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<tr>
<th>Name</th>
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<tr>
<td>Kamal H. Khayat</td>
<td>Director</td>
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<td>Magdy Abdelrahman</td>
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<td>Kwame Awuah-Offei</td>
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<td>K. Chandrashekhara (KC)</td>
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<td>Genda Chen</td>
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<td>Islam H. El-adaway</td>
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<td>Sanjay Madria</td>
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<td>John J. Myers</td>
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<td>Monday Okoronkwo</td>
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<td>Jonghyun Park</td>
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<td>Ruwen Qin</td>
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<td>Thomas Schuman</td>
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<td>Lesley Sneed</td>
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<td>Jianmin Wang</td>
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<td>Chenglin (Bob) Wu</td>
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<td>Xiong Zhang</td>
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DEPARTMENT OF CIVIL, ARCHITECTURAL, AND ENVIRONMENTAL ENGINEERING

Infrastructure Sustainability through Recycling

Asphalt Modifications to Meet Diverse Requirements
- Mechanism of Interaction of Asphalt with Crumb Rubber Modifier (CRM) to Controlling Binder Properties
- Physical/Chemical Characterization of Modified Asphalt Binders
- Environmental Aspects of Asphalt Recycling

Recycled Asphalt Pavement (RAP)
- Performance of RAP Applications
- Modeling of RAP-Aggregate as Base Layer

Enhancing the Civil Engineering Curriculum
- Infrastructure Sustainability and Recycling Components
- Integrating Fundamentals and Research Findings in Civil Engineering Curriculum
- Improving Student-Learning Outcomes

Magdy Abdelrahman, Ph.D.
College of Engineering and Computing
Professor, Holder of the Missouri Asphalt Pavement Association (MAPA) Endowed Professorship in Flexible Pavement
m.abdelrahman@mst.edu

Funding
National Science Foundation, Minnesota Department of Transportation (DOT), North Dakota DOT, Nebraska Department of Roads

Keywords
- #Asphalt, #Modified Binder, #Crumb Rubber Modifier (CRM), #Recycled Asphalt Pavement (RAP), #Hot Mix Asphalt (HMA), #Pavement Maintenance and Rehabilitation

Recognitions
- National Science Foundation CAREER Award
- Associate Editor, the American Society of Civil Engineers (ASCE) Journal of Materials in Civil Engineering
- Three National titles as the Academic Advisor of the North Dakota State University Steel Bridge Team
- National Committee Service, 10 terms

Progression of the Interaction of Asphalt with CRM. Relating Binder Properties to Interaction Activities

Viscosity
Time
At Elevated Temperature

Change of binder viscosity over time at elevated temperature.

Un-Swollen Particle
Swollen Particle
Swollen Particle Starting Depolymerization
Depolymerized Particle

Change of particle size over time at elevated temperature.

Change of binder matrix over time at elevated temperature.

a- Change of binder viscosity over time at elevated temperature.
b- Change of particle size over time at elevated temperature.
c- Change of binder matrix over time at elevated temperature.
Modeling, Simulation & Optimization for Sustainable Mining Systems

Cost effective reclamation plans
- Wetland and BCR designs; plant species selection for sustainable post-mining land use

Energy efficiency of mining systems
- Modeling operator effects to improve energy efficiency

Optimization applications for automation
- Algorithms for solving optimization problems arising in mining including mine sequencing problems (problems with large precedence constraints)

Understanding dynamics of mining community acceptance to reduce socio-political risks
- Survey design and quantitative analysis tools to better understand your local community’s concerns

Applying computer simulation and optimization to make mining systems sustainable

PoC: Kwame Awuah-Offei, PhD, PE, Associate Professor
kwamea@mst.edu, http://mst.edu/~kabp3/

Funding
- US Securities & Exchange Commission
- US Department of Defense
- US Department of Interior (Office of Surface Mining, Reclamation & Enforcement)
- Illinois Clean Coal Institute

