

Purdue University

ENVIRONMENTAL AND ECOLOGICAL ENGINEERING

-Faculty and Research-

Mailing Address:
Division of Environmental and Ecological Engr.
Purdue University
Potter Engineering Center, Room 322
500 Central Drive
West Lafayette, IN 47907-2022

Phone: (765) 496-9697

Email: deee@ecn.purdue.edu



About Purdue's Division of Environmental and Ecological Engineering (EEE)

Environmental and sustainability concerns are growing in importance both in the U.S. and globally. Current environment-related issues include renewable energy, LEED building design, the gulf oil spill, shortages in materials (e.g., rare earths), water stress, oil depletion, decaying urban infrastructures, management of industrial waste, and climate change. To illustrate the importance of the environment, many of the NAE Grand Challenges of Engineering relate to the environment. To respond to these challenges, the Purdue College of Engineering established the Division of Environmental and Ecological Engineering (EEE) in 2006 to serve as a focus for learning, discovery, and engagement with respect to environmental topics. EEE has been charged with establishing undergraduate and graduate curricula, promoting research collaborations, and becoming a national leader on environmental issues.

Across the U.S., environmental engineering programs have historically been housed within a single engineering department. Unlike these other programs, EEE has an independent mission statement and a crosscutting and interdisciplinary structure that draws upon faculty members from all Schools across the College of Engineering. The advantage of such a structure is that expertise can be easily synthesized to respond to complex environmental challenges and opportunities.

Traditionally, environmental engineering programs focus their research and education activities on minimizing negative environmental impacts by controlling, treating, and mitigating waste streams. The unique interdisciplinary nature of EEE ideally positions Purdue to address challenges and opportunities that cannot be solved by traditional environmental engineering disciplinary practices, but rather through a systems approach that reaches across disciplines to proactively address the root causes of the issue.

EEE Research

The research of Purdue University's Division of Environmental and Ecological Engineering may be characterized as being multidisciplinary and focused on cutting edge issues. The EEE discovery mission is positioned to respond to society's need to understand the world we live in, and to develop strategies for sustainably, managing Earth's limited resources and ecosystems so that they will be available for generations to come. Topics emphasized within the EEE research portfolio include:

- The environmental fate of air, water, and soil contaminants;
- Sustainable urban design;
- Renewable energy and the water-energy nexus;
- Anthropogenic impacts on the ecosphere;
- Sustainable industrial systems;
- Water, air, and nutrient cycling;
- Sustainability engineering education; and
- Characterizing interactions between biological systems and abiotic environments.

The pages that follow describe some of the research activities of the EEE faculty.



Ernest R. Blatchley III

blatch@purdue.edu, (765) 494-0316

Professor of Civil Engineering and Environmental and Ecological Engineering

Ph.D., Civil Engineering, University of California, Berkeley, 1988

M.S., Civil Engineering, University of California, Berkeley, 1983

B.S., Civil Engineering, Purdue University, 1981

Research Interests: The Blatchley group has led the development of photochemical reactor theory, and has also made important contributions relative to chemical disinfection processes, including implementation of new analytical methods and definition of kinetics and mechanisms of several important reactions. Applications include drinking water production, wastewater treatment, and swimming pool chemistry. More recently, the Blatchley group has worked to translate basic principles of water treatment to improve access to potable water in developing countries.

**Selected Publications:**

Mbonimpa, EG; Vadheim, B; **Blatchley III, ER** (2012) "Continuous-Flow Solar UVB Disinfection Reactor for Drinking Water," *Water Research*, **46**, 7, 2344-2354, DOI: 10.1016/j.watres.2012.02.003.

Li, J; **Blatchley III, ER** (2009) "UV Photodegradation of Inorganic Chloramines," *Environmental Science & Technology*, **43**, 1, 60-65. DOI: 10.1021/es8016304.

Blatchley III, E.R.; Shen, C.; Naunovic, Z.; Lin, L.; Lyn, D.A.; Robinson, J.P.; Ragheb, K.; Grégori, G.; Bergstrom, D.E.; Fang, S.; Guan, Y.; Jennings, K.; Gunaratna, N. (2006) "Dyed Microspheres for Quantification of UV Dose Distributions: Photochemical Reactor Characterization by Lagrangian Actinometry," *Journal of Environmental Engineering, ASCE*, **132**, 11, 1390-1403.

James E. Braun

jbraun@purdue.edu, (765) 494-9157

Herrick Professor of Mechanical Engineering and Professor of Environmental and Ecological Engineering

Ph.D., Mechanical Engineering, University of Wisconsin, 1988

M.S., Mechanical Engineering, University of Wisconsin, 1980

B.S., Mechanical Engineering, University of Massachusetts, 1976

Research Interests: Dr. Braun's research combines the use of computer modeling, optimization, and experiments to study and improve the performance of thermal systems. His application focus areas include optimal control of building systems, automated diagnostics applied to cooling and heating equipment, and development and assessment of novel technologies for energy conversion, including heating, cooling, and power producing equipment.

**Selected Publications:**

Li, H. and **Braun, J.E.** "Decoupling Features and Virtual Sensors for Diagnosis of Faults in Vapor Compression Air Conditioners," *International Journal of Refrigeration*, Vol. 30, No. 3, Pages 546-564, 2007.

Braun, J.E., "A Near-Optimal Control Strategy for Cool Storage Systems with Dynamic Electric Rates," *HVAC&R Research*, Vol. 13, No. 4, Pages 557-580, 2007.

Mathison, M., **Braun, J.**, Groll, E., "Performance Limit for Economized Cycles with Continuous Refrigerant Injection," *International Journal of Refrigeration*, Vol. 34, No. 1, Pages 234-242, 2011.



Indrajeet Chaubey

ichaubey@purdue.edu, (765) 494-5013

Professor of Agricultural and Biological Engineering, Earth and Atmospheric Sciences, and Environmental and Ecological Engineering

Ph.D., Biosystems Engineering, Oklahoma State University, 1997

M.S., Biological and Agricultural Engineering, University of Arkansas, 1994

B.S., Agricultural Engineering, University of Allahabad (India), 1991

Research Interests: Dr. Chaubey's research has focused on understanding the watershed and its transport of nonpoint source pollution. His current research focuses on analyzing how land use changes related to the extraction of biofuels impacts water quality and quantity. He is also currently developing modeling tools designed to optimize best management practices while protecting water quality and sustaining agricultural production.

