arkansas, and are the source of concern and conflict because of sediment and phosphorus loading to Oklahoma (Illinois River) and Beaver Lake (White River). Low density, automobile-oriented urban development—the prevalent model for new development—is generating sediment loads that are listed as pollutants of concern in both the Illinois and White Rivers. The impact of urbanization on NPS sediment loads occurs in two phases: 1) Direct loading during construction, and 2) Increased peak flows that erode stream banks, beds, and ground surfaces throughout the urban environment and within stream channels downstream of urban systems.

Action

In the effort to change the prevailing development model towards the integration of urban infrastructure and watershed planning, this project proposes to demonstrate Low Impact Development (LID) BMPs in urban tributaries to the Illinois and White River Systems. In order to demonstrate a LID model for urban ecologies along urban tributaries to the Illinois and White River Systems we will perform the following tasks: 1) Develop municipal planning policies to protect streams from NPS impact from urban development, 2) Design a green neighborhood for Habitat for Humanity to demonstrate the impact and effectiveness of LID technologies in Fayetteville, AR., 3) Measure the impact of LID technologies in reducing sediment loads to the White River in Northwest Arkansas, and 4) Develop and Implement Educational Workshops for LID technologies.

Impact

Fayetteville, AR sits on the watershed divide of the headwater streams of the Illinois and White River watersheds, and is rapidly urbanizing. Streams in the headwaters of these rivers provide critical ecological services for treating and removing pollution from the urban watershed. BMPs in ecological engineering alone, however, will not change nonpoint source problems as environmental planning and urban planning disciplines—each with their own BMPs and optimization tendencies—are conventionally practiced as parallel and separate fields. This project offers an integrated development model that embeds ecological metrics into urban planning templates, land-use policy, and infrastructure design. This project is only in its second year, and has already been recognized by many national and state awards for excellence in design.

Funding

Arkansas Natural Resources Commission
USEPA

Assessment and Sustainable Management of Ecosystem Services

Marty Matlock, *Professor*

Issue

Underrepresented minorities are falling further behind in representation across disciplines in science and engineering. Experience with mentors in hands-on activities early in their undergraduate experience can be very helpful in increasing participation in these fields.

Action

The University of Arkansas is providing an integrated research experience for three cohort groups of 15 undergraduate students each working with federally recognized Native American Tribal programs in Oklahoma, Kansas, and Nebraska, and South Dakota. This experience integrates classroom and field research within each cohort with Tribal management of ecological services. Cohorts are recruited through Tribal educational programs from Native-serving two-year colleges, four-year universities, Tribal Universities, and research universities.

Impact

During the first year of this project nine undergraduate students worked with five faculty to develop and implement research projects.

Funding

National Science Foundation

Demonstration of an Algal Turf Scrubber for Biofuels Feedstock Development

Marty Matlock, *Professor*

Issue

Alternative biofuel feedstocks are in high demand, especially as competition for alternative uses of traditional food and feed crops increases.

Action

The project objective is to operate the test bed ATS for one year. Algae will be harvested from the scrubber once per week over an annual cycle. Details of harvesting methods will be established by the CER and will be consistent with methods used at other project sites (Potomac River, Susquehanna River) so that direct comparisons of data can be made. Samples of algae from the ATS test bed will be dried and weighed to establish productivity rates. Some samples will be analyzed for nitrogen and phosphorus content, either once or twice per month. Other samples will be sent off for further analysis at the Smithsonian Institution and at Western Michigan University.

Impact

A demonstration scale algal turf scrubber was constructed in Springdale, AR and has operated for 10 months. Algal production efficiency and effectiveness is being evaluated.

Funding

Department of Energy

Water Quality Changes in Arkansas's Trans-boundary Watersheds

Brian Haggard, Professor

Issue

Water quality in streams and rivers draining from Arkansas into our neighboring states has been an environmental concern, resulting in multiple changes in watershed management of both nonpoint and points sources of pollution. Water quality issues impact every citizen in Arkansas, from the rural farmers relying on the agricultural landscape to urban dwellers relying on municipal water and wastewater infrastructure.

Action

The Arkansas Water Resources Center has been collecting water samples in streams draining multiple trans-boundary watersheds, and then getting those analyzed in its fee–based lab; this water quality data and other data sources (e.g., the U.S. Geological Survey National Water Information Systems database) have been used to evaluate changes in water quality of streams and rivers. Several specific studies on water quality have also been completed looking at the effects of municipal effluent discharges, hydrology and land use changes on water quality.

Impact

Water quality (particularly phosphorus concentrations and loads) have decreased over the last several years at many of these streams and rivers, resulting from watershed management changes. The local citizens, municipalities, and state agencies benefit from understanding which management actions result in improved water quality of Arkansas's streams and rivers. The water quality issues in these trans-boundary watersheds could result in costly total maximum daily loads (TMDLs), and our analysis allows everyone to know whether water quality is improving or not in these waters.

Contacts

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Cooperating Scientists or Institutions

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Marty D. Matlock, Professor and Director, Center for Agricultural and Rural Sustainability, University of Arkansas – Division of Agriculture.

Funding Sources:

Arkansas Natural Resource Commission 319 Nonpoint Source Program, U.S. Environmental Protection Agency Region VI, the Cities of Fayetteville, Rogers, Siloam Springs and Springdale, Arkansas, and the U.S. Geological Survey 104B Program.

Extension Projects

Extension and Outreach Programs

Biodrying-Gasification of Dairy Manure– Wheat Straw Mixture

Samy Sadaka, Assistant Professor, Extension

Issue

The increase in size of animal farms, their proximity to urban centers, and the restrictions on manure soil application made manure disposal a challenge to livestock producers. This study explored a two-stage approach to convert wet dairy manure, along with wheat straw, to gaseous fuel. The first stage investigates biodrying as a renewable, cheap alternative to reduce the manure moisture thus making it fit for thermochemical conversion. The biodrying process is essentially a partial degradation of biological waste in which the target is the removal of moisture without addition of external heat. The second stage investigates the gasification process on the biodried mixture to generate gaseous fuel.

Action

Biodrying

- As-excreted dairy manure, and chopped wheat straw, as shown in Figure 1, were mixed to achieve initial moisture content of 56% wb.
- Nine reactors were built in the RREC, Stuttgart, AR for this study, as shown in Figure 2. Three aeration levels [0.05, 0.80, and 1.50 L/min/kg VM] were tested with 3 reactors under each aeration level.
- Temperatures of mixtures were monitored continuously, and samples were collected every 3 days for the duration of the study (21 days).

Gasification

- In this part of the study, a fluidized bed gasifier [0.75 Mg/day capacity] was used with Alumina sand as bed material and ambient air as the gasifying agent, as shown in Figure 3.
- After completion of biodrying, the biodried mixture was ground and fed to the gasification system [at 21% wb].
- Three ER were studied in this investigation [0.25, 0.30, and 0.35] with one run under each ER [duration of run: 40 – 60 min].
- Temperature was monitored in multiple levels inside the bed [5 points], with bed temperatures ranging between 700 and 780°C in all three runs.
- An orifice meter was designed to monitor the producer gas flow.
- NOVA ® analyzer [5-gases] was used to identify the dry composition of producer gas.

Contact

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Funding

California Energy Commission: Project Title: A Novel Technique to Produce Syngas from Dairy Manure - Wheat Straw Mixture to Replace Natural Gas.

Fast Pyrolysis and Torrefaction of Cotton Gin Waste

Samy Sadaka, Assistant Professor, Extension

Issue

The annual estimated production of cotton gin waste in the United States is about 1.2 million metric tons. Arkansas produces about 16,000 metric tons of cotton gin waste per year. This vast amount of waste creates a significant disposal problem in the ginning industry. Currently, the most common methods of disposal include composting, direct land application, and livestock feed. It has been reported that 63% of United States cotton producers pay for cotton gin waste disposal. This study explored the production of bio-oil from cotton gin waste via fast pyrolysis process and investigated the effects of torrefaction residence time on the physical and thermochemical characteristics of cotton gin wastes. Torrefaction is a relatively new technique that has the potential to enhance the physical and thermochemical characteristics of biomass.