Keywords
- #Mining, #Sustainability, #MinePlanning, #Geostatistics, #EnergyEfficiency, #StakeholderAnalysis, #DiscreteChoiceTheory, #ABM, #Optimization, #BranchAndCut, #BranchAndBound, #GradientSearch

Recognitions
- 2019/20 Society for Mining, Metallurgy & Exploration Henry Krumb Lecturer
- Academic Fellow, US Securities & Exchange Commission
DEPARTMENT OF CIVIL, ARCHITECTURAL, AND ENVIRONMENTAL ENGINEERING

Smart Infrastructure for Durability and Safety

Structural Health Monitoring (SHM)
- Lab-on-sensor Design for Monitoring of Structural Behaviors (e.g. Crack, Delamination, Corrosion, Scour)
- Adaptive Transform of Nonstationary and Nonlinear Responses for Feature Extraction and System ID
- Sensor Data Enhanced Modeling of Infrastructures

Infrastructure Deterioration and Rehabilitation
- Interface Mechanics and Deterioration Mechanism
- Steel Corrosion Protection with Enamel Coating
- Corrosion-free Bridges with Fiber Reinforced Polymer (FRP) Bars and PVC Confined Concrete Columns

Multi-hazard Engineering
- Seismic Retrofitting and Blast Hardening of Bridges
- Tsunami/Hurricane Induced Damage Assessment
- Fire Induced Damage Assessment

Accurate Condition Assessment Enables Extension of Service Life and Assurance of Safety of Infrastructure.

PoC: Genda Chen, Ph.D., P.E.
College of Engineering and Computing
Professor and Abbett Distinguished Chair in Civil Engineering

gchen@mst.edu; http://web.mst.edu/~gchen/

Funding
- National Science Foundation, National Institute of Standards and Technology, US Department of Transportation, Army Research Laboratory
- EERI Newsletter, Special Earthquake Report on Mw8.8 Chile Earthquake of February 27, 2010
- NSF CAREER Award
- Fellow: American Society of Civil Engineers (ASCE), Structural Engineering Institute (SEI)

CEC Research
Computational Intelligence in Complex Systems

Computational Intelligence (Evolutionary Computation)
• Evolutionary computation theory and applications
• Artificial life, agent-based modeling, numerical optimization

Bioinformatics
• Clustering and classification of Big Data in Biological data sets
• Integration of advanced computational to medical device design

Complex System Modeling
• Combine disparate models and simulations to represent system as a whole
• Increase confidence in technical performance and reduce risk before system is created

PoC: Steven Corns, Associate Chair for Graduate Studies, Engineering Management and Systems Engineering Department
corns@mst.edu; http://mst.edu/~cornss

Funding
• United States Army Corps of Engineers, United States Geological Survey, Federal Manufacturing and Technologies (Honeywell), Department of Veterans’ Affairs, The Boeing Company

Keywords
• #Computational Intelligence, #Complex Systems, #Evolutionary Computation, #Model-Based Systems Engineering, #Bioinformatics

Recognitions
• IEEE Computational Intelligence
  • Technical Activities Committee
  • Evolutionary Computation Technical Committee
  • Chair of Bioinformatics and Bioengineering TC
• INCOSE Model-Based Systems Engineering Leadership team
High Frequency Sensing and Imaging

Active Microwave Thermography (AMT)
- Utilize a microwave-based heat excitation and subsequent thermal imaging for defect detection.
- Using a microwave excitation allows for a focused and tailored (to the application) heat excitation.

Frequency Selective Surface (FSS) Based Sensors
- Sensors can be embedded into structures during manufacture or surface-mounted to existing structures.
- Sensors are remotely interrogated for structural health monitoring (strain, material changes, etc.).

Materials Characterization
- Relate dielectric (electromagnetic) properties of materials to chemical and physical properties.
- Example applications: determination of temporal moisture content and state in geopolymer materials, detection of ASR gel in cement-based materials.