Selected Publications:

Cibin, R., **I. Chaubey**, and B. Engel. 2011. Watershed Scale Impacts of Corn Stover Removal for Biofuel on Hydrology and Water Quality. *Hydrological Processes*. DOI: 10.1002/hyp.8280.

Maringanti, C., **I. Chaubey**, M. Arabi, and B. Engel. 2011. Application of a Multi-objective Optimization Method to provide Least Cost Alternatives for NPS Pollution Control. *Environmental Management*. DOI: 10.1007/s00267-011-9696-2.

Chaubey, I., L. Chiang, M.W. Gitau, and M. Sayeed. 2010. Effectiveness of BMPs in Improving Water Quality in a Pasture dominated Watershed. *Journal of Soil and Water Conservation* 65(6):424-437.



Keith A. Cherkauer

cherkaue@purdue.edu, (765) 496-7982

Associate Professor of Agricultural and Biological Engineering and Environmental and Ecological Engineering

Ph.D., Civil and Environmental Engineering, University of Washington, 2001

M.S., Aerospace Engineering, University of Colorado, 1994

B.A., Physics, Augustana College, 1992

Research Interests: Dr. Cherkauer's research integrates field observations, remote sensing products, and hydrology models to address environmental change and the hydrologic cycle. Recent research includes studying seasonal soil frost in North America; monitoring snow cover, soil moisture, temperature and seasonal freeze-thaw processes; quantification of land use and climate change impacts on the movement of water through the environment; and the applicability of remote sensing for monitoring water quality in rivers and lakes.

Selected Publications:

Yang, G., L. C. Bowling, **K. A Cherkauer**, and B. C Pijanowski (2011), The impact of urban development on hydrologic regime from catchment to basin scales, *Landscape and Urban Planning*, doi: 10.1016/j.landurbplan.2011.08.003.

Mishra, V. and **K. A. Cherkauer** (2011), Influence of cold season climate variability on lakes and wetlands in the Great Lakes region, *Journal of Geophysical Research*, 116, D12111, doi:10.1029/2010JD015063.

Cherkauer, K. A., and *T. Sinha* (2010), Hydrologic Impacts of Projected Future Climate Change in the Lake Michigan Region, *Journal of Great Lakes Research*, doi: 10.1016/j.jglr.2009.11.012.



Monica F. Cox

mfc@purdue.edu, (765) 496-3461

Associate Professor of Engineering Education and Environmental and Ecological Engineering

Ph.D., Leadership and Policy Studies, Vanderbilt University, 2005

M.S., Industrial Engineering, University of Alabama, 2000

B.S., Mathematics, Spelman College, 1998

Research Interests: Dr. Cox has made critical contributions to shaping the field of engineering education via the innovation of her research and through her imaginative use of mixed methodologies for inquiring into significant research questions in engineering education; her integration of concepts from higher education and learning science into the new field; and her development and dissemination of reliable and valid assessment tools for use across the engineering education continuum.

Selected Publications:

Cox, M.F., & Cordray, D.S. (2008). "Assessing Pedagogy in Engineering Classrooms: Quantifying Elements of the 'How People Learn' Model Using the VaNTH Observation System (VOS)." *Journal of Engineering Education*, 97, 4, 413-431.

Cox, M.F., Hahn, J., McNeill, N., & Cekic, O., Zhu, J., & London, J. (2011). Enhancing the Quality of Engineering Graduate Teaching Assistants through Multidimensional Feedback, *Advances in Engineering Education*, 2, 3, 20 pages.

Cox, M.F., & Harris, A.H. (2010). "Comparison of Pretenured and Tenured Engineering Professors' Pedagogical Practices within Undergraduate Bioengineering Courses." *International Journal of the Scholarship of Teaching and Learning*, 4, 1, 11 pages.

**Bernard A. Engel**

bengel@purdue.edu, (765) 494-1162

Head of Agricultural and Biological Engineering, Professor of Agricultural and Biological Engineering and Environmental and Ecological Engineering

Ph.D., Agricultural Engineering, Purdue University, 1988

M.S., Agricultural Engineering, University of Illinois, 1985

B.S., Agricultural Engineering, University of Illinois, 1984

Research Interests: Dr. Engel has been a leader in the national effort to integrate GIS and information technologies with watershed modeling. As a result of his research he has designed powerful user-friendly modeling tools that reduce complex information into a model that can be used for evaluating research hypothesis or making design decisions. The tools he invented have shaped a new approach to water quality modeling, enabling "basin-level" water quality modeling.

**Selected Publications:**

Engel, B., Indrajeet Chaubey, Mark Thomas, Dharmendra Saraswat, Patrick Murphy, Budhendra Bhaduri. 2010. Biofuels and Water Quality: Challenges and Ppportunities for Simulation Modeling. *Biofuels* 1(3):463-477.

Kim, J., **B. A. Engel**, Y. S. Park, L. Theller, I. Chaubey, D.S.Kong, K. J. Lim. 2012. Development of Web-based Load Duration Curve system for analysis of total maximum daily load and water quality characteristics in a waterbody. *Journal of Environmental Management* 97 (2012) 46-55.

Ahiablame, L., **Engel, B.,** Chaubey, I. (2012). Effectiveness of Low Impact Development Practices: Highlights of the Current Knowledge and Suggestions for Future Research. *Water, Air, & Soil Pollution*. DOI 10.1007/s11270-012-1189-2\



Abigail S. Engelberth

aengelbe@purdue.edu, (765) 494-1009

Assistant Professor of Agricultural and Biological Engineering and Environmental and Ecological Engineering

Ph.D., Chemical Engineering, University of Arkansas, 2009

M.E., Chemical Engineering, Iowa State University, 2006

B.S., Chemical Engineering, Iowa State University, 2004

Research Interests: Dr. Engelberth's research focuses on the recovery of valuable co-products from the production of fuels from renewable biological sources, either pre- or post-processing. Along with product recovery, Dr. Engelberth explores the design of the recovery process in order to obtain an economic analysis of the process to determine the value of the co-product. Her postdoctoral research studied process simulation of the conversion of a hemicellulose-rich pre-pulping extract into drop-in transportation fuels.

Selected Publications:

Engelberth, A. S. and G. P. van Walsum (2012). Adding Value to the Integrated Forest Biorefinery with Co-Products from Hemicellulose-Rich Pre-Pulping Extract Biorefinery Co-Products: Phytochemicals, Primary Metabolites and Value-Added Biomass Processing. C. Bergeron, D. J. Carrier and S. Ramaswamy, Wiley: 287-306.

Engelberth, A. S., E. C. Clausen, et al. (2010). "Comparing extraction methods to recover ginseng saponins from American ginseng (*Panax quinquefolium*), followed by purification using fast centrifugal partition chromatography with HPLC verification." Separation and Purification Technology 72(1): 1-6.

Engelberth, A. S., D. J. Carrier, et al. (2008). "Separation of Silymarins from Milk Thistle (*Silybum Marianum*L.) Extracted with Pressurized Hot Water using Fast Centrifugal Partition Chromatography." Journal of Liquid Chromatography & Related Technologies 31(19): 3001-301.

**Audeen W. Fentiman**

fentiman@purdue.edu, (765) 494-1870

Associate Dean of Engineering for Graduate Education and Interdisciplinary Programs, Professor of Nuclear Engineering, Engineering Education, and Environmental and Ecological Engineering

Ph.D., Nuclear Engineering, Ohio State University, 1982

M.S., Nuclear Engineering, Ohio State University, 1977

M. A., Mathematics, West Virginia University, 1974

B.S., Mathematics, Glenville State College, 1972

Research Interests: Dr. Fentiman has an interdisciplinary background in engineering research topics. Among her current research interests are engineering education topics such as recruitment and retention of engineering students from underrepresented groups and design of the first year engineering curriculum. Within the nuclear engineering field, her research interests include radioactive waste management and the nuclear fuel cycle. Her environmental research currently focuses on alternative energy resources and environmental risk assessment.

Selected Publications:

Smith, D.A., D. Holt, and **A.W. Fentiman**, "A Conceptual Model for Determining the Level of Impact from a Radiological Dispersal Event", Journal of Emergency Management, accepted Feb. 2010.

Smith, M.A., I.L. Larsen, and **A.W. Fentiman**, "Fate of Co at a Sludge Land Application Site, Journal of Environmental Radioactivity, Vol. 99, Oct. 2008, pp 1611-1616.

Saling, J.H. and **A.W. Fentiman**, Radioactive Waste Management, Taylor and Francis, NY, NY, 2002.



Jane R. Frankenberger

frankenb@purdue.edu, (765) 494-1194

Professor of Agricultural and Biological Engineering and Environmental and Ecological Engineering

Ph.D., Agricultural and Biological Engineering, Cornell University, 1996

M.S., Agricultural Engineering, University of Minnesota, 1984

B.A., Physics and Religion, St. Olaf College, Minnesota. 1979



Research Interests: Dr. Frankenberger's research and extension goal is to advance tools for effective watershed management, reduce nutrient and pesticide losses to surface and ground water, and protect drinking water. Her research focuses on watershed modeling, agricultural drainage management, and water quality impacts of agricultural conservation practices. She recently developed a GIS-based model of the variable source area runoff-generating process responsible for transport of pollutants such as pathogens and pesticides transported primarily by surface runoff.

Selected Publications:

- Sui, Y. and **J.R. Frankenberger**, 2008. Nitrate loss from subsurface drains in an agricultural watershed using SWAT 2005. *Trans. Am. Soc. Agric. Biol. Eng* 51(4): 1263-1272.
- Ale, S., L.C. Bowling, **J.R. Frankenberger**, S.M. Brouder, and E.J. Kladvko, 2010. Climate Variability and Drain Spacing Influence on Drainage Water Management System Operation. *Vadose Zone Journal*. doi:10.2136/vzj2008.0170.
- Ale, S., L.C. Bowling, P.R. Owens, S.M. Brouder and **J.R. Frankenberger**, 2012. A distributed modeling approach to assess the watershed-scale impact of drainage water management. *Agricultural Water Management*. 107:23-33. doi:10.1016/j.agwat.2012.01.003.

James L. Garrison

jgarriso@purdue.edu, (765) 496-7482

Associate Professor of Aeronautics and Astronautics, Electrical and Computer Engineering, and Environmental and Ecological Engineering

Ph.D., Aerospace Engineering Sciences, University of Colorado-Boulder, 1997

M.S., Aeronautics and Astronautics, Stanford University, 1990?

B.S., Aeronautical Engineering, Rensselaer Polytechnic Institute, 1988



Research Interests: Dr. Garrison's research focuses on developing new techniques for Earth remote sensing in microwave frequencies using signals of opportunity. His is presently conducting several projects to improve the sensing of ocean winds, ocean salinity, atmospheric water vapor and seismic events. Recently he has proposed methods for measuring soil moisture at depths of several decimeters and is conducting field experiments to test this approach. The size, weight and power of instruments based upon these principles are an order of magnitude smaller than the present state of art instruments, enabling them to be deployed on small "nanosatellites" or unmanned aerial vehicles (UAVs).

Selected Publications:

- Garrison, J.L.**, Voo, J.K., Yueh, S.H., Grant, M.S., Fore, A.G., and Haase, J.S., "Estimation of Sea Surface Roughness Effects in Microwave Radiometric Measurements of Salinity Using Reflected Global Navigation Satellite System (GNSS-R) Signals," *IEEE Geoscience and Remote Sensing Letters*, Vol. 8, No. 9, p 1170 – 1174, Nov. 2011.
- Shah, R., Garrison, J.L.**, and Grant, M.S., "Demonstration of Bistatic Radar for Ocean Remote Sensing using Communication Satellite Signals," *IEEE Geoscience and Remote Sensing Letters*, in press, Nov., 2011.
- Yang, Y-M, **Garrison, J.L.**, and Lee, S-C, "Ionospheric Disturbances Observed Coincident with the 2006 and 2009 North Korean Underground Nuclear Tests," *Geophysical Research Letters*. Vol. 39, No. 2, L02103 DOI: 10.1029/2011GL050428, Jan. 27, 2012.



Carol A. Handwerker

handwerker@purdue.edu, (765) 494-0147

Professor of Agricultural Engineering, Food Science, and Environmental and Ecological Engineering

Sc.D., Ceramics, Massachusetts Institute of Technology, 1983

S.M., Ceramics, Massachusetts Institute of Technology, 1983

S.B., Materials Science Engineering, Massachusetts Institute of Technology, 1978

B.A., Art History, Wellesley College, 1973

Research Interests: Dr. Handwerker's research program at Purdue is focused on Pb-free interconnects, particularly for high reliability server, military, and aerospace electronic systems, on innovative strategies for next-generation electronic packaging, and on including sustainability in the design of new electronic materials, processes, and products. Dr. Handwerker is also the faculty principle investigator for IGERT's "Global Traineeship in Sustainable Electronics."