Action

An externally heated batch pyrolysis unit was designed and fabricated to achieve thermal decomposition of cotton gin waste into volatile compounds (gases such as carbon monoxide, carbon dioxide, and water vapor; and liquids such as bio-oil), and solids (biochar) in the absence of oxygen. Cotton gin wastes were pyrolyzed using the batch pyrolysis system. About (750 grams) was placed in the reactor and heated to the desired temperature in absence of oxygen.

Several batches of cotton gin waste were torrefied at 260 oC for 0, 15, 30, 45 and 60 min using a batch torrefaction system. Changes in the physical and thermochemical characteristics of cotton gin wastes were observed.

Impact

Results of this study showed that increasing reactor temperature resulted in a decrease in the bio oil and char production and an increase in the gas yield. About 20%, 40% and 40% of the cotton gin waste could be converted to bio-oil, biochar and gas, respectively via the proposed pyrolysis technique.

The results also, showed that torrefaction enhanced the physical and thermochemical characteristics of cotton gin waste. Moisture content of cotton gin waste was reduced by about 48%, compared to original moisture content, after 1 hour torrefaction under 260 oC. The heating value for cotton gin waste gradually increased with increase in residence time. Overall increase in the heating value for cotton gin waste was 6.33%.

Contact

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Funding

Cotton Incorporated. Project Title: fast pyrolysis of cotton gin waste to produce liquid fuel.

Sealed Poultry Litter Bag Storage: A Promising Innovation

Karl Vandevender, *Professor, Extension*

Issue

Storing poultry litter is often needed. Usually the cited justification for storage is protecting surface water from rain induced runoff from exposed litter storage piles. While the environmental concerns are pertinent often overlooked is the degradation of litter physical and chemical properties and associated reduction in litter value when exposed to the weather. At times a structure or stacking shed is economically feasible due to the combination of repeated storage need, storage volume, and consistence storage location. An example of this is a stacking shed used on the poultry farm to store the small portion of crusted litter removed after each flock. Often however the volume of litter to be stored and variable storage locations make a storage structure and uneconomical. Therefore a temporary litter storage method is recommended when stacking sheds are not appropriate. However, the use of tarps and other plastic sheet are problematic for various reasons.

Action

This Pilot project initiated investigations into the use of large polyethylene bags to store litter. These bags, or tube, range in size and weight when used for cattle silage and grain storage. For this project 9 mil grain bags 9 foot diameter and up to 200 feet in length were used. In several field trials modified grain handling equipment was used to load the storage bags. These trails demonstrated that the equipment was able to pack the poultry litter in the bags with the resulting storage capacity of approximately 1.5 tons linear foot of bag. An associated storage trail comparing bagged litter to litter stored in an exposed open pile indicated that the bagging not only protected the litter from the weather and prevented runoff, it also appeared to seal the litter preventing nutrient and carbon losses as compared to the litter stored in the open pile. After almost 18 months of storage the polyethylene bag was still providing weather protection. When the bag was emptied and land applied the litter was found to be uniform in texture and handled well in the loading and spreading process. In contrast litter that is exposed to the weather for extended periods of time is often crusted on top and higher moisture at the bottom of the pile, which has an adverse impact on litter handling.

At this time additional research and demonstration opportunities are being sought.

Impact

While this is an investigated project and additional research and demonstration is needed to further quantify potential benefits, equipment refinement, and cost effectiveness of the practice it shows great promise to have both environmental and production benefits.

Contact

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Funding

UA Division of Ag; Delta Grain Bags Systems, Inc.; US DOE

Developing Novel Criteria for Establishing Monitoring Gages

Dharmendra Saraswat, Assistant *Professor, Extension*

Accomplishment

Assessment of stream flow or water quality is determined by installing monitoring gages at some location of interest. Location of monitoring gages is a critical decision because the samples collected should be representative of the water mass and quality. Often, state and federal agencies responsible for collecting water quality samples make decisions for locating monitoring gages on the basis of convenience. In this study, it was hypothesized that nutrient output from a distributed watershed model, Soil and Water Assessment Tool (SWAT), will help identify critical subwatersheds that could in turn lead to identifying location of monitoring gages. The subwatershed scale model output was subjected to analysis of variance (ANOVA) to identify if differences exist between subwatershed TP and NO3-N concentration. After this initial screening, Tukey's honestly significant difference (HSD) method was applied to identify subwatersheds with significantly higher TP and NO3-N concentrations. This approach provided an objective way of determining location of monitoring gages in a watershed.

Role

My role was to conceive, plan, and direct this modeling study besides data analysis and preparation of presentations / reports / publications.

Impact

These preliminary results are promising and further efforts are required to validate measured data for deciding location of monitoring gages based on SWAT model output and Tukey's HSD technique. During the year, research results have been shared through one presentations in a local conference.

Funding

Arkansas Natural Resources Commission (ANRC)

Extension Projects

Extension and Outreach Programs

Inventorying Riparian buffer cover along Waterbodies

Dharmendra Saraswat, Assistant *Professor, Extension*

Riparian inventory was conducted using 2006 land use land cover (LULC) maps in a GIS environment to calculate percentage of each land use within the riparian buffer.

Issue

- Vegetation along riparian buffer is critical to the health of water body
- Inventorying riparian buffer width can help identify deficient areas
- Manual measurement of riparian buffer width is laborious and time consuming and many a times impossible to conduct

Solution

- An algorithm was developed to automatically detect streambanks using 1m resolution aerial imagery
- Streambanks were detected with a mean error of 2.2 m (RMSE 3.07 m) and then used to measure the width of riparian land uses using a geographical information system (GIS).

Role

My role was to conceive, plan, and direct development of algorithm for conducting inventory of riparian buffer cover. In addition, I liaised with Arkansas Natural Resources Commission (ANRC), Environmental Protection Agency (EPA), ETF of University of Arkansas and prepared presentations / reports / publications.

Impact

These preliminary results are promising and to continue further refining the technology, second phase of the project has been subjected for funding consideration. During the year, research results have been shared through one peer reviewed submitted paper and two presentations in National/ Local conferences.

Funding

Arkansas Natural Resources Commission (ANRC)

Tool for Analyzing Best Management Practices

Dharmendra Saraswat, Assistant *Professor, Extension*

Issue

- Conservation practice implementation at watershed scale is an expensive proposition and hence, modeling provides an efficient way to evaluate their benefits before implementation,
- Pollutant reduction estimates from selected BMPs at the subwatershed scale were desired in four priority watersheds

Solution

- Vegetative filter strip (VFS) were simulated in a priority watershed in Lake Conway Point Remove watershed (LCPRW) and Bayou Bartholomew watershed (BBW)
- Grazing intensity and VFS scenarios were simulated in a priority watershed in Beaver Reservoir watershed (BRW) and Illinois River Drainage Area in Arkansas (IRDAA).
- These BMPS were evaluated at six spatial scales which resulted in 18 scenarios for LCPRW and BBW, and 36 scenarios for BRW and IRDAA
- Simulated weather for 25-years(2009-2033) was generated for evaluating long term impacts of BMPs
- Pollutant reduction efficiency for sediment, total phosphorus, and nitrate-nitrogen ranged from -34% increase (for intensive grazing) to 68% reduction (largest VFS area).

Role

My role was to conceive, plan, and implement various BMPs scenario in the model and help in the analysis and interpretation of results.