Utilize high frequency sensing and imaging to “see” beyond the surface for improved structural health monitoring.

PoC: Kristen M. Donnell, Assistant Professor
Electrical and Computer Engineering
kmdgfd@mst.edu, 573.341.6229
https://ece.mst.edu/faculty-directory/kristen-donnell/

Funding
- National Science Foundation
- Texas Research Institute (Army SBIR/STTR, NASA STTR)
- Dept. of Transportation
- American Society of Nondestructive Testing, IEEE Instrumentation and Measurement Society

Keywords
- #Active Microwave Thermography, #Materials Characterization, #Frequency Selective Surfaces, #Embedded Sensing, #Geopolymers

Recognitions
- Research featured on news.mst.edu in Sept 2015 (http://news.mst.edu/2015/09/researcher-uses-microwave-to-bake-experiments/)
- IEEE Instrumentation and Measurement Society 2012 Outstanding Young Engineer
Civil Infrastructure System-of-Systems Interdependency Lab (CI2SI-L)

The goal of CI2SI-L is to investigate how an integrated approach - which is based on broad system interdependencies of the built environment - can mitigate the management challenges associated with the sustainability of infrastructure systems.

The interrelated objective is to provide the associated stakeholders with the technical knowledge necessary for designing, constructing, managing, maintaining, restoring, operating, and protecting efficient, resilient, and sustainable communities.

CI2SI-L utilized various interdisciplinary adaptable research tools including: multi-agent based modeling; system dynamics simulation; social network analysis and graph theory; game and auction theory; option and hedging theory; bootstrapping and resampling techniques; and statistical factor analysis.

The research component of MO-CCI strives to proactively pinpoint the industry challenges and create innovative tools and/or best practices to help industry have more effective and efficient operations.

Faculty Member

Islam H. El-adaway, Ph.D., P.E., CEng., F.ASCE, F.ICE
Hurst-McCarthy Professor of Construction Engineering and Management, Professor of Civil Engineering, and Founding Director of Missouri Consortium for Construction Innovation

Email: eladaway@mst.edu
Phone: (573)341-4030
Webpage: https://web.mst.edu/~eladawayi/

Awards and Recognitions
Engineering New Record Top Young Professional in 2019, Editor’s Choice peer-reviewed papers for two different ASCE journals in 2018, 2017 ASCE Best Peer-Reviewed Journal Paper by the Journal of Management in Engineering, selected seven different times as an Outstanding Reviewer by ASCE, invited by the National Academy of Engineering (NAE) to attend its Frontiers of Engineering Education Symposium as being one of the most innovative engineering educators, recipient of a Young Faculty Research Award by ASEE, selected to receive an Outstanding Teaching Recognition Award, Academy of Distinguished Teachers Award, a Young Faculty Research Award, the David Carlisle Hull Faculty Leadership Award, and the Chip Crane State Pride Award.
Sustainable Material and Resilient Infrastructure

Vulnerability and resiliency of infrastructures under multi-hazard loads

- Diagnosis and retrofitting of existing infrastructures subjected to manmade and natural hazards such as earthquakes, wind, hurricane, and blast
- Developing innovative structural systems to increase the resilience of new infrastructure
- Using new materials to increase resilience of infrastructure

New material and systems for accelerating and sustainable construction

- Using innovative systems and materials to accelerate bridge construction
- Using more sustainable concrete and masonry using recycled materials such as shredded tires, mine tailing, and fly ash

**PoC:** Mohamed ElGawady, Ph.D.
College of Engineering and Computing
Professor and Benavides Faculty Scholar
elgawady@mst.edu; [http://web.mst.edu/~gcl](http://web.mst.edu/~gcl)

**Funding**
- Washington State DOT, Missouri DOT, Missouri DNR, US Department of Transportation, National Concrete Masonry Association Foundation, Industry

**Keywords**
- #MultiHazard, #Deterioration, #Accelerated construction, #Recycled material, #Retrofitting, #Masonry, #Concrete, #Steel structures

**Recognitions**
- Board of Directors, The Masonry Society
- Associate Editor the American Society of Civil Engineering Journal of Bridge Engineering
- Chair American Concrete Institute Committees 441 and 341ACEC Research

**Assessment under extreme loads**
- Innovative and Sustainable Structural Systems and Material for Resilience Infrastructure.
How Placement Affects Concrete Performance

Mix Design – Rheology – Placement – Performance Interaction

• Mix design of concrete currently controlled by requirements for strength and durability. Placement can affect performance due to segregation, stiffening or pressure, but knowledge is limited
• Characterization of rheological properties of cement-based materials, potentially under pressure
• Assessment of horizontal and vertical shear-induced particle migration
• Full-scale tests to evaluate performance: casting long beams and pumping concrete
• Practical guidelines for mix design, rheology and placement to assure adequate performance

Active Control of Rheology of Cement-based Materials

• Interaction between chemical admixtures and different phases of cement (C₃S, C₃A+gypsum)
• Activation of admixtures at desired time

PoC: Dimitri Feys, Ph.D.
College of Engineering and Computing Assistant Professor feysd@mst.edu;

Funding
US Department of Transportation, American Concrete Institute, UMRB, Precast/Prestressed Concrete Institute

Keywords
• #Rheology, #Placement, #Pumping, #Self-Consolidating Concrete, #Segregation, #Durability

Recognitions
• Board of Directors, ACI Missouri
• Outstanding Paper Materials and Structures 2016
Reinforcement Learning
- Actor-Critic Algorithms
- Semi-Markov Decision Processes

Disaster Management
- Risk Analysis
- Disaster Risk Reduction

Operations Management
- Total Productive Maintenance
- Queueing Approximations
- Airline Revenue Management

My research is focused on modeling and optimization of large-scale discrete-event systems

Abhijit Gosavi, Ph.D.
Associate Professor
210 EMAN BLDG,
Department of Engineering Management & Systems Engineering, Rolla 65409

Funding
- National Science Foundation
- Institute of Industrial & Systems Engineering

Keywords
- Data Analytics, Reinforcement Learning, Discrete-Event Simulation, Disaster Management, Preventive Maintenance

Recognition
- Second Runner-Up for Best Paper Award at Complex Adaptive Systems Conference
Secure and Smart Cyber-Physical Systems

Cyber-Physical Systems (CPS)
• Large complex distributed Critical Infrastructures
• Ensure correctness through distributed invariant monitoring

Security
• Mitigate cyber-physical attacks
• Determine a unified cyber-physical information flow model to determine potential attack vectors

Smart Living
• Develop Sustainable Cyber-Physical living environments
• Develop Privacy and Security for smart living environments

Security needs to move beyond the Fortress Mentality of Firewalls

Keywords
• #CyberPhysicalSecurity, #Information Assurance, #SmartLiving, #Invariants, #CriticalInfrastructure

Recognitions
• OpEd: Moving beyond medieval cybersecurity, St. Louis Post Dispatch, Oct 30, 2015
• IEEE Computer Society Board of Governors

PoC: Bruce McMillin, Associate Dean, College of Engineering and Computing Professor of Computer Science
ff@mst.edu, http://mst.edu/~ff
@bmcmillinSandT

Funding
• National Science Foundation, National Institute of Standards and Technology

CEC Research
Infrastructure Renewal and Sustainable Materials for Civil Engineering Applications

Structures / High Performance Concrete Materials
- High strength concrete (HSC), High strength-self consolidating concrete (HS-SCC), Ultra high performance concrete (UHPC), High volume fly ash concrete (HVFAC).

Fiber-Reinforced Polymers (FRP) in Structural Applications
- FRP, Fiber reinforced cementitious matrix (FRCM), Steel reinforced polymers (SRP), Hybrid composite systems.