Selected Publications:

Integrated Sustainable Life Cycle Design: A Review, K. Ramani, D. Ramanujan, W.Z. Bernstein, F. Zhao, J. Sutherland, C. Handwerker, J.K. Choi, H. Kim, D. Thurston, Journal of Mechanical Design, 132 (9) 091004, Sept. 2010.

GreenTV: A Project-based Learning Module on Sustainable Electronics, Proceedings of IEEE International Symposium on Sustainable Systems and Technology (ISSST) Chicago, IL May 16-18, 2011.

Utilizing the thermodynamic nanoparticle size effects for low temperature Pb-free solder J. P. Koppes, K.A. Grossklaus, A.R. Muza, R.R. Revur, S. Sengupta, A. Rae, E.A. Stach, C.A. Handwerker, Materials Science and Engineering B – Advanced Functional Solid-State Materials, 177 (2) 197-204 2012.

**Michael T. Harris**

mtharris@purdue.edu, (765) 496-9697

Associate Dean of Engineering for Undergraduate Education, Professor of Chemical Engineering and Environmental and Ecological Engineering

Ph.D., Chemical Engineering, University of Tennessee-Knoxville, 1992

M.S., Chemical Engineering, University of Tennessee-Knoxville, 1987

B.S., Chemical Engineering, Mississippi State University, 1981

Research Interests: Dr. Harris' research is in the field of environmental control technology. It focuses on the formation of calcium carbonate nanoparticles during the scrubbing of CO₂ from gases, and the development of novel electrokinetics techniques for the removal of ions and charge-carrying contaminants from concrete and other porous media. In the case of the electrokinetics research, algorithms are being developed to accurately account for the complex chemistry of the porous media and the constituents in the liquid phase.

Selected Publications:

M. T. Harris*, D. W. DePaoli and M. R. Ally, "Modeling the Electrokinetic Decontamination of Concrete," /Sep. Sci. Technol., /32/, /827-848 (1997).

D. W. DePaoli, M. T. Harris, I. L. Morgan and M. R. Ally, "Investigation of Electrokinetic Decontamination of Concrete," /Sep. Sci. Technol., /32/, 387-404 (1997).

Y. Zhao, M. T. Carvajal, Y. Y. Won and M. T. Harris, "Preparation of Calcium Alginate Microgel Beads by Electrodipersion Reaction Using Internal Source of Calcium Carbonate Nanoparticles," /Langmuir/, *23*, 12489-12496/ (2007).



John A. Howarter

howarter@purdue.edu, (765) 496-3103

Assistant Professor of Materials Engineering and Environmental and Ecological Engineering

Ph.D., Materials Engineering, Purdue University, 2008

B.S., Materials Science & Engineering, Ohio State University, 2003

Research Interests: Dr. Howarter's research group is focused on surface and interfacial phenomena of soft materials. They are currently investigating new synthesis and processing methods to improve performance of desalination membranes. Other projects include design of functional polymer-clay nanocomposites, measurement and characterization of polymer degradation mechanisms in aqueous environments, and development of polymer coatings with selective ion transport properties.

**Selected Publications:**

- W. L. Elban, **J. A. Howarter**, M. C. Richardson, P. E. Stutzman, A. M. Forster, A. J. Nolte, G. A. Holmes; Influence of solvent washing on interlayer structure of alkylammonium montmorillonites. *Applied Clay Science* 2012, 61 (2012) 29–36.
- J. A. Howarter**, C. M. Stafford; Instabilities as a measurement tool for soft materials. *Soft Matter* 2010, 6 (22), 5661 – 5666.
- J. A. Howarter**, J. P. Youngblood; Amphiphile grafted membranes for the separation of oil-in-water dispersions. *Journal of Colloid and Interface Science* 2009, 329 (1), 127-132.

Inez Hua

hua@purdue.edu, (765) 494-2409

Professor of Civil Engineering and Environmental and Ecological Engineering

Ph.D., Environmental Science and Engineering, California Institute of Technology, 1995

M.S., Environmental Science and Engineering, California Institute of Technology, 1992

B.A., Biochemistry, University of California, Berkeley, 1990

Research Interests: Dr. Hua has expertise in aquatic chemistry, environmental sustainability, and water pollution control, and the environmental fate of organic contaminants. She has recently completed projects related to the photochemistry of emerging contaminants, and water consumption in supply chains. Additional research areas include sustainable electronics, and environmental sustainability in engineering education. Dr. Hua is also the Director of an REU Site: "Tackling some of the Grand Challenges for Engineering."

**Selected Publications:**

- Kuo, Y-M., Sepulveda, Maria S., Sutton, T.M., Ochoa-Acuna, H.G., Muir, A. M., Miller, B., **Hua, I.**, Bioaccumulation and biotransformation of decabromodiphenyl ether and effects on daily growth in juvenile lake whitefish (*Coregonus clupeaformis*), *Ecotoxicology*, published on-line December 22, 2009. DOI 10.1007/s10646-009-0451-x.
- Nienow, A.; **Hua, I.**; Poyer, I.; Bezares-Cruz, J.C.; Jafvert, C., A Multifactor Statistical Analysis of the H₂O₂ Enhanced Photodegradation of Nicotine and Phosphamidon, *Industrial and Engineering Chemistry Research*, 48(8), pp. 3955–3963, 2009.
- Bezares-Cruz*, J., Jafvert, C., **Hua, I.**, Solar Photodecomposition of Decabromodiphenyl Ether: Products and Quantum Yield, *Environmental Science and Technology*, 8(15), pp. 4149 -4156, 2004.



Chad T. Jafvert

jafvert@purdue.edu, (765) 494-2196

Professor of Civil Engineering and Environmental and Ecological Engineering

Ph.D., Civil and Environmental Engineering, University of Iowa, 1985

M.S., Civil and Environmental Engineering, University of Iowa, 1982

B.S., Biochemistry, Iowa State University, 1979

Research Interests: Dr. Jafvert's research areas include chemical speciation and distribution in engineered and natural systems, environmental photochemistry, environmental monitoring and assessment, environmental chemistry of surfactants, sediment remediation and risk assessment, and chlorine chemistry. His current research project topics include manufactured carbon nanomaterials in the aquatic environment, photochemical and fungal transformations of carbon nanotubes in the environment, and coal tar contaminated sediments.

Selected Publications:

Hou, Wen-Che, Lingjun Kong, Kevin A. Wepasnick, Richard G. Zepp, D. Howard Fairbrother, and **Chad T. Jafvert**, "Photochemical Transformation of Aqueous C60 Clusters: Wavelength Dependency and Product Characterization", *Environ. Sci. Technol.*, 44:6674-6679, 2010.

Gall, Heather E., Stephen A. Sassman, Linda Lee, **Chad T. Jafvert**, "Hormone Discharges from a Midwest Tile-Drained Agroecosystem Receiving Animal Wastes", *Environ. Sci. Technol.*, 45:8755-8764, 2011.

Hyun, Seunghun, Hyun Park, Mi-Youn Ahn, Andrew R. Zimmerman, and **Chad T. Jafvert**, "Fluxes of PAHs from coal tar-impacted river sediment under variable seepage rates", *Chemosphere*, 80:1261-1267, 2010.

**Rabi H. Mohtar**

mohtar@purdue.edu, (765) 494-1791

Professor of Agricultural and Biological Engineering and Environmental and Ecological Engineering

Ph.D., Agricultural Technology and Systems Management, Michigan State University, 1994

M.Sc., Civil and Environmental Engineering, Michigan State University, 1992

M.Sc., Irrigation Science, American University in Beirut, 1985

B.S., Agricultural Engineering, American University in Beirut, 1983

Research Interests: Professor Mohtar has integrated research from field and lab into multimedia computer technologies in order to develop water quality and hydrologic system research programs that can be used by others. He led the development of a new paradigm in multi-scale soil water characterization and modeling which distinguishes between the micro, macro, and local water exchange of the representative elementary volume (REV) and characterizes the medium considering the soil shrinkage, swelling, and water potential properties of the medium.

Selected Publications:

Abou Najm, M.R., **R.H. Mohtar**, K.A. Cherkauer, and B.F. French. 2009. Effect of Integrating Hydrologic Scaling Concepts on Students' Learning and Decision Making Experiences. *Advances in Engineering Education*. In press.

Ouessar, M., A. Bruggeman, F. Abdelli, **R.H. Mohtar**, D. Gabriels, and W. Cornelis. 2009. Modelling water-harvesting systems in the arid south of Tunisia using SWAT. *Hydrology and Earth System Sciences Discussions. Hydrology and Earth System Sciences*, 13:2003-2021, 2009. www.hydrol-earth-syst-sci.net/13/2003/2009/

Belhouchette, H., E. Braudeau, **R.H. Mohtar**, M. Donatelli, and Wery. 2008. Integrating Spatial Soil Organization Data with a Regional Agricultural Management Simulation Model: a Case Study in Northern Tunisia. *Transactions of the ASABE*. 51(3): 1099-1109.



Larry Nies

Nies.ecn.@purdue.edu, (765) 494-8327

Professor of Civil Engineering and Environmental and Ecological Engineering

Ph.D., Civil and Environmental Engineering, The University of Michigan, 1993

M.S.E, Civil and Environmental Engineering, The University of Michigan, 1989

B.S., Civil Engineering, Michigan State University, 1987

B.A., Chemistry, Michigan State University, 1982



Research Interests: Dr. Nies' research interests include optimizing the future capacities of interdependent urban infrastructure systems and the molecular genetic characterization of the structure and function of microbial communities. Dr. Nies' research group also develops molecular genetic tools to assess the effects of anthropogenic chemicals on microbial communities. These tools can be used to evaluate and monitor the progress of bioremediation projects by quantifying catabolic genes, or to investigate the potential toxic impacts of new chemicals.

Selected Publications:

Turco R.F., M. Bischoff, Tong, Z., and **L.F. Nies**. 2011. Environmental implications of nanomaterials: are we studying the right thing? *Current Opinion in Biotechnology*, 22:527-532.

Grant, G.B., T. Seager, G. Massard. **L. Nies**. 2010. Information and Communication Technology for Industrial Symbiosis. *J. Industrial Ecology*, 14:740-753.

Baldwin, B. R., C.H. Nakatsu, J. Nebe, G.S. Wickham, C. Parks, and **L. Nies**. 2009. 163:524-530. Enumeration of Aromatic Oxygenase Genes to Evaluate Biodegradation during Multi-Phase Extraction at a Gasoline-Contaminated Site. *J. Hazardous Materials*.

Karthik Ramani

ramani@purdue.edu, (765) 494-5725

Donald W Feddersen Professor of Mechanical Engineering, Professor of Environmental and Ecological Engineering, Professor of Electrical and Computer Engineering (by courtesy)

Ph.D., Mechanical Engineering, Stanford University, 1991

M.S., Mechanical Engineering, The Ohio State University, 1987

B.S. IIT, Madras, Mechanical Engineering, 1985



Research Interests: Dr. Ramani's research lies at the intersection of mechanical engineering and information science and technology. His research areas encompass design and manufacturing, machine learning, geometric computing and human-computer natural user interaction and interfaces. A major area of emphasis in his group are computer support for early design, shape representations for search, sketch-based design, cyber-learning for design education, and sustainable design.

Selected Publications:

Devanathan S, Ramanujan D, Bernstein WZ, Zhao F, **Ramani K**, 2010, "Integration of Sustainability into Early Design through the Function Impact Matrix," *Journal of Mechanical Design*, Vol. 132, No. 8, 081004 (8 pp).

Ramani K, Ramanujan D, Bernstein WZ, Zhao F, Sutherland J, Handwerker C, Choi JK, Kim H, Thurston D, 2010, "Integrated Sustainable Life Cycle Design: A Review," *Journal of Mechanical Design*, Vol. 132, No. 9, 091004 (15 pp).

Bernstein WZ, Ramanujan D, Zhao F, Cox MF, **Ramani, K**, 2012, "Teaching Design for Environment through Critique within a Project-Based Product Design Course," *International Journal of Engineering Education*, Vol. 28, No. 4, pp. 1-12.



P Suresh Rao

pscr@purdue.edu, (765) 496-6554

Lee A. Rieth Distinguished Professor of Civil Engineering, Professor of Agronomy, Professor of Environmental and Ecological Engineering

Ph.D., University of Hawaii, 1974

M.S., Colorado State University, 1970

B.S., Agriculture University, India, 1967



Research Interests: Dr. Rao's current research and educational interests are focused on two themes: multi-scale modeling and analysis of landscape hydrologic and biogeochemical process linkages across human-impact gradients, including intensively managed croplands, urban catchments, and wetlandscapes; and resilience-based analysis of coupled natural and engineered complex systems, including food-bioenergy-water sustainability issues. His past projects have involved development and use of models for water and chemical dynamics in soil and groundwater systems.

Selected Publications:

Basu, N., G. Destouni, J. W. Jawitz, S. E. Thompson, N. V. Loukinova, A. Darracq, S. Zanardo, M. Yaeger, M. Sivapalan, A. Rinaldo, and **P. S. C. Rao** (2010), Nutrient loads exported from managed catchments reveal emergent biogeochemical stationarity, *Geophysical Research Letters*, 37, L23404.

Harman, C. J., **P. S. C. Rao**, N. B. Basu, G. S. McGrath, P. Kumar, and M. Sivapalan (2011), Climate, soil, and vegetation controls on the temporal variability of vadose zone transport, *Water Resources Research*, 47, W00J13.

Thompson, S. E., C. J. Harman, R. Schumer, J. S. Wilson, N. B. Basu, P. D. Brooks, S. D. Donner, M. A. Hassan, A. I. Packman, **P. S. C. Rao**, P. A. Troch, and M. Sivapalan (2011), Patterns, puzzles and people: implementing hydrologic synthesis, *Hydrological Processes*, 25(20), 3256-3266.

John W. Sutherland

jwsuther@purdue.edu, (765) 496-9697

Professor and Fehsenfeld Family Head: Division of Environmental and Ecological Engineering

Ph.D., Mechanical Engineering, University of Illinois at Urbana-Champaign, 1987

M.S., Industrial Engineering, University of Illinois at Urbana-Champaign, 1982

B.S., Industrial Engineering, University of Illinois at Urbana-Champaign, 1980



Research Interests: Professor Sutherland's research is focused on environmentally responsible design and manufacturing. Specific initiatives that he has pursued include: promoting closed loop material cycles through remanufacturing and recycling, pursuing more energy efficient and reduced environmental footprints of manufacturing processes, planning the logistics of biofuel production, developing indicators for corporate assessment of social sustainability, and investigating sources of manufacturing airborne emissions.

Selected Publications:

Kumar, V., and **J. W. Sutherland**, "Development and Assessment of Strategies to Ensure Economic Sustainability of the U.S. Automotive Recovery Infrastructure," *Resources, Conservation & Recycling*, 53/8, 2009, pp. 470-477.

Hutchins, M. J. and **J. W. Sutherland**, "An Exploration of Measures of Social Sustainability and Their Application to Supply Chain Decisions," *Journal of Cleaner Production*, Vol. 16, 2008, pp. 1688-1698.

Sutherland, J. W., D. P. Adler, K. R. Haapala, and V. Kumar, "A Comparison of Manufacturing and Remanufacturing Energy Intensities with Application to Diesel Engine Production," *Annals of CIRP*, 57/1, 2008, pp. 5-8.



Bernard Y. Tao

tao@purdue.edu, (765) 494-1183

Professor of Agricultural Engineering, Food Science, and Environmental and Ecological Engineering

Ph.D., Chemical Engineering, Iowa State University, 1988

M.S., Chemical Engineering, Massachusetts Institute of Technology, 1977

B.S., Chemical Engineering, Massachusetts Institute of Technology, 1976

Research Interests: Dr. Tao's research focuses on utilizing biological and chemical technologies to utilize renewable resources in the production of commercial and industrial products. His research involves using genetic and chemical techniques to understand enzymatic mechanisms and biochemical conversion of natural materials to make industrial products. Current research projects involve developing lipid-based biofuels and chemicals, bio-based super adhesives, bio-based concrete sealants, and novel DNA-protein bioconjugates.

Selected Publications:

Allen, D. K and **B. Y. Tao**, Kinetic Characterization of Enhanced Lipid Activity on Oil Bodies, *Bioprocess and Biosystems Engineering*, 30(4) 2007 271-279.

Kim, Hyun, S. Y. Kim, N. S. Han, and **B. Y. Tao**, Solubilization Conditions for Hydrophobic Membrane Protein, Oleosin, in Soybeans, *Biotechnol. Bioprocess Eng.* 12 (5) 2007 542-547.

Coates, K. C., S. Mohtar, **B. Y. Tao**, and Weiss, J., Can Soy Methyl Esters Reduce Fluid Transport and Improve Durability of Concrete, *J. Transportation Research Board*, 2113, 2009, 22-30.

**Fu Zhao**

zhao@purdue.edu, (765) 494-6637

Assistant Professor of Mechanical Engineering and Environmental and Ecological Engineering

Ph.D., Mechanical Engineering, University of Michigan, 2005

M.S., Electrical Engineering Systems, University of Michigan, 2001

M.E., Thermal Engineering, Tsinghua University, 1996

B.S., Environmental Engineering, Thermal Engineering, Tsinghua University, 1993

Research Interests: Dr. Zhao's research focuses on sustainability issues related to the manufacturing process and the life cycle of manufactured products. Some of his current research project topics include assessing the sustainability of solar thermal systems, integrating sustainability factors into product design and process planning, soybean oil based metalworking fluids, water footprint quantification of manufacturing processes, gasification of waste biomass for liquid fuel production, and biofuel supply chain dynamics under disturbances.

Selected Publications:

Quantifying the water inventory of machining processes, **Zhao, Fu**; Ogaldez, Jonathan; Sutherland, John W.; *CIRP Annals - Manufacturing Technology*, 2012.

Life cycle assessment of potential biojet fuel production in the United States, Agusdinata, Datu B; **Zhao, Fu**; Ileleji, Klein; Delaurentis, Dan; *Environmental Science and Technology*, v 45, n 21, p 9133-9143, November 1, 2011.

Integration of sustainability into early design through the function impact matrix, Devanathan, Srikanth; Ramanujan, Devarajan; Bernstein, William Z.; **Zhao, Fu**; Ramani, Karthik; *Journal of Mechanical Design, Transactions of the ASME*, v 132, n 8, p 0810041-0810048, August 2010.



Representative EEE Research Projects

Water Sustainability Issues

- “Aging and Degradation of Polymer Thin Films and Membranes for Water Treatment Applications,” Purdue Research Foundation, J. A. Howarter.
- “Characterization of Chloramines in Source Waters from an Advanced Water Purification Facility by membrane Introduction Mass Spectrometry (MIMS) and Wet-Chemical Methods,” Orange Cry Soil and Water Conservation District, E. R. Blatchley.
- “Cumulative Impacts of BMP Implementation in the Maumee River Basin,” Environmental Protection Agency, J. R. Frankenburger, I. Chaubey, V. M. Merwade.
- “Darcy Flux and Water Level Elevation Data Collection of the Grand Calumet River, Hammond, IN,” Weston Solutions, U.S. Department of Energy, C. T. Jafvert.
- “Design and Processing of Porous Polymer Components for Slow Sand Water Filters,” Kimberley-Clark, J. Howarter, C. Jafvert.
- “Design of a Low Cost, Self-Operating Hydraulic Ram Pump for Water Retention and Lifting in Developing Countries: Bringing Clean Water to Haiti,” Environmental Protection Agency, B. A. Engel.
- “Empowering Water Quality Programs with Data Flows and Web-Based Decisions in the Field,” Environmental Protection Agency, B. A. Engel.
- “French-American Symposium. Developing Partnerships for Sustainable Water,” National Science Foundation, R. H. Mohtar.
- “The Great Lakes Tributary Modeling Program,” U.S. Army Corps of Engineering, K. Cherkauer, B. Engel, I. Chaubey.
- “Impact of Biofeedstock Production on Hydrology and Water Quality in Midwest and Southeast USA,” Cooperative State Research Service, U.S. Department of Agriculture, I. Chaubey.
- “Meeting Indiana’s Changing Needs for Building Capacity among Watershed Leaders to Address Nonpoint Source Pollution,” Indiana Department of Environmental Management, Environmental Protection Agency, J. R. Frankenburger, L. Prokopy.
- “Mobile Computing Technologies to Enable More Efficient Water Management Decisions in the Field,” National Institute of Food and Agriculture, U.S. Department of Agriculture, I. Chaubey, J. R. Frankenburger, D. Buckmaster, J. Krogmeier.
- “Monitoring Episodic River Inflow Plumes Using In-Situ and Remote Sensing Data,” University of Illinois, Environmental Protection Agency, I. Chaubey, K. Cherkauer, C. Troy.
- “Multi-objective Watershed Management Support System for Spatial Allocation of Agricultural Conservation Practices,” Cooperative State Research Service, U.S. Department of Agriculture, B. A. Engel, J. R. Frankenburger, I. Chaubey, J. G. Lee.
- “Multi-sensor Assessment of Urban Impacts in the Great Lakes Region,” National Aeronautics and Space Administration, K. Cherkauer, L. Bowling, S. Pijanowski, D. Niyogi.
- “Numerical Models for Prediction of Fouling and its Effects on Reactor Performance in UV Disinfection Systems,” Water Research Foundation, E. R. Blatchley.
- “Preparing Tomorrow’s Leaders to Tackle Complex Water Quality Problems through Field Experiment Capabilities at Purdue,” Purdue University College of Agriculture, K. Cherkauer, I. Chaubey, L. Bowling, R. Goforth, R. Mohtar, S. Hoffman.
- “Regional Water Quality Leadership,” University of Wisconsin-Madison, U.S. Department of Agriculture, J. R. Frankenburger, L. Prokopy, B. Joern, E. Kladviko.
- “Remote sensing of Water Quality Indicators in the Wabash River,” Purdue Agricultural Research Program, K. Cherkauer, I. Chaubey.
- “Removal of Organic Contaminants From Drinking Water Using Functionalized Polyester Films,” DuPont Teijin Films, E. R. Blatchley.
- “State Water Research Institute Program,” U.S. Geological Survey, U.S. Department of Interior, R. H. Mohtar, P. S. C. Rao, R. F. Turco.
- “Using Great Lakes Regional Research Information Network to Better Understand Lake Michigan Nutrients,” Environmental Protection Agency Great Lake Restoration Initiative, K. Cherkauer, I. Chaubey, C. Troy.



- “Water Quality Exchange Data (WQX) Program,” Environmental Protection Agency, B. A. Engel.
- “Watershed Scale Optimization to Meet Sustainable Cellulosic Energy Crop Demand,” U.S. Department of Energy, J. R. Frankenberger, B. A. Engel, I. Chaubey, K. Cherkauer, P. Murphy, R. Goforth, J. Volenec, L. Bowling, B. Gramig.
- “Watershed Planning and Management in the Great Lakes region (USEPA Region),” University of Wisconsin, U.S. Department of Agriculture, J. R. Frankenberger.
- “The Great Lakes Tributary Modeling Program: Work Plan for Purdue University and Michigan State University,” U.S. Geological Survey, U.S. Department of Interior, B. A. Engel.
- “USDA Science Advisor-Water Quality Initiatives,” National Resources Conservation Services, U.S. Department of Agriculture, J. R. Frankenburger.
- “U.S.-India Consortium on International Water Management,” Iowa State University, U.S. Department of Agriculture, R. H. Mohtar.

Sustainable Energy

- “Bioenergy and Biological Systems Engineering; an Educational Consortium for a Sustainable Agriculture,” University of Illinois, U.S. Department of Education, B. A. Engel.
- “Development of a High Performance Cold Climate Heat Pump,” U.S. Department of Energy, J. E. Braun, W. T. Horton, E. Groll.
- “Energy Efficient Building Systems Regional Innovation Cluster Initiative,” Pennsylvania State University, U.S. Department of Energy, J. E. Braun, Q. Chen, A. Tzempelikos, M. Saeedifard, P. Karava, J. Hu, W. T. Horton, S. Pekarek.
- “OISE-PIRE: Sustainability, Ecosystem Services, and Bioenergy Development across the Americas”, National Science Foundation, J. W. Sutherland, W. E. Tyner.
- “Performance Testing of Ductless Heat Pumps,” Ecotope Inc, National Renewable Energy Laboratory, J. E. Braun.
- “Sustainable Production and Distribution of Bioenergy for the Central USA,” Iowa State University, U.S. Department of Agriculture, I. Chaubey, K. Johnson, J. Volenec, P. Murphy, K. Johnson, N. Olynk, C. Martin, K. Orvis, C. Alexander.
- “Wind Energy and Sustainable Energy Solutions,” Wichita State University, U.S. Department of Energy, F. Zhao.

Climate Change and Greenhouse Gasses

- “Assessing 21st Century Changes in Flood Risk Related to Climate Change along the Upper Mississippi River,” Bipartisan Policy Center’s National Commission on Energy Policy, K. Cherkauer.
- “Carbon Footprint Reduction,” Biomet Inc., F. Zhao and J. W. Sutherland.
- “Climate Change, Mitigation, and Adaption in Corn-Based Cropping,” Iowa’s State University, U.S. Department of Agriculture, C. T. Jafvert, J. R. Frankenburger, E. Kladienko, L. Bowling, E. Kladienko, P. Owens, C. Hibberd.
- “Climate-Induced Changes to Fisheries Habitat in Lake Michigan, An Integrated System Approach,” National Oceanic and Atmospheric Association, K. Cherkauer, T. Hook, J. Doucette, L. Ivan, L. Prokopy, C. Troy.
- “Interactive Effects of Climate Change and Land Use on Indiana’s Glacial Lakes,” Purdue University Discovery Park, K. Cherkauer, I. Chaubey, L. Prokopy, B. Pijanowski.

Life Cycle Assessment and Analysis, Sustainable Manufacturing

- “Development of a Unit Process Life Cycle Inventory for Deformation Processes,” General Dynamics, F. Zhao and J. W. Sutherland.
- “Development of a Unit Process Life Cycle Inventory,” Department of Energy, Wichita State University, F. Zhao and J. W. Sutherland.
- “Enabling Economic and Environmental Sustainability of Solar Thermal Systems via Temporally and Spatially Explicit Life Cycle Assessment,” National Science Foundation, F. Zhao, M. Qu.
- “Evaluation of Sealers and Water-proofers for Extending the Life Cycle of Concrete,” Indiana Department of Transportation, U.S. Department of Transportation, B. Y. Tao, W. J. Weiss.



- “Integrating Design and Manufacturing Considerations towards Sustainable Decision Making,” National Science Foundation, K. Ramani, F. Zhao, and J. W. Sutherland.
- “Life Cycle Assessment and Policy Aspects of Brominated Flame Retardants,” I Hua.
- “Planning Grant: I/URC for Resource, Recovery. And Recycling,” National Science Foundation, C. Handwerker, F. Zhao, J. Youngblood, A. Iyer, and J. W. Sutherland.
- “Sustainable Electronics: Materials Design and Life Cycle Assessment of Polymer-Clay Composites for Circuit Board Applications,” National Science Foundation IGERT, I. Hua, J. Howarter.
- “Value Characterization across the Product Lifecycle to Support Green Project Lifecycle Management and New Business Creation,” Project Lifecycle Management Center, K. Ortegón, L. Nies, and J. W. Sutherland.
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Engineering Education

- “An Examination of Graduate Education’s Role in Preparing Engineering Students for Careers in Academia and Industry, National Science Foundation: CARREER, M. Cox.
- “Creation of an Instrument to Measure Selected Attributes in Purdue’s Engineer of 2020, Purdue University, M. Cox.
- “Developing Leadership Capacity in Undergraduate Engineering Students,” Purdue University Leadership Case Studies, M. Cox, B. D. Sypher, E. Groll, Y. Haller.
- “Enable Project-Based Learning of Ecodesign: Method Development and Curriculum Reform,” National Science Foundation, K. Ramani, F. Zhao.
- “Engineering Students’ Attitudes and Threshold Concepts Toward Sustainability,” National Science Foundation, I. Hua, J. Strobel.
- “How Can Large Scale Hydrologic Modeling Enhance Student Learning and Decision Making?” U.S. Department of Agriculture, R. H. Mohtar, K. C. Cherkauer, B. F. French.
- “Partnership for Recruiting and Retaining High Need, High Potential Students to Food, Environmental, Engineering, and Life Sciences (FEELS),” National Science Foundation, R. H. Mohtar, W. D. Burgess, P. Morris.
- “Reinvigoration Engineering and Changing History (REACH) Scholars Program,” Scholarships in Science, Technology, Engineering and Mathematics (S-STEM), M. Cox, A. Fentimen, C. Lynch, P. Dunston, D. Evangelou.

Nutrient Cycling

- “Adaptive management to increase adoption rates of emerging nutrient management and load reduction practices,” National Resources Conservation Services, U.S. Department of Agriculture, J. R. Frankenburger.
- “Demonstrating Nitrogen Treatment Effectiveness through Innovative Bench Wetland Systems,” National Resources Conservation Services, U.S. Department of Agriculture, I. Chaubey, L. Bowling, R. Goforth.

Environmental Fate of Nano Materials

- “NIRT: Response of Aquatic and Terrestrial Microorganisms to Carbon-Based Manufactured Nanoparticles,” National Science Foundation, L. F. Nies, R. F. Turco.
- “Photochemical and Fungal Transformations of Carbon Nanotubes in the Environment,” Environmental Protection Agency, C. T. Jafvert, T. Filley.
- “Photochemical Fate of Manufactured Carbon Nano Materials in the Aquatic Environment,” Environmental Protection Agency, I. Hua, C. T. Jafvert.

Other Environmental Topics

- “Development and Demonstration of Outcomes-Based Evaluation Framework for the Indiana Nonpoint Source Program,” Indiana Department of Environmental Management, Environmental Protection Agency, J. R. Frankenburger.
- “Effects of UV-Based Treatment on Air and Water Chemistry in Chlorinated, Indoor Swimming Pool Facilities,” National Swimming Pool Foundation, American Chemistry Council, E. R. Blatchley.
- “Greatly Increased Use of Fly Ash in Hydraulic Cement Concrete (HCC) for Pavement Layers and Transportation,” Federal Highway Administration Office of Financial Services, B. Y. Tao, W. J. Weiss, J. Olek.



- "IGERT: Global Traineeships in Sustainable Electronics," National Science Foundation, C. Handwerker, M. Hosur, I. Hua, K. Ramani, A. Fentiman.
- "Investigating the Characteristics of Lower Tropospheric Airborne GPS Radio Occultation Observations and their Impact in Hurricane Studies," National Science Foundation, J. L. Garrison, J. Haase.
- "Minimizing Equivalent System Mass For A Regenerative Life-Support System By Optimizing Kinetics And Energetics of Major Bio-Transformations," National Air and Space Administration, L. F. Nies, C. A. Mitchell.
- "Modeling Methods to Evaluate Low Impact Development," University of Illinois, National Oceanic and Atmospheric Administration, B. A. Engel.
- "Nanostructural Design for Selective Ion Transport in Polymer Membranes," Purdue Research Foundation, J. A. Howarter.
- "Predicting DNAPL Source Zone and Plume Response Using Site-Measured Characteristics," University of Florida, Strategic Environmental Research and Development Program, P. S. C. Rao.
- "Pyroprocessing of Scrap Nuclear Fuel," Argonne National Laboratory, A. Fentiman.
- "Systemic Evaluation of Biotransformation Potentials Of Commercial Model Fluorotelomers in Soils," National Science Foundation, L. F. Nies, L. S. Lee.
- "Tackling Some of the Grand Challenges of Engineering, REU Site," National Science Foundation, I. Hua and M. Harris.