Impact

This project helped in gaining critical insight into performance of two selected BMPs under different hydrological conditions and during wet and dry years. It helped assess their long term mitigation potential prior to their implementation and also provided a comparative assessment for determining the most appropriate BMP for various implementation scenarios simulated in this project.

Funding

Arkansas Natural Resources Commission (ANRC)

VISUALIZATION TOOL FOR GENERATING MODEL OUTPUT: FIELD SWAT

DHARMENDRA SARASWAT, ASSISTANT *PROFESSOR, EXTENSION*

Issue

- Hydrological/water quality(H/WQ) model outputs are mostly obtained at three spatial scales: whole watershed, sub-watershed, and hydrological response units (HRUs)(smallest modeling unit)
- Although SWAT HRU level output represents its finest spatial output; due to non spatial relationship between different HRUs, SWAT outputs are not communicated aligned to actual field boundaries.

Solutions

- Developed a software that reads HRU outputs from the SWAT database and apportion it to field boundaries within the study area
- Created a standalone graphical user interface tool to allow users to interactively provide inputs, process data using this algorithm, and visualize the field-based outputs

Role

My role was to conceive, plan, and direct development of novel tools and supervise the modeling project. In addition, I acted as the liason with Arkansas Natural Resources Commission (ANRC), Environmental Protection Agency (EPA), ETF of University of Arkansas and prepared presentations / reports / publications.

Impact

Water quality is an increasing concern nationally and globally. Determination of specific sources and causes of non-point source (NPS) pollution remains an issue of special concern because management practices are mostly "voluntary" in nature and limited funding restricts a holistic approach in tackling the water quality problems. For NPS planning and management purposes, use of models as one among many assessment tools is quite common. This work has resulted in development of innovative methodology to incorporate dynamic land use changes in the model in an automated manner, allowed to utilize cyberinfrstructure for performing expansive and detailed modeling, and utilize modeling outputs for educational purposes in a novel manner. During the year, research results have been shared through one peer reviewed submitted paper, one book chapter , one online/CD-ROM published papers, two technical reports and two presentations in National/ Local conferences.

Funding

Arkansas Natural Resources Commission (ANRC)

WATERSHED MODELING FOR SUBWATERSHED PRIORITIZATION

DHARMENDRA SARASWAT, ASSISTANT *PROFESSOR, EXTENSION*

Accomplishment

Developed H/WQ model for all the four watersheds by adopting "user defined" approach. This approach allowed delineating subwatersheds conforming to USGS certified 12-digit HUC boundaries. It was considered essential to avoid impacts of geomorphologic resolution of subwatersheds on the SWAT model outputs. Although "user-defined" watershed delineation approach has been available as an option since the previous version of SWAT model (SWAT2005) but it has not been commonly reported in research literature because of lack of certified watershed boundaries. Also, research literature is lacking on decision criterion to be used for creating user defined watershed boundaries in SWAT model. Therefore, a framework was developed to topologically connect subwatersheds in head-to-tail fashion. This framework, henceforth referred to as "source and sink approach" was used to obtain sediment and nutrient loading information from individual subwatersheds. A map of priority subwatersheds was obtained for each of the four watersheds by treating all the subwatersheds falling in 81-100 percentile range.

Role

My role was to conceive, plan, and direct development of "source and sink approach", borne out of discussions with ETF, and develop maps of priority subwatersheds.

Impact

Arkansas Natural Resources Commission (ANRC) is looking for science based, cost effective approaches to identify 12-digit HUC subwatersheds for NPS program management purposes. This study provides a science based approach that could help ANRC for planning management intervention at small size watersheds for assessing impact of management interventions on mitigating water quality. During the year, research results have been shared through one online/CD-ROM published paper , two technical reports , and one presentations in an international conference.

Funding

Arkansas Natural Resources Commission (ANRC)

Cooling Broiler Chickens Using Controlled Surface Wetting

Yi Liang,, *Assistant Professor*

Issue

Large amount of water is used by commercial broiler farms to provide summer cooling to flocks of birds, using either high-cost, high-efficiency evaporative cool cell system, or low-cost, low-pressure but low-efficiency fogging system. The current evaporative cooling methods inevitably increase the humidity level inside the chicken houses during the summer. High humidity level is detrimental to heat dissipation by birds, and potentially associated with wet litter conditions.

Action

An alternative method in cooling broiler chickens was evaluated in two tunnel-ventilated commercial broiler houses during summers of 2009 and 2010 in NW Arkansas. Direct surface wetting by sprinkling achieved satisfactory cooling of birds. Bird performance including feed conversion, livability, and live weights from sprinkler cooling houses and conventional evaporative cooling houses were not significantly different. Sprinkler cooling houses saved at least 62% of water used by evaporative cooling houses, but consumed equivalent amount of electricity for fan operations. Litter conditions from the sprinkler cooling houses were equivalent with the evaporative cooling houses.

Impact

Data from these four flocks suggest that surface wetting by sprinkler systems may have a value in poultry production for maintaining bird comfort and productivity while reducing water usage. This information could have a large impact as poultry growers look for economical and effective methods to provide cooling to broiler chickens.

Contacts

Yi Liang, Department of Biological & Agricultural Engineering
479-575-4862 / yliang@uark.edu

Funding Source

UA-Division of Agriculture

Vegetative Buffer and Windbreak Wall in Mitigating Aerial Emissioni from Poultry Houses

Yi Liang, *Assistant Professor*

Issue:

Modern broiler production use large number of powerful ventilation fans to provide good air quality to chicken housed in high density. Air emissions from these facilities have increasingly become scrutinized in contributing to air pollution and downwind odor nuisance.

Action

Windbreak walls (dimension of 10 ft by 40 ft) consisting of 5 panels of shade cloth material fastened to steel posts 20 feet away from another bank of tunnel fans was installed on the Applied Broiler Research Farm. Numerous wind vanes and anemometers were installed in the vicinity of the artificial windbreak wall to quantify the local wind pattern. Smoke bomb tests were conducted to depict winder pattern as affected by the windbreak. Monitoring of particulate matter downwind of the tunnel ventilation fans are scheduled to be conducted in summer of 2009 and 2010 to evaluate their efficacy as mitigation technology. Guidelines and recommendation of design and maintenance for vegetations and structural windbreak are to be developed to assist local livestock producers in adopting these affordable, cost-effective technologies.

Results

Vegetative buffer is a natural barrier for gaseous and dust exhausted from broiler facilities. Structural windbreak provided immediate mitigation effect for reducing wind generated by powerful tunnel fans and served as screen for dust emission. The adoption of these simple yet effective management practices demonstrate the growers' environmental stewardship.

Contacts:

Yi Liang, Department of Biological & Agricultural Engineering,
479-575-4862 / yliang@uark.edu

Funding Source

UA-Division of Agriculture

Research Grants

Grants

The following grants have been awarded to the faculty during 2010 to fund research in specific areas.

An Ammonia Emission Mitigation System for Commercial Broiler Houses
Dr. Sreekala Bajwa
USDA-NRI seed grant
2009-2010
$30,000

Application of Cotton Gin Waste and Recycled Cotton Bale Wrap in Lignocellulosic Composites
Dr. Sreekala Bajwa
Cotton, Inc.
2010
$15,000

Modeling Watershed Scale Sediment Loading and Effect of Application of bmp on the wfwr
Dr. Sreekala Bajwa
Honors Grant
2010
$1,000

Evaluation of Plant Fibers for Oil Absorption
Dr. Sreekala Bajwa
CoE-Freshman Program
2010-2011
$1,000

Characterization and Quantification of Hemicellulose, Monomers, Oligomer and By-Porducts from Xylan During Biomass pretreatment
Dr. Julie Carrier
National Science Foundation (NSF)-CBET
2008-2011
$87,090

Can Understory from Managed Pine Forests be used as Feedstock in the Biochemical Biorefinery?
Dr. Julie Carrier
Sun Grant
2009-2011
$28,000

Arkansas Center for Plant-Powered Production
Dr. Julie Carrier
NSF-EPSCOR
2010-2015
$58,240

SURF
Dr. Julie Carrier
Arkansas Department of Higher Education
2010
$3,900

SURF
Dr. Julie Carrier
Arkansas Department of Higher Education
2010
$3,900

An Open Water Curtain System to Reduce Particulate Matter Emissions from Commercial Poultry Houses
Dr. Tom Costello
USDA-NRI (Air Quality)
2010
$10,000

Energy Audits of Contract Broiler Production in NW Arkansas and NE Oklahoma
Dr. Tom Costello
USDA Rural Energy for America
2010
$10,000

Arkansas AgrAbility
Dr. Tom Costello
USDA-NIFA
2010
$10,000

Research Grants

Integrated Resource Management tool to Mitigate the Carbon Footprint of Swine Produced in the U.S.
Dr. Tom Costello
USDA/NIFA/AFRI
2010-Funding starts next year
$250,000

Sager Creek Water Quality Monitoring
Dr. Brian Haggard
City of Siloam Springs
2010
$26,570

Phosphorus Leaching in Alluvial Soils and Gravel Deposits
Dr. Brian Haggard
USGS 104G
Since 2004
$62,124

Headwaters aquatic habitat assessment
Dr. Brian Haggard
AGFC SWG Program
2010
$15,400

Water Resource Assessment at Gulf Mountain WMA
Dr. Brian Haggard
AGFC SWG Program
2010
$45,936

Gengeration of Pancreatic b-cells from hESC/iPSC
Dr. Sha Jin
NSF-ASTA
2010
$2,750

Synergetic Regulations of Signal Molecules for hES Cells
Dr. Sha Jin
NIH/COBRE
2010
$10,000

hES Cells Differentiation into Pancreatic Lineage
Dr. Sha Jin
ABI
2010
$62,974

Molecular Probe Development
Dr. Sha Jin
ABI
2010
$29,999

Undergraduate Honors Thesis Research
Dr. Sha Jin
Honors College
2010
$3,000

Conference Grant
Dr. Sha Jin
Honors College
2010
$750

Conference Grant
Dr. Sha Jin
microEP/NSF REU
2010
$600

Research Grants

Development of 3D Scaffolds for Pancreatic Differentiation from ES Cells
Dr. Sha Jin
JDRF
Since 2009
$20,000

Generate Glucose-responsive, Insulin-producing Cells from Human Embryonic Stem Cells in 3D Cultures
Dr. Sha Jin
NSF
Since 2008
$30,000

HA Surface Presented Yeast Flu Vaccines and its Enhancement by CD154 Codisplay
Dr. Sha Jin
NIH
Since 2009
$70,000

Point Source Ozonation to Minimize Antibiotic Resistance
Dr. Jin-Woo Kim
NIH-STTR II (BlueInGreen)
Since 2008
$84,032 a year

Engineering Multimodal Imaging and Therapeutic Probes Through Programmable Self-assembly of Multifunctional Nanoparticle Ensembles
Dr. Jin-Woo Kim
NSF
2010
$343,315

A Flagellar Motor Based biosensor for trace level TNT detection
Dr. Jin-Woo Kim
NSF
2010
$160,206

Nanowire Switch and Nanoelectrode/Nanofluidcs Based Biosensor for Rapid Screening of Avian Influenza Virus
Dr. Yanbin Li
USDA/NRI (NanoTech)
2010
$85,000

Development of aptamerssDNA Intelligent Hydrogel Materials for Magnatoelastic Detection of Avian Influenza Virus
Dr. Yanbin Li
NSF/STTR Phase I (SenMater Technology)
2010
$37,500

Aptamer SPR Biosensor for Detection of Avian Influenza
Dr. Yanbin Li
ABI
2010
$50,000

A Multi-Component Ammonia Emission Mitigation Strategy for Commercial Broiler Houses
Dr. Yi Liang
USDA-NRI
2009-2011
$7,500

Systematic Evalution of In-House Broiler Litter Windrowing Effects on Production Benfits and Environmental Impact
Dr. Yi Liang
US Poultry
2011-2012
$30,213

Field Testing of Ammonia Sensor in Poultry House with Sensor-Controlled Environment
Dr. Yi Liang
USDA-CSREES
2010-2011
$7,500

Energy Audits of Contract Broiler Farms in NW Arkansas and NE Oklahoma
Dr. Yi Liang
USDA Rural Development
2010
$49,000

Assessment and Sustainable Management of Ecosystem Services
Dr. Marty Matlock
NSF
2010
$75,000

Research Grants

LCA for Beef
Dr. Marty Matlock
National Cattleman's Association
2010
$120,000

LCA for Pork
Dr. Marty Matlock
USDA NIFA
2010
$195,000

NSF REU SITE
Dr. Marty Matlock
NSF
2010
$70,000

Development of a Life Cycle Analysis for Cocoa GHG
Dr. Marty Matlock
WCF
2010
$15,000

Use of SDOX to Provide Dissolved Oxygen to Enhance Bioremediation of New-shore Spilled Oil in the Gulf of Mexico
Dr. Scott Osborn
NSF
2010
$174,979

SDOX Oxygenation of Retention/Detention Pond at Enterprise Center
Dr. Scott Osborn
Walmart Stormwater Compliance Team
2010
$43,000

Oxygenation of Lake Wister Using SDOX
Dr. Scott Osborn
Poteau Valley Improvement Authority
2010
$17,000

Proposal to Conduct a Preliminary Evaluation to Support Revisiting the Arkansas Water Plan
Dr. Scott Osborn
Arkansas Natural Resource Commission
2010
$2,000

A Portable Dissolved Oxygen Delivery System for Rapid Treatment of Organic Spills
Dr. Scott Osborn
NSF
2010
$154,166

Production of Syngas and Bio-Oil from Woody Biomass
Dr. Samy Sadaka
DOE
2010
$36,000

Integrated Resource Management Tool to Mitigate the Carbon Footprint of Swine Produced in the U.S.
Dr. Samy Sadaka
AFRI
2010
$60,000

Conversion Technologies
Dr. Samy Sadaka
DOE
2010
$13,500

Production of Syngas and Bio-Oil from Poultry Manure-Forest Floor Residues
Dr. Samy Sadaka
Department of Energy (DOE)
2010
$27,000

Lime Requirements of Soybean
Dr. Dharmendra Saraswat
Arkansas Soybean Promotion Board
2008-2010
$29,900

Research Grants

Ongoing Planning Support, Data Management, and Continuing Review of the Arkansas Non Point Source Adaptive Management Plan and completion of the 2012-2015 Adaptive Management Plan
Dr. Dharmendra Saraswat
DOE
2010
$26,811

Using e-Learning Solutions for Imparting Training on Geospatial Technologies
Dr. Dharmendra Saraswat
CSREES
2010
$10,919

Site-Specific Determination of in-season Corn Nutrients and pH Variability Under Arkansas Growing Conditions
Dr. Dharmendra Saraswat
Arkansas Corn and Grain Sorghum Board
2008-2010
$34,000

Impact of Biofeedstock Production on Hydrologic/Water quality in Midwest and Southwest USA
Dr. Dharmendra Saraswat
DOE
2010
$26,811

Development of a SWAT Model and Spatial Analysis for Bio-Energy Feedstocks
Dr. Dharmendra Saraswat
DOE
2010
$26,811

Practicality Evaluation of Grain Storage Techniques
Dr. Karl VanDevender
Arkansas Corn and Grain Sorghum Board
2010
$30,500

Vegetative Shelterbelts and Windbreak Walls to Mitigate Dust and Odor Emissions Downwind From Poultry Farms
Dr. Karl VanDevender
Extension Internal Grants Funding
2008-2010
$20,553

Production of Syngas and Bio-Oil from Poultry Manure– Forest Floor Residues
Dr. Karl VanDevender
DOE
2010
$27,000

Alternative Uses for Animal Manure
Dr. Karl VanDevender
CSREE Southern Region Extension Water Quality Program
2010
$49,585

Organic Dairy Training Conferences and Educational Materials for Professionals
Dr. Karl VanDevender
SARE
2009-2010
$20,962

Production of Syngas and Bio-Oil from Woody Biomass
Dr. Karl VanDevender
DOE
2010
$36,000

Systematic Evaluation of In-House Broiler Litter Windrowing Effects on Production Benefits and Environmental Impact
Dr. Karl VanDevender
US Poultry and Egg
2010
$36,000

Integrated Resource Management Tool to Mitigate the Carbon Footprint of Swine Produced in the U.S.
Dr. Karl VanDevender
AFRI
2010
$120,000

Nitric Oxide-Superoxide Interaction in Endothelial Cell Dysfunction
Dr. Kaiming Ye
NIH
2010
$13,458

Research Grants

Generate Glucose-responsive, Insulin-Producing Cells from Human Embryonic Stem Cells in 3D Culture
Dr. Kaiming Ye
NSF
2010
$81,333

REU Supplemental to " Generate Glucose-responsive, Insulin-Producing Cells from Human Embryonic Stem Cells in 3D Culture"
Dr. Kaiming Ye
NSF
2010
$22,500

GRA Supplemental to " Generate Glucose-responsive, Insulin-Producing Cells from Human Embryonic Stem Cells in 3D Culture"
Dr. Kaiming Ye
NSF
2010
$35,995

Phase 1: Glucose Indicator Proteins for Continuous Glucose Monitoring
Dr. Kaiming Ye
Bayer Healthcare Diabetes Inc.
2010
$41,000

Development of 3D Scaffolds for Pancreatic Differentiation from ES Cells
Dr. Kaiming Ye
JDRF
2010
$110,000

HA Surface Presented Yeast Flu Vaccine and its Enhancement by CD154 Codisplay
Dr. Kaiming Ye
NIH
2010
$330,000

Purchase of a Lumina XR in Vivo Imaging System
Dr. David Zaharoff
ABI
2010
$204,109

Chitosan-Based Delivery and Immunopotentiation of Cancer Vaccines
Dr. David Zaharoff
NCI
2010
$166,584

PUBLICATIONS

BOOKS

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B.E. Haggard and J.T. Scott. 2010. Chapter 3 "Water Quality Standards: Designated Uses and Numeric Criteria Development", Editors: Y. Li and K.W. Migliaccio, *Water Quality Concepts, Sampling, and Analyses*, CRC Press Taylor and Francis Group, LLC. pp. 21-40.

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Abbott, J, Medina Bolivar F, Martin E, Engelberth A, Villagarcia H, Clausen E and Carrier DJ. "Purification of resveratrol, arachidin-1 and arachidin-3 from hairy root cultures of peanut (*Arachis hypogaea*) and determination of their antioxidant activity and cytotoxicity." *Biotechnology Progress* 26: 1344-1351.

Bajwa, S. G., A. R. Mishra, and R. J. Norman. 2010. "Canopy reflectance response to plant nitrogen accumulation in rice." *Precision Agriculture* 11(5): 488-506.

Garg, V., I. Chaubey, C. Maringani, and **S. G. Bajwa**. 2010. "Inverse modeling of Beaver Reservoir's water spectral reflectance." *Transactions of the ASABE* 53(2):373-383.

Kulkarni, S. S., and **S. G. Bajwa**. 2010. "Investigation on effects of soil compaction in cotton." *Transactions of the ASABE* 53(3): 667-674.

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Post, J., **S. G. Bajwa**, Y. Liang, and T. A. Costello. 2010. "Comparison to two PM monitoring devices in a commercial broiler house". Air Quality Conference and Symposium, September 2010, Dallas.

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Zaharoff, D.A., Hance, K.W., Rogers, C.J., Schlom, J., Greiner, J.W. "Intratumoral immunotherapy of established solid tumors with chitosan/IL-12." *Journal of Immunotherapy*, 33(7):697-705, 2010.

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Carrier, DJ.2010. "Overview of the biochemical platform." University of Kansas, EPSCoR review session, Lawrence, KS, June 2010.

Carrier, DJ.2010. "Overview of biomass-derived bioenergy." University of Graz, Graz Austria July 2010.

Carrier, DJ.2010. "Co-products from a biorefinery." University of Arkansas, Department of Food Sciences October 2010.

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Haggard, B., and T. Scott. "Water Quality Monitoring and Trends in Our Trans-Boundary Watersheds." Joint Oklahoma Governor's Water Conference and Oklahoma Water Resources Research Institute Research Conference, Oklahoma City – October 2010

Haggard, B., and T. Scott. "Facilitating Nutrient Criteria Development in the Red River Basin: Frequency Distribution and Nutrient-Chlorophyll Relations." International Symposium of the North American Lake Management Society, Oklahoma City, Oklahoma – Nov 2010

Haggard, B., M. Matlock, A. Brown, and E. Cummins. "Water Quality Assessment at Spring and Osage Creeks, 2007–2009." Arkansas Water Works and Water Environment Conference, Hot Springs, Arkansas – May 2010.

Haggard, B. "Arkansas – Oklahoma Nutrient Issues: What's Happened on the Arkansas Side?" USDA National Land and Sea Grant Water Conference, Integrating Science and Policy Symposium, Hilton Head, South Carolina – Feb 2010

Haggard, B., H. Liechty, and K. Cunningham. "Riparian Forest Buffers – Role in Watershed Management." South Central Chapter, International Erosion Control Association, Muddy Water Blues Conference, Bentonville, Arkansas – March 2010.

Haggard, B., M. Matlock, A. Brown, and E. Cummins. "Water Quality Assessment at Spring and Osage Creeks, 2007–2009." Northwest District of the American Water Works and Water Environment Association, Rogers, Arkansas – March 2010.

Kim, J.W.. 2010. Self-Assembled Nanoparticle Composites for Laser-Induced *In Vivo* Medical Diagnostics of Cancer Stem Cells. 2010 Annual Meeting of Korean Society for Stem Cell Research, Joint Symposium with Korean Society of Gene & Cell Therapy and 2nd Korea-UK Stem Cell Symposium, October 22, Seoul, Korea (as a "Plenary Speaker").

Kim, J.W. 2010. Nanoparticles and Their Self-Assembled Nano-Composites for Multiplex, Multimodal Biomedical Sensing and Therapy. 2010 International BIOTRONICS Conference, October 28, Seoul, Korea.

Kotagiri, N. and **J.-W Kim**. 2010. Sugar Coated Stealth Carbon Nanotubes. IEEE International Conference on Nano/Molecular Medicine and Engineering (IEEE-NANOMED), December 5-8, Hong Kong, China.

Kim, J.W. and V.P. Zharov. 2010. Laser-Induced Nanoparticles for Biomedical Sensing and Therapy. 5th IEEE International Conference on Nano/Micro Engieered and Molecular Systems (IEEE-NEMS), Xiamen, China.

Kim, J.W. 2010. Bio/Nano Technology for Nanoscale Self-Assembly. Myongji University, Yongin, Korea.

Kim, J.W., 2010. Laser-Induced Nanoparticles for Biomedical Sensing and Therapy. Shenyang Institute of Automation Chinese Academy of Science, Shenyang, China.

Zharov, V.P. and **J.-W. Kim**. 2010. Nanotechnology-Based *In Vivo* Photoacoustic Diagnosis and Photothermal Therapy. Nanotechnology for Healthcare Conference, January 6 -9, Winthrop Rockefeller Institute, Petit Jean Mountain, AR

Zharov, V.P. and **J.-W. Kim**. 2010. Nanotechnology-Based *In Vivo* Photoacoustic Diagnosis and Photothermal Therapy. Arkansas Biosciences Institute Board Meeting, January 19, Little Rock, AR.

Li, Y., B. Hargis, S Tung, L. Berghman, Tony Huang, and H. Lu. 2010. "A portable impedance biosensor for rapid screening of avian influenza." Invited presentation at the MOST-USDA Agro-Product Processing Forum, International Agricultural Engineering Conference (IAEC 2010), September 17-20, 2010, Shanghai, China.

PUBLICATIONS

INVITED LECTURES

Li, Y. 2010. "Applications of biosensor technologies in agriculture, food and environment." Invited presentation at IBE-KSBB Joint Symposium, 2010 KSBB Annual Meeting, October 7-8, 2010, Incheon, Korea.

Li, Y. 2010. "Biosensors and their applications in biosystems engineering." Invited presentation at the Summer Program of Outstanding Undergraduate Students for Biological Engineering in China, July 12-15, 2010, Hangzhou, China.

Li, Y. 2010. "Biosensors and their applications in agriculture, food and environment." Invited presentation at 2010 Forum on Quality Sensing and Processing Technology for Agro-products, September 21, 2010, Hangzhou, China.

Osborn, G.S. 2010. Department of Energy Hydropower Environmental Mitigation Summit.
June 3, 2010. Washington DC. Invited to present data regarding use of SDOX to oxygenate tailwaters from dams to allow hydropower generation without fish kills.

Osborn, G. S. 2010. Corollo Engineers, Seattle WA. Invited to discuss SDOX technology for integration into wastewater treatment design by firm.

Osborn, G. S. 2010. Washington Department of Ecology, Olympia, WA. Invited to discuss SDOX technology for integration into wastewater treatment to allow regulations to be met.

Osborn, G. S. 2010. King County Washington, Seattle, WA Invited to discuss SDOX technology for reducing impact of small scale decentralized treatment systems impacting Puget Sound.

Thompson, C., **G. S. Osborn.** 2010. Arkansas Environmental Managers Conference, Hot Springs, AR. October. Invited to present data on HyDOZ testing at Springdale Wastewater Treatment Plant for removing drug residuals and endocrine disruptors.

Osborn, G. S. 2010. Arkansas Rural Water Authority. Invited to discuss ARWA purchase of SDOX technology to respond to spills of oxygen consuming material into water in Arkansas.

Osborn, G. S. 2010. Enviroquip Company. Invited to discuss SDOX technology for integration into companies MBR technology as part of an ECOBLOX summit for the new product commercially released.

Osborn, G. S. 2010. WEFTEC New Orleans, LA. Invited by Ovivo to discuss SDOX technology for integration into MBR technology for presentation at technical conference.

Osborn, G. S. C.T. Brewer. 2010. Arkansas Venture Forum, Little Rock. Invited to present BlueInGreen product and company to potential investors. One of 8 companies selected throughout Arkansas for this presentation.

Saraswat, D. 2010 . "Potential collaboration opportunities with University of Arkansas." Delivered before students, staff and faculty of the MGCGV, Chitrakoot, India, January 11. 65 students.

Saraswat, D. 2010**. "**Geospatial Technologies: Unlimited Possibilities for Outreach Education." Delivered before students, staff, and faculty of the Department of Food, Agricultural and Biological Engineering, The Ohio State University, Columbus, OH, October 15.

Veetil, J., Jin, S. and Ye, K., "Design FRET indicator proteins for continuous glucose monitoring in vitro and in vivo", The 10th World Congress on Biosensors, May 26-28, 2010, Glasgow, UK.

Ye, K., J. Leach, and S. Jin "Design of Aptameer-based Nanoparticle Carriers Targeting Prostate Tumors", 2010 International Congress of Antibody, March 2010, Beijing, China.

Zaharoff, D.A. "Chitosan-based Delivery Systems for Cancer Vaccines and Immunotherapies," Winthrop P. Rockefeller Cancer Institute Forum, October 4, 2010, Little Rock, AR.

Zaharoff, D.A. "Engineering Immunotherapies for Cancer," Ralph E. Martin Department of Chemical Engineering, Winthrop P. Rockefeller Cancer Institute Forum, September, 23, 2010, Fayetteville, AR.

Zaharoff, D.A. "Engineering Translatable Cancer Immunotherapies," Cell and Molecular Biology seminar series, September 30, 2010, Fayetteville, AR.

Bajwa, S. G., D. S. Bajwa, and G. A. Holt. "Application of Cotton Burr/Stem inThermoplastic Composites. In. Arkansas Cotton Research Summaries" - 2010, D.M. Oosterhuis (ed.), Arkansas Agricultural Experiment Station, Fayetteville, AR.

Bajwa, D. S., **S. G. Bajwa**, and G. H. Holt. 2010. "Laboratory to commercial scale -correlation in the physical properties of biofiber-polymer composites" -. In. *Proc.11th International Conference on Biocomposites: Transition to Green Materials*, 2-4May 2010, Toronto, Canada.

Bajwa, D. S., **S. G. Bajwa**, and G. H. Holt. 2010. "Laboratory to commercial scale –correlations in the physical properties of biofiber-polymer composites." *Twelfth International Conference on Progress in Biofibre Plastic Composites*. Toronto,Canada.

Bunnell K, Martin E, Lau C, Clausen E, Pelkki M and Carrier DJ. "Hot water and hot dilute acid pretreatment from the understory of *Populus* sp." 32nd Symposium on Biotechnology for Fuels and Chemicals, Clearwater, FL.

Carrier, DJ and Clausen E. "Oligomer purification." ASABE Pittsburgh, June 2010.

Carrier, DJ and Clausen E. "Oligomer degradation." Pacifichem, Honolulu, December 2010.

Dijoleu A, Lingbeck J, Martin E, Clausen E and Carrier DJ. "Toxicity of pretreated switchgrass exudates." 32nd Symposium on Biotechnology for Fuels and Chemicals, Clearwater, FL

Busch, D. and **B. Haggard**. 2010. "Alternative Surface-Water Sampling Methods." UW Platteville, Pioneer Farms: Producer Driven Agricultural Research, 2 pp.

Sharpley, A., P. Moore Jr., K. VanDevender, M. Daniels, W. Delp, **B. Haggard**, T. Daniels, and A. Baber. "Arkansas Phosphorus Index." UA Division of Agriculture Cooperative Extension Service FSA9531, 8 pp.

Sharpley, A., M. Daniels, K. VanDevender, P. Moore Jr., **B. Haggard**. N Slaton, and C. West. "Using the 2010 Arkansas Phosphorus Index." UA Division of Agriculture Cooperative Extension Service MP487, 17 pp.

Haggard, B., A. Sharpley, and L. Massey (Editors), 2010. "*Handbook of Best Management Practices for the Upper Illinois River Watershed and Other Regional Watersheds*." Arkansas Water Resources Center Technical Publication MSC 357.

Haggard, B., A. Sharpley, and L. Massey. 2010. "Water Quality and Watershed Conditions in the Upper Illinois River Watershed." Arkansas Water Resources Center Technical Publication MSC 359.

Haggard, B. 2010. Chapter 10: "Lake Frances Management." Editors: B. Haggard, A. Sharpley, and L. Massey, *Handbook of Best Management Practices for the Upper Illinois River Watershed and Other Regional Watersheds*, Arkansas Water Resources Center Technical Publication MSC 357.

Pennington, J., A. Sharpley, D. Philipp, **B. Haggard**, and L. Massey. 2010. Chapter 6: "Agricultural Conservation Practices and Programs." Editors: B. Haggard, A. Sharpley, and L. Massey, *Handbook of Best Management Practices for the Upper Illinois River Watershed and Other Regional Watersheds*, Arkansas Water Resources Center Technical Publication MSC 357.

Massey, L., W. Cash and **Haggard, B**. 2010. "Illinois River Watershed Partnership – Constituent Loads at eight sites within the Upper Illinois River Watershed, Arkansas." Final Report, Arkansas Natural Resources Commission, USEPA 319 Program. Arkansas Water Resources Center Technical Publication MSC 360.

Massey, L., W. Cash and **Haggard, B**. 2010. "Beaver Water District – Constituent Loads at eight sites within the Beaver Lake Watershed." Final Report, Arkansas Natural Resources Commission, USEPA 319 Program. Arkansas Water Resources Center Technical Publication MSC 361.

Massey, L., W. Cash and **Haggard, B**. 2010. "Kings River Watershed Partnership – Constituent Loads at the Kings River." Final Report, Arkansas Natural Resources Commission, USEPA 319 Program. Arkansas Water Resources Center Technical Publication MSC 362.

Haggard, B., A. Sharpley, and L. Massey. 2010. "Final Report to the Illinois River Watershed Partnership: Recommended Watershed Based Strategy for the Upper Illinois River Watershed, Northwest Arkansas." Arkansas Water Resources Center Technical Publication MSC 355.

Kim, J.H. and J.-W. Kim. 2010. "Controlled Functionalization of Water-Soluble Nanoprobes for Site-Specific Biomedical Sensing." IEEE International Conference on Nano/Molecular Medicine and Engineering (IEEE-NANOMED), Hong Kong, China (accepted).

Kim, J.H. and J.-W. Kim. 2010. "Hierarchical Functionalization of Nanocolloids for Site-Directed Self-Assembly of

PUBLICATIONS

OTHER LECTURES, PAPERS, AND ORAL PRESENTATIONS

Bio/Nano Ensembles." Arkansas Biosciences Institute (ABI) Fall Symposium, Little Rock, Arkansas.

Koppolu, B., Zaharoff, D.A. "Visualization of HIV Protease Inhibition Using a FRET Molecular Probe", BMES Annual Conference meeting, October 7-10, 2010, Austin, TX.

Lau C, Bunnell K, Clausen E, Lay J, Gidden J, Thoma G and Carrier DJ. "Characterization of xylose oligomers from birchwood xylan during pretreatment." 32nd Symposium on Biotechnology for Fuels and Chemicals, Clearwater, FL

Jones, C. N., **M. D. Leh**, and S. G. Bajwa. 2010. "Modeling watershed scalesedimentation in the West Fork of White River with the Soil and Water AssessmentTool." Arkansas Water Resource Center Annual Meeting and Conference. 13-14April 2010. Fayetteville, AR.

Leh, M. D., S. G. Bajwa, I. Chaubey. 2010. "Modeling water quality of West Fork of White River with Annualized Agricultural Non-Point Source (AnnAGNPS) pollutionmodel." Arkansas Water Resource Center Annual Meeting and Conference. 13-14April 2010. Fayetteville, AR.

Li, Y., T. Huang, H. Lu, W. Bottje, R. Wang, X. Mao, K. Lassiter, and J. Lum. 2010. "Nanobeads/nanoelectrode based impedance biosensor for rapid screening of avian influenza virus." Presented at ASABE 2010 Annual International Meeting, June 20-23, 2010, Pittsburgh, PA. ASABE Paper No. 1009466.

Lin, J., J. Lum, R. Wang, S. Tung, B. Hargis, **Y. Li**, H. Lu and L. Berghman. 2010. "A portable Impedance Biosensor Instrument for Rapid Detection of Avian Influenza Virus." Presented at IEEE Sensors 2010 Conference, November 1-4, 2010, Waikoloa, Hawaii. Paper No. 1636.

Lum, J., R. Wang, D. Abi-Ghanem, B. Hargis, L. Berghman, S. Tung, and **Y. Li**. 2010. "A more specific and sensitive detection method for avian influenza H5N1 using anti bodies against N1 subtype and red blood cell amplification in an impedance biosensor." Presented at the 2010 Joint Annual Meeting of ADSA, PSA, AMPA, CSAS, and ASAS, July 11-15, Denver, CO. Paper number M-305.

Lum, J., R. Wang and **Y. Li**. 2010. "A more specific and sensitive detection method for avian influenza H5N1 using antibodies against N1 subtype and red blood cell amplification in an impedance biosensor." AAFP 2010 Annual Meeting, September 28-29, Springdale, AR.

Srinivasan, B., H. Rokadia, S. Tung, R. Wang, and **Y. Li**. 2010. "AFM Investigation of avian influenza viruses." Presented at the ASME 2010 International Mechanical Engineering Congress and Exposition, November 12-18, 2010, Vancouver, Canada. Paper IMECE2010-38952 in the Proceedings of IMECE`10.

Wang, H., **Li, Y**., and M. Slavik. 2010. "Comparison of different magnetic nanobeads for simultaneous immunoseparation of multiple foodborne pathogens." Presented at IAFP 2010 97th Annual Meeting, August 1-4, 2010, Anaheim, CA.

Wang, R., **Y. Li**, X. Mao, T. Huang, and H. Lu. 2010. "Magnetic bio-nanobeads and nanoelectrode based impedance biosensor for detection of avian influenza virus." Presented at IEEE-NanoMed 2010, December 5-9, 2010, Hong Kong, China. Paper No. 13.

Zhao, J., R. Wang, T. Jiang, Y. Kwon, and **Y. Li**. 2010. "In vitro selection of aptamers for detection of avian influenza virus H5N1." Presented at ASM (American Society for Microbiology) 110th General Meeting, May 23-27, 2010, San Diego, CA. Poster No. 10-GM-A-3820-ASM.

Zhao, J., B. Bai, R. Wang, and **Y. Li**. 2010. "Aptamer selection and aptamer-based SPR biosensor for detection of avian influenza virus." AAFP 2010 Annual Meeting, September 28-29, Springdale, AR.

Huang, H., C. Ruan, J. Lin, M. Li, L. Cooney, A. Wang, and **Y. Li**. 2010. "Magnetic nanoparticles based magnetophresis for efficient separation of foodborne pathogens." Presented at ASABE 2010 Annual International Meeting, June 20-23, 2010, Pittsburgh, PA. ASABE Paper No. 1009458.

Kanayeva, D., R. Wang, B. Srinivasan, S. Tung, and **Y. Li**. 2010. "Detection of *Listeria monocytogenes* using microfluidics and interdigitated microelectrode based impedance immunosensor coupled with magnetic nanoparticle-antibody conjugates." Presented at ASM (American Society for Microbiology) 110th General Meeting, May 23-27, 2010, San Diego, CA. Poster No. 10-GM-A-3797-ASM.

Kanayeva, D., R. Wang and **Y. Li**. 2010. "Detection of *Listeria monocytogenes* using microfluidics and interdigitated microelectrode based impedance immunosensor coupled with magnetic nanoparticle–antibody conjugates." AAFP 2010 Annual Meeting, September 28-29, Springdale, AR.

Li, Y., R. Wang, K. Lassiter, B. Srinivasan, B. Hargis, W. Bottje, S. Tung, L. Lin, and H. Lu. 2010. "An impedance biosensor for rapid screening of avian influenza virus in poultry swab samples." Presented at the 11th World Congress for Biosensors, May 26-28, 2010, Glasgow, UK. Paper No. P1.1.102.

Liang, Y., G.T. Tabler, I. Berry, and S.E. Watkins. 2010. "Field evaluation of controlled surface wetting system to cool broiler chickens." ASABE Paper No. 1008478, St. Joseph, Mich.: ASABE.

Liang, Y, K.W. VanDevender. 2010. "Vegetative shelterbelts and windbreak walls to mitigate dust and odor emissions downwind from poultry farms." VP's Internal Innovative Grant Final Report.

Liang, Y., G.T. Tabler, I. Berry, and S.E. Watkins. 2010. "Field evaluation of controlled surface wetting system to cool broiler chickens." ASABE Annual meeting, Pittsburgh, Pennsylvania.

Liang, Y., G.T. Tabler. 2010. "Ventilation Management Effect on Air Quality and Energy Use in Broiler Housing." ASABE Annual meeting, Pittsburgh, Pennsylvania.

Liang, Y. K.W. VanDevender, and G.T. Tabler. 2010. "Field evaluation of windbreak effect on airflow downwind of poultry housing tunnel fans." Proceedings of International Symposium on Air Quality & Manure Management for Agriculture, Dallas, TX.

Liang, Y. G.T. Tabler, and K.W. VanDevender. 2010. "Ammonia emissions from downtime litter management in broiler housing." Proceedings of International Symposium on Air Quality & Manure Management for Agriculture, Dallas, TX.

Lin, J., J. Lum, R. Wang, S. Tung, B. Hargis, Y. Li, H. Lu and L. Berghman. 2010. "A portable Impedance Biosensor Instrument for Rapid Detection of Avian Influenza Virus." Presented at IEEE Sensors 2010 Conference, November 1-4, 2010, Waikoloa, Hawaii. Paper No. 1636 in the Proceedings of IEEE Sensors 2010.

Osborn, G. S., A. McCain, G. Richardson. 2010. New Approaches: Introduction to the SDOX a new method for adding dissolved oxygen to rivers and shallow lakes. Lakeline – The Journal of the North American Lake Management Society, Summer 2010 p. 13-17.

Osborn, G.S. 2010. A Firm Foundation: The Personal Side of the PE Exam, p. 16-17. Resource. Jan/Feb 2010. ASABE, St. Joseph, MI (Invited article to motivate Agricultural Engineers to take the PE exam to become licensed).

Pai, N. and D. Saraswat. 2010. Identifying potential monitoring gage locations in the Lake Conway Point Remove watershed using SWAT. In 47th Annual Meeting of the Arkansas Section of American Society of Agricultural and Biological Engineers, Little Rock, AR, October 1.

Pai, N. S. Sarkar, and D. Saraswat. 2010. Utilizing Cyberinfrastructure for Watershed Modeling. In Cyberinfrastructure Days, Fayetteville, AR, May 16-17.

Pai, N. and D. Saraswat. 2010. Field_SWAT: A Tool for Mapping SWAT Output to Field Boundaries. In 2010 Land Grant and Sea Grant National Water Conference, Hilton Head, SC, February 21-25.

Pai, N. and D. Saraswat. 2010. A Geospatial Technique for Inventorying Riparian Buffer Cover. In 3rd Annual Graduate Student Symposium & Career Networking Event, Fayetteville, AR, February 12.

Post, J.P., S.G. Bajwa, Y. Liang, T.A. Costello. 2010. "A Comparison of Particulate Matter Concentration Measured by TEOM and DustTrak." International Symposium on Air Quality and Manure Management for Agriculture, DoubleTree Hotel Dallas, Dallas, Texas USA, September 13-16,

Saraswat, D., N. Pai, and M. Daniels. 2010. Identifying Prioritized Subwatersheds from SWAT Model Simulated Flow, Sediments and Nutrient Loadings in the Illinois River Drainage Area in Arkansas. In *ASABE 2010 Annual International Meeting*, Pittsburg, PA, June 20-23.

Chaubey, I., B. Engel, M. Thomas, C. Raj, and **D. Saraswat**. 2010. Quantifying Impact of Biofeedstock Production on Hydrology/Water Quality in Midwest USA. EGU General Assembly 2010, Vol. 12, EGU2010-14599. Vienna, Austria, May 2-7.

Saraswat, D. and N. Pai. 2010. Developing Inventory of Riparian Buffer Cover in L'Anguille River Watershed using Geospatial Technologies. In *2010 Land Grant and Sea Grant National Water Conference*, Hilton Head, SC, February 21-25.

Engel, B., I. Chaubey, M. Thomas, **D. Saraswat**, P. Mur-

phy, and B. Bhaduri. 2010. Impact of Biofeedstock Production on Hydrology/Water Quality in Midwest and Southeast USA. In 2010 Land Grant and Sea Grant National Water Conference, Hilton Head, SC, February 21-25.

Srinivasan, B. J.S. Lee, J. Hohnbaum, S. Tung, and J.-W. Kim. 2010. "Performance Evaluation of a Pneumatic-Based Micromixer for Bioconjugation Reaction." 5th IEEE International Conference on Nano/Micro Engieered and Molecular Systems (IEEE-NEMS), Xiamen, China.

Srinivasan, B., H. Rokadia, S. Tung, R. Wang, and Y. Li. 2010. "AFM Investigation of avian influenza viruses." Presented at the ASME 2010 International Mechanical Engineering Congress and Exposition, November 12-18, 2010, Vancouver, Canada. Paper IMECE2010-38952 in the Proceedings of IMECE`10.

Ellis, E., Yao, H., **Veetil, J**., Ye, K., Jin, S., "Visualization of HIV Protease Inhibition Using a FRET Molecular Probe", 239th America Chemistry Society Annual meeting, March 21-25, 2010 San Francisco, CA.

Veetil, J., Jin, S., and Ye, K. "A novel sensor for continuous glucose monitoring", 2010 Biomedical Engineering Society Annual Meeting, October 6-9, 2010 Austin, Texas.

Veetil, J. V., Jin, S. and Ye, K. "Glucose binding protein based nanosensors as a versatile platform for developing reagentless biosensor for intracellular and in vitro glucose monitoring", The 2010 National Biotechnology Conference, May 16 -19, 2010, San Francisco, CA.

Wang, R., Y. Li, X. Mao, T. Huang, and H. Lu. 2010. "Magnetic bio-nanobeads and nanoelectrode based impedance biosensor for detection of avian influenza virus." Presented at IEEE-NanoMed 2010, December 5-9, 2010, Hong Kong, China. Paper No. 13 in the Proceedings of IEEE NanoMed 2010.

Wang, W., Jin, S., Ye, K., "Directed differentiation of human embryonic stem cells toward pancreatic lineage in 3D environments" Tissue Engineering and Regenerative Medicine International Society, 2010 North America Meeting, December 5-8, 2010, Orlando, Florida, USA

Wang, W., Jin, S., and Ye, K. "Generation of mature beta cells from embryonic stem cells", Tissue Engineering and Regenerative Medicine International Society, 2010 Asia Pacific Meeting, September 15-17, 2010, Sydney, Australia.
Wick H, Brown L, Martin E, Clausen E, and Carrier DJ**."** Microbial load in switchgrass pre and post pretreatment." 32nd Symposium on Biotechnology for Fuels and Chemicals, Clearwater, FL

Wang, W., Zhu, Y., Jin, S., and Ye, K. "Three-dimensional differentiation of human embryonic stem cells into definitive endoderm". 2010 Biomedical Engineering Society Annual Meeting, October 6-9, 2010 Austin, Texas.

Zhou, L., Masniuk, Y., Jin, S. and **Ye, K**. "Development of Influenza Vaccines Using Yeast Proteins Surface Display Vectors", 2010 Biomedical Engineering Society Annual Meeting, October 6-9, 2010 Austin, Texas.

Li, Y., M. Varshney, and Z. Ye. 2010. "Separation System and Efficient Capture of Contaminants Using Magnetic Nanoparticles." US Patent No. 7,699,979 B2, April 20, 2010.

Li, Y., R. Wang, T. Jiang, Y. Kwon and J. Zhao. 2010. "Avian Influenza H5N1 Specific Monoclonal Aptamer." US Patent Application No. 61/346,561, May 20, 2010.

Ye, K. and Jin, S. (2010) "pH Insensitive Glucose Indicator Proteins", US 12/902725

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