Structural Health Monitoring and Load Testing of Bridges
- Use and implementation of sensors for monitoring and load testing including vibrating wire strain gauges, thermistors, LIDAR, and high precision surveying systems.

Structural Hardening and Blast Mitigation
- Development of systems for blast mitigation and structural hardening.

Use of advanced composites for rehabilitation and new material development for sustainable construction

Keywords
- #HPC, #HSC, #HS-SCC, #UHPC, #HVFAC, #FRP, #FRCM, #SRP, #SHM, #Blast Mitigation, #Infrastructure Renewal, #Rehabilitation.

Recognitions
- Award: ASCE Professional Recognition Award, 2014.
- Award: ACI EAC Committee Member of the Year Award, 2010.
- Award: Society of Military Engineers (SAME) Award, 2010.
- Fellow: ACI, ASCE, TMS.

PoC: John J. Myers, Ph.D. P.E., Associate Dean, College of Engr. and Computing Professor of Civil, Arch. And Envr. Engr jmyers@mst.edu, http://mst.edu/~jmyers

Funding
- US Department of Transportation, Federal Highway Transportation, Missouri Department of Transportation, National Science Foundation, Air Force Research Laboratory, Department of Homeland Security, Army Research Laboratory.
Glass Science and Technology

Spectroscopic Studies of Glass Structure
• Utilize many tools, including Raman, NMR spectroscopies, neutron and x-ray diffraction techniques, to characterize the molecular-level structures of oxide glasses

Corrosion Studies of Glass
• Characterize and model interactions between oxide glasses and aqueous environments to develop new compositions for a variety of applications, including bioactive glasses and glasses for nuclear waste encapsulation

Designing Glasses for Engineering Applications
• Developing oxide glass compositions that can be used to seal solid oxide fuel cells, apply as protective coatings for metals, used as optical filters or substrates, processed using additive manufacturing techniques, etc.

Aging and Fatigue Studies of Glass
• Use mechanical tests and surface characterization tools to understand how environment controls glass strength

PoC: Richard K. Brow, Interim Dean, College of Engineering and Computing Curators’ Distinguished Professor, Materials Science and Engineering brow@mst.edu; http://mse.mst.edu/faculty/staffandfacilities/brow/

Recent Funding
National Science Found, Dept of Education, Dept of Energy, Lawrence Livermore Lab, Sandia National Labs, PPG Ind.

Keywords
• #GlassScience, #Corrosion, #Bioglass, #GlassStructure, #WasteVitrification, #OpticalGlass, #SealingGlass

Recognitions
• Award: 2016 N.F. Mott Award, J. Non-Cryst. Solids
• Award: 2004 George W. Morey, glass science
• Service: 2012-13 President of the American Ceramic Society
• Fellow: American Ceramic Soc., Soc. Glass Technology (UK)

Relate composition to atomic structure in order to design new glasses for engineering applications

CEC Research
Smart Transportation Systems, Computing and Data Science

Smart Transportation Systems
• Connected and Autonomous Vehicles
• Electric Vehicles
• Active Traffic and Demand Management

Transportation Big Data Analytics
• Mobility Behavior Modeling and Analytics
• Machine Learning and Artificial Intelligence
• Multi-Source Transportation Data Mining

Traffic Flow and System Modeling
• Traffic Flow Modeling and Applications
• Dynamic Traffic Assignment
• Origin-Destination Demand Calibration

XianBiao (XB) Hu, Ph.D.
Assistant Professor
Civil, Architectural & Environ. Eng.
xbhu@mst.edu (+1)-573-341-6178

Funding
• US Department of Transportation, Department of Energy, Department of Education, Federal Highway Administration, Missouri Department of Transportation, Colorado Department of Transportation

Connecting Technology, Big Data, Computational Intelligence and Traffic Fundamentals for a Smarter Transportation System

Keywords
• Smart Transportation Systems, Connected and Autonomous Vehicles, Electric Vehicles, Big Data, Artificial Intelligence, Computational Intelligence;
• Mobility Modeling, Traffic Flow Theory, Dynamic Traffic Assignment, Traffic Operation and Safety;

Recognitions
• Excellent Paper Award. 2018 World Transport Convention
• Provost’s eFellow. Missouri University of Science and Technology
Advanced Sensors Enables New Frontiers in Basic & Applied Research

Research Thrust

- **Innovating Advanced Fiber Optic Sensor Systems**
  - Human hair-like sensors (small size, light-weight, immune to EMI)
  - Spatially-distributed, high-speed sensing (multiple sensors per fiber)
  - Diverse measurement capabilities (pressure, strain, temperature, inclination, chemical threats, flow, EM fields, etc.)

- **Micromachining Novel Sensors and Devices**
  - Femtosecond laser micro-machining of photonic devices
  - Lab-in-a-fiber
  - Optical waveguide fabrication
  - Optofluidics (microfluidics and optics)

- **Applying Sensors with Ultrahigh Sensitivity and Resolution in Basic & Applied Research**
  - Fiber optic sensors in harsh environment (e.g., steel industry)
  - Fiber optic sensors for military applications
  - Fiber optic sensors for structural health monitoring applications
  - Novel coaxial cable sensors for human health applications

**Principal Investigator**

Jie Huang, Assistant Professor
Electrical and Computer Engineering
Missouri S&T
jieh@mst.edu; (573) 341-4836

**Recent Funding:** Army Research Lab, Air Force Office of Scientific Research, National Science Foundation, Department of Energy, Los Alamos National Lab, PSMRC, Honeywell, ArcelorMittal

**Awards**

- Faculty Excellence Award at Missouri S&T 2019
- Research Momentum Award at Missouri S&T 2019
- Economic Development Award at Missouri S&T 2019
- IEEE St. Louis Section Outstanding Researcher 2019

**Keywords**

- #Fiber optic sensors, #Femtosecond laser micro-machining, #Microwave photonics, #Measurement and instrumentation
Composite Materials and Structures

**Composite materials and structures**
- Fiber reinforced polymer composite for aerospace structures
- Multifunctional composites for specific applications such as transparent composites and smart structures
- Reinforced ceramics for high temperature applications
- Bio-based composites for structural applications

**Polymer and metal additive manufacturing**
- Composite tooling using additive manufacturing of polymers
- Manufacturing and testing of metallic cellular structures
- Numerical homogenization and unit-cell modeling

**Modeling and finite element simulation**
- Modeling of steel hot-rolling process
- Modeling of oxidation induced degradation and ceramic composites using unit cell modeling
- Process modeling of composite fabrication

**Keywords**
- #CompositeMaterials, #FiniteElementAnalysis, #CellularStructures, #Bio-Composites, #AdditiveManufacturing

**Recognitions**
- Fellow: ASME
- Society of Military Engineers Award (2008)
- American Foundry Society- Best Paper Award (2013)
- SAMPE Journal Feature Article (2016)

**Recent Funding**
National Science Foundation, Office of Naval Research, Naval Air Systems Command, Boeing, Nucor, Gerdau, GKN Aerospace, Honeywell, Spirit AeroSystems, United Soybean Board.

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**PoC: K. Chandrashekhara, Curators’ Distinguished Professor, Mechanical and Aerospace Engineering**
chandra@mst.edu; http://web.mst.edu/~chandra/
DEPARTMENT OF CIVIL, ARCHITECTURAL, AND ENVIRONMENTAL ENGINEERING

Advanced Construction Materials for Sustainable Infrastructure

**Design and Performance of Advanced Materials**
- High-Performance Concrete with Adapted Rheology
- Self-Consolidating Concrete
- Fiber-Reinforced Concrete
- High Strength and Ultra-High-Performance Concrete
- Specialty Chemical Admixtures
- Recycled Materials and Sustainable Concrete
- Rheology Design and CFD Modeling

**Repair and Rehabilitation**
- Tailor-Made Repair Materials
- Underwater Concrete and Grouting
- Novel Testing Methodologies
- Structural Performance of Novel Concrete

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**Kamal H. Khayat**, P. Eng., Ph.D., F.ACI, F.RILEM
Vernon & Maralee Jones Professor of Civil Engineering
Director, Center for Infrastructure Engineering Studies
Director, RE-CAST University Transportation Center
khayatk@mst.edu

**Recognitions**
- 2019 Life Time Achievement Award - RILEM
- 2018 ACI Wason Medal for the Most Meritorious paper
- 2017 ACI J-C Roumain Innovation in Concrete Award
- 2016 Elsevier Top 150 Most Cited People in CE in the World
- 2015 ACI Arthur R. Anderson Medal
- Fellow: ACI, 2004; RILEM, 2015

http://cies.mst.edu/
Sustainable Materials for Construction Infrastructure
- Microcalorimetry and Ion-chromatography methods to assess and enhance intrinsic reactivity of silicate and aluminosilicate waste materials
- Thermo-Kinetic modelling and experimental characterization of reaction processes, equilibrium phase assemblages, and microstructural development in concrete provisioned with high volumes of waste materials

Organic/Inorganic Additives for Reaction Control
- Microcalorimetry methods and Nucleation-and-growth models to characterize and regulate the influence of various organic and inorganic additives on reaction kinetics and microstructural development in cementitious systems

Fluid-and-ion Transport in Porous Media
- Lattice Boltzmann models and experimental methods to estimate fluid/ion permeability & diffusivity in porous media

Inertial Microfluidics for Size-based Particle Separation
- High-throughput separation of particles on the basis of their size using Inertial Microfluidics methods and computational fluid dynamics (CFD) techniques

Keywords
- #Cement, #Concrete, #Aluminosilicate, #GlassDissolution, #HighPerformanceConcrete, #DurableInfrastructure, #Sustainability

Recognitions
- Member: American Ceramic Society (ACers), American Concrete Institute (ACI), RILEM
- Co-chair: Microstructural modelling chapter, ACI

PoC: Aditya Kumar, Assistant Professor, Materials Science and Engineering
kumarad@mst.edu; http://mse.mst.edu/facultystaffandfacilities/kumarad/

Funding (Current and Prospective)
Dept. of Energy (DOE), National Science Foundation (NSF), U.S. Department of Transportation (U.S. DOT), Federal Highway Administration (FHWA)
Structures and Materials Engineering

Research interests
- Teaching innovations and educational technologies, Active, collaborative, and problem-based learning, Educational app, entrepreneurial mindset learning
- Advanced Composite Materials: Cement based mixtures with adapted rheology, Fiber reinforced composites (FRC), Roller compacted concrete
- Computational Mechanics and Applied Mathematics
  - Meshfree methods, Radial Basis Functions collocation Method, Ill-conditioned systems, Adaptive Solution of PDEs

Courses:
- Mechanics of Materials: +440 students/year
- Materials Testing lab: +420 students/year

Name Nicolas A. Libre, PhD
Contact details libren@mst.edu

Recent Funding:
Teaching and pedagogy development: >10,000$ (internal and external grants)
Research on construction materials ($180,000$) (external grant, 25% co-PI)

Keywords
Teaching Innovation, Educational App, Solid Mechanics, Construction Materials

Recognitions
FTTC Teaching Award (Midwest Regional Conference)
President Award for Teaching Innovation (UM System)
Provost eFellow award, Faculty Achievement Award, CERTI Service Award (S&T Campus)
Joseph H. Senne Faculty Award (Department)
Civil Infrastructure Materials and Pavement Engineering

Understanding and Application of Civil Infrastructure Materials
- Engineering characterization and modeling of materials
  - Cementitious materials (HSC, HPC, FRC, light weight concrete, grout)
  - Asphaltic materials (asphalt cement, HMA, WMA, gilsonite, paving interlayer)
  - Granular and stabilized bases (aggregