Research Centers and Institutes

Center for Bone and Tissue Repair and Regeneration (CBTRR)

McNutt Hall
Mohamed N. Rahaman (Director)

Faculty
R.K. Brow, R.F. Brown, D.E. Day, C.S. Kim, M.C. Leu, F.S. Miller, H. Xiao

Research Investigators
R.K. Brow (Materials Science & Engineering); R.F. Brown (Biological Sciences); D.E. Day (Materials Science & Engineering); Y-W. Huang (Biological Sciences); C-S. Kim (Electrical & Computer Engineering); H-K. Lee (Mining & Nuclear Engineering); M.C. Leu (Mechanical & Aerospace Engineering); Y. Liu (Materials Science & Engineering); Y. Ma (Chemistry); H. Shi (Chemistry); S. Usman (Mining & Nuclear Engineering); J.C. Wang (Chemical & Biological Engineering); H. Xiao (Electrical & Computer Engineering); Z. Yin (Computer Science); Y.R. Zheng (Electrical & Computer Engineering)

The Center for Bone and Tissue Repair and Regeneration (CBTRR) is a multidisciplinary research center with a mission to research and develop advanced biomaterials and biomedical devices for the repair and regeneration of bone and soft tissues.

The objectives of the Center are to:
- Promote interdisciplinary collaboration that enhances the rate of scientific discovery and technological advances to develop the next generation of biomaterials and biomedical devices
- Enhance facilities and equipment for research in biomaterials and biomedical devices
- Develop research and education programs to train the next generation of biomedical/biomaterials engineers, providing a future workforce for the vital biotechnology industry in Missouri and the US
- Promote technology transfer and entrepreneurship to commercialize new knowledge, which should improve patient outcomes and expand economic development in Missouri and the US

Key research and development areas include:
- Bioactive glass science and engineering
- Bioactive glass and bioactive ceramic scaffolds for regenerating bone
- Nanofibrous bioactive glass for healing soft tissue wounds
- Nanostructured biocompatible phosphate devices for drug and growth factor delivery
- Biomedical devices to monitor healing of bone and soft tissues

To contact us, please visit our web page at http://cbtrr.mst.edu or e-mail: cbtrr@mst.edu or call (573)341-4711.

Center for Environmental Science and Technology (CEST)

Bureau of Mines Building #1
Virgil J. Flanigan, Ph.D.; P.E. (Director)

Senior Investigators
K. Chandrashekhara (Mechanical Engineering), D. Forciniti (Chemical Engineering), S. Kapila (Chemistry), Y. Ma (Chemistry), Gerald Wilemski (Physics)

Research Investigators
J. Drallmeier, P. Nam (Chemistry),R. Richter, R. Seemamahannop (Chemistry), D.J. Westenberg (Biological Sciences).

The Center for Environmental Science and Technology (CEST) is an expression of commitment by the University to be a positive force in helping society deal with environmental problems and concerns. Its mission is to involve students in the resolution of real-world environmental problems by enlisting them in research programs at Missouri S&T. To this end, CEST fosters academic (students and faculty), industrial, and government laboratory participation in interdisciplinary environmental research. This multi-faceted program brings to bear new and existing technologies to the solution of environmental problems.

CEST may, therefore, be considered a catalyst for environmental research and teaching. It brings together under a common umbrella more than 15 faculty as senior investigators, research investigators, and adjunct investigators. Represented are nine engineering, physical science, biological science, mining, and metallurgical disciplines. CEST also brings together a wide array of extraordinary laboratories and institutes. These have an impressive array of capabilities and unique expertise in cloud and aerosol sciences, materials research and recycling, environmental trace analysis, material characterization, toxicology, coatings technology, environmental monitoring, and many other areas. To contact us e-mail CEST@mst.edu.

Center for Infrastructure Engineering Studies (CIES)

223 Engineering Research Lab
Kamal H. Khayat (Director)

Staff
Jason Cox (Senior Research Specialist); Abigayle Sherman (Program/Project Support Specialist); Gayle Spitzmiller (Administrative Assistant); John Bullock (Research/Laboratory Technician); Cheryl Geisler (Secretary).

Researchers
Kamal Khayat (CArE); Neil Anderson (Geological Sciences & Engineering); Bate Bate (CArE); Chandrashekhara, K. (Mechanical and Aerospace Engineering); Genda Chen (CArE); Joon-Ho Choi (CArE); Suzanna Long (EMSE); Ronaldo Luna (CArE); Norbert Maerz (Geological Sciences & Engineering); John J. Myers (CArE); David Richardson (CArE); John W. Sheffield (Mechanical & Aerospace Engineering); Lesley Sneed (CArE); Jeffery Volz (CArE); Jianmin Wang (CArE).

The Center for Infrastructure Engineering Studies (CIES) was created through the University of Missouri's Mission Enhancement Program at the Rolla campus. The center provides research expertise in the area of buildings and civil infrastructure and infrastructure management.

The mission of CIES is to provide leadership in research and education for solving the problems affecting the nation's infrastructure systems. CIES is the primary conduit for communication among those on the Missouri S&T campus interested in infrastructure studies. The center provides coordination for collaborative, interdisciplinary efforts with emphasis on:

Interdisciplinary research and development with projects tailored to address needs of federal agencies, state agencies, and private industry; technology transfer and continuing distance education to the engineering community and industry.

CIES is the home of the National University Transportation Center (UTC) which was established by the US Department of Transportation to advance technology and expertise in many transportation-related disciplines through the mechanisms of education, research, and technology transfer at university-based centers of excellence. The Missouri S &T UTC funds research proposals in the areas of advanced materials, non-destructive testing technologies, and alternative fuels with the objective of advancing the state-of-the-art of transportation structures. Three examples of such areas are: improvement of existing civil engineering construction materials, FRP composites, and non destructive testing.

CIES is also the home of the Mid-America Transportation Center (MATC)-Missouri S&T Partner. MATC is a consortium partnership among the Region VII State Universities. The theme of the Center is to improve safety and minimize risk associated with increasing multi-model freight movements.

The Natural Hazards Mitigation Institute (NHMI), also housed within CIES, is a multi-disciplinary program of research focused on evaluation of naturally-occurring phenomena and developing effective mitigation techniques utilizing new technologies and materials. NHMI draws on faculty expertise in civil and environmental engineering, geology, seismology, geophysics, and geological engineering. E-mail cies@mst.edu, visit our website at: www.cies. mst.edu or phone: (573)341-4497.

Cloud and Aerosol Sciences Laboratory (CASL)

Norwood Hall
Donald E. Hagen (Director)

Faculty: R. W. Alexander (Emeritus Prof. Phys.); D.J. Alofs (Emerius Prof. M&AE and EM); J.C. Carstens (Emeritus Prof. Phys.); N. Ercal (Chem); B.N. Hale (Phys.); S. Kapila (Chem.); U.O. Koylu (M&AE); P. Nam (Chem); J.L. Schmitt (Phys.); D.R. White, (Assoc. Prof. Emeritus, B.E.); P.D. Whitefield (Chem.); G. Wilemski (Phys.).

Global, regional, and local environmental concerns have propelled the atmospheric sciences to international prominence. Well known issues such as the local air quality, ozone, acid rain, photo-chemical smog, and global warming attest to the urgency of atmospherically related problems now facing society.

CASL is a multidisciplinary effort drawing on the solid base of engineering and sciences provided by Missouri S&T. Students from various academic departments perform their thesis research within the laboratory in partial fulfillment of the M.S. or Ph.D. degree requirements of their "home" department.

The program is directed toward a fundamental understanding of the role of aerosols, including clouds and fogs, in our atmospheric environment. Current studies focus on the generation and environmental impact of anthropogenic combustion aerosols, basic nucleation processes of water and ice, cluster structure both in the gaseous phase and on substrates, homogenous binary nucleation, neutron scattering measurements on nanodroplet aerosols, particle formation in supersonic expansions, the heterogeneous chemistry and chemical composition of air borne aerosols and their impact on the atmosphere, and the behavior of aerosol particles in the human respiratory system.

CASL provides leadership in international and national research programs. It is the home for the Missouri S&T lead federal Center of Excellence for Aerospace Particulate Emissions Reduction Research, is a member of the FAA-NASA-Transport Canada Center of Excellence for Aviation Noise and Aircraft Emissions Mitigation, and leads the air related mission for the Missouri S&T Center for Emerging Contaminants. Its brief extends to particulate mitigation strategies for new combustor development.

The Laboratory houses a variety of instrumentation, much of it unique. This includes a finely tuned expansion chamber used to study nucleation phenomena, instrumentation designed to directly determine the

chemical composition of particles on which droplets form, and an extensive mobile facility for both the on-ground and in-flight collection and analysis of combustion (e.g. jet exhaust) aerosols.

In addition to acquiring knowledge of cloud, aerosol, and atmospheric science, the laboratory imparts to students a familiarity with a wide variety of data acquisition, signal conditioning, and system engineering problems. Visit our website at http://coe.mst.edu.

Energy Research and Development Center (ERDC)

305 McNutt Hall
Mariesa L. Crow (Director)

The Energy Research and Development Center (ERDC) provides an environment for researchers from various Missouri S&T disciplines to collaborate on sponsored projects involving energy and its impact on society and the environment. The mission of the ERDC is to educate students in energy topics to solve problems of society to deliver solutions for energy-related issues by forming collaborative relationships with industry and government, for the benefit of the university, the state of Missouri, and the nation. Topics of interest include the development of biofuels, alternative energy sources including wind and solar, plug-in hybrid vehicles, the bulk power system, hydrogen technologies, cyber-security of energy management systems, synthetic fuel development, advancing nuclear energy, and petroleum exploration and extraction methods. More than 41 faculty researchers are affiliated with the Center. Researchers affiliated with the Energy R&D Center also closely collaborate with other research centers including Materials Research Center, Intelligent Systems Center, Center for Infrastructure Engineering Studies, and the Environmental Research Center. For more information visit the web site at http://energy.mst.edu or contact erdc@mst.edu.

Environmental Research Center for Emerging Contaminants (ERCEC)

201 Butler Carlton Hall
Dan Oerther (Director)

The mission of the Environmental Research Center (ERC) is to provide the infrastructure and coordinated faculty base to conduct wide range of large-scale federally-funded research initiatives designed to protect public health from emerging contaminants. ERC investigators conduct research sponsored by a wide range of entities including the NSF, USEPA, USDA, USGS, Missouri Department of Natural Resources, American Water Works Association Research Foundation, as well as industry in Missouri and elsewhere.

Examples of current research areas in the ERC include: occurrence and control of antibiotics and antibiotic resistant bacteria at concentrated animal feed operations (CAFOs) and in drinking water; occurrence, fate and removal of estrogenic,endocrine disrupting chemicals, disinfection byproducts, pharmaceuticals, and cyanobacterial toxins in drinking water and wastewater treatment plants; reactions of indoor air pollutants in home and business environments; phytoremediation technology for treatment of organic contaminants in soil and groundwater; nutrient control using struvite precipitation; control of heavy metals with constructed wetlands; control of odor emissions from CAFOs; fate of mercury in incinerator flyash; treatment of MTBE and alternative fuel oxygenates; and transport of lead and zinc in Missouri rivers in the Old and New Lead Belts.

Laboratories associated with the Environmental Research Center maintain state-of-the-art instrumentation including: a wide variety of gas chromatographs with mass spectrometer and other detectors; high pressure liquid chromatographs with mass spectrometer and UV detectors; ion chromatograph; total organic carbon analyzer; atomic absorption spectrometers with graphite furnace and flame combustion; inductively couple plasma mass spectrometer with laser ablation; a wide variety of ultraviolet and visible spectrophotometers; stopped flow spectrophoto-meter; molecular biology tools including polymerase chain reaction (PCR) instrumentation and denaturing gradient gel electrophoresis (DGGE) and clone libraries; microscopes; respirometers; and wide variety of other instruments. Specialized research equipment and facilities include temperature control rooms; a trailer-mounted experimental water treatment system; a trailer-mounted mobile air pollution analysis laboratory; a rooftop greenhouse; pilot-scale air stripping system; pilot-scale advanced oxidation and ozonation systems; laminar flow hoods; anaerobic microbiology facilities; and a variety of other research equipment. The original Environmental Research Center (ERC) was established in 1965. Phone: 573-341-6908. E-mail address is erc@mst.edu or visit the website at: http://campus.mst.edu/environ/index.html.

Intelligent Systems Center (ISC)

320 Engineering Research Lab
Ming C. Leu (Director)

Senior Research Investigators
Frank Liou, Bruce McMillin, Jag Sarangapani, Don Wunsch.

Research Investigators
Ghulam Bham, K. Chandrashekhara, Badrul Chowdhury, Xiaoping Du, Medhi Ferdowsi, Scott Grasman, Robert Landers, Xiaoqing Frank Liu, Sanjay Madria, Anthony Okafor, Kent Peaslee, Sahra Sedigh, Shun Takai, Daniel Tauritz, Hai-Lung Tsai, Hai Xiao, Yangchuan Xing, Lifeng Zhang, Y. Rosa Zheng.

Affiliated Members
Levent Acar, Venkat Allada, Douglas Bristow, Sriram Chellappan, Maggie Cheng, Joon-Ho Choi, Mariessa Crow, Abhijit Gosavi, Zhen Liu, Ruwen Qin, Xiaodong Yang, Maciej Zawodniok, Zhaozheng Yin, Jie Gao.

The Intelligent Systems Center (ISC) mission is to provide an interdisciplinary research environment in which faculty from various departments can cooperate and conduct research on sponsored projects involving real physical systems with special emphasis on an intelligent (smart) system approach. ISC has integrated its primary research mission with Missouri S&T's commitment to develop internationally recognized graduate research programs focused on key technologies.

The approaches for accomplishing ISC's objectives consist of (i) developing interdisciplinary research programs to match the emphasis areas of sponsoring agencies with the expertise of Missouri S&T faculty, (ii) obtaining long-term federal research grants and industrial contracts, and (iii) developing multidisciplinary research facilities.

ISC considers the education of graduate students as one of its major activities and provides graduate research assistantships through the Center's investigators. The students supported by research grants choose their thesis topics to be closely related to the grant. The interdisciplinary nature of research provides an excellent opportunity for the students to interact with students from other disciplines. The students also gain valuable experience in working as a team and acquire communication and project organization skills. The interaction between graduate students and program managers from industries and federal agencies is very helpful in the application of their research to real-world problems.

Multidisciplinary research teams consisting of faculty members and graduate students from the departments of computer science, electrical and computer engineering, engineering management and systems engineering, mechanical and aerospace engineering, and material sciences and engineering have been established to conduct research in emerging technologies. The ISC has also developed state-of-the-art laboratories to conduct research on virtual reality, smart structures, neural networks, energy systems, agile manufacturing and automatic inspection, MEMS, robotics, and structural health monitoring. The Center provides computing facilities to its research investigators and graduate students working on research projects. Active research is in progress in the following interdisciplinary research areas:

1. Intelligent Manufacturing Processes and Systems
    - 1.1 Virtual and Rapid Prototyping & Manufacturing
    - 1.2 Laser Based Deposition & Prototyping
    - 1.3 Laser Micromachining
    - 1.4 Friction Stir Processing
    - 1.5 Composite Manufacturing
    - 1.6 Liquid Metal Processing
    - 1.7 Machining, Structural Health Monitoring & NDE
    - 1.8 Integrated & Collaborative Design & Manufacturing
2. Cyber Physical Systems
    - 2.1 Advanced Critical Infrstructure Systems
    - 2.2 Advanced Simulation of Cyber-Physical Systems
    - 2.3 Hardware/Software Co-Design
3. Advanced Simulation, Sensing, Control, and Communication
    - 3.1 MEMS and Nanosensors
    - 3.2 Wireless Sensor Networks
    - 3.3 Intelligent and Adaptive Control
    - 3.4 Virtual Reality and Advanced Simulation
4. Computational Intelligence and Embedded Systems
    - 4.1 Data Processing, Fusion and Management
    - 4.2 System Design and System Support
    - 4.3 Trustworthy and Embedded Hybrid Systems

Internet Home Page: http://isc.mst.edu.

Materials Research Center (MRC)

Straumanis-James Hall
Matthew J. O'Keefe (Director)

Senior Investigators

R. Brow (MSE), L. Dharani (MAE), J. Drewniak (ECE), W. Fahrenholtz (MSE), G. Hilmas (MSE), J. Switzer (Chem), D. Van Aken (MSE), H. Xiao (ECE).

Research Investigators

B. Bai (GE), B. Bate (Civil), D. Bristow (Mech), C. Castano (Nuc), A. Choudhury (Chem), H. Collier (Chem), D. Day (Chem), F. Dogan (MSS), C.S. Kim (ECE), M. Koledintseva (ECE), X. Liang (Chem), F. Lou (Mech), R. Luna (Civil), M. Nath (Chem), J. Newkirk (MSE), K. Peaslee (MSE), C. Ray (MSE), V. Richards (MSE), J. Rovey (Mech), J. Volz (Civil), J. Winiarz (Chem), D. Wronkiewicz (GE), X. Yang (Mech), L. Zhang (MSE).

The Graduate Center for Materials Research was established for the purpose of multidisciplinary research on materials and to provide improved centralized laboratories and specialized equipment for faculty and students involved in materials research. The Center provides graduate students in many academic departments (e.g. Materials Science and Engineering, Chemical and Biological Engineering, Mechanical and Aerospace Engineering, Chemistry, Biological Sciences and Physics) with advanced training in materials related engineering and science research.

The research conducted in the Center ranges from fundamental science to applied engineering and includes the development, evaluation, application, and understanding of metals, polymers, biomaterials, electronic materials and composites.

Accomplishments from the Center include: glass microspheres for treatment of liver cancer, transparent composites for windows/armor, environmentally friendly corrosion coatings, laser glasses, epitaxial chiral surfaces, biomineralization, fuel cell electolytes and sealing materials, electrochemical biosensors, multi-layer nano-capacitors, enhanced magnetic materials, and thin film electromagnetic probes.

The Center is located in Straumanis-James Hall, a four-story building with 30,000 square feet of laboratory and office space. The Center contains the modern equipment needed for research on materials development, characterization and evaluation, and for measuring

common mechanical, thermal, electrical, and optical properties. It contains specialized and adaptable experimental facilities for:

- Electrochemical deposition and corrosion
- Electronic materials
- Glass melting and processing
- Nanomaterials
- Plasma deposition of materials
- Biomaterials
- Composites
- Microfabrication including sputter deposition, evaporation, reactive ion etching and photolithography equipment
- Characterization of materials by x-ray diffraction, focused ion beam (FIB) microscopy, scanning and transmission electron microscopy, scanning tunneling and atomic force microscopy, thermal analysis, optical techniques, x-ray photoelectron and Auger electron spectroscopy.

The Center has an active interest in industrial research and economic development suitable for graduate and undergraduate student education that falls within the technical expertise of the staff.

E-mail mrc@mst.edu or visit our website at http://mrc.mst.edu.

Rock Mechanics and Explosives Research Center (RMERC)

Stewart Gillies (Interim Director)

Research Investigators

Kwame Awuah-Offei (MinEng), Jason Baird (MinEng), Jeffrey Cawlfield (GeoEng), Sriram Chellappan (CompSci), Andreas Eckert (PetroEng), Grzegorz Galecki (MinEng), Mao Chen Ge (MinEng), Leslie Gertsch (GeoEng), Hyoung Lee (NucEng), Norbert Maerz (GeoEng), Runar Nygaard (PetroEng), David Summers (MinEng), Jerry Tien (MinEng), Jeffery Volz (ArchEng), Wan Yang (Geol).

Staff

Mike Bassett (Research Technician), Diane Henke (Secretary), Leanne Nuckolls (Administrative Assistant), John Tyler (Research Engineer).

The Rock Mechanics and Explosives Research Center brings together leading investigators from different disciplines to research static and dynamic rock mechanics, rock fragmentation and excavation, and explosives technology. The High Pressure Waterjet Laboratory of the Center has developed a world-renowned team of waterjet technology specialists. The Linear Rock Cutting Machine is one of only two such full-scale facilities operating in the U.S.; with an accompanying suite of full-scale Rotary Rock Cutting Machines, it provides world-class research capability in mechanical rock excavation.

Areas of current research capability are: mine design, strata control, rock stress measurement, centrifugal testing – simulation of stress in complex geological structures, properties of rock under confining pressures, similitude studies, rock mechanics and applied geology, dynamic rock mechanics, dynamic strain measurement, high-pressure waterjet rock cutting, constitutive properties of rocks, high-pressure waterjet long-wall mining of coal, deep mine problems, ultrasonic wave measurements in rock, dynamic creep in rock, wall breaking, cratering with explosives, fracture propagation in rock, explosives and blasting, explosive labeling and detection, rock penetration and disintegration for rapid excavation, coal mine roof stability, concrete cutting and scarifying with water, and waterjet cleaning. Center faculty work in the development of new methods and machines for excavation, and concurrently the means to protect structures from blast and other methods of attack.E-mail rockmech@mst.edu or visit our website at http://rockmech.mst.edu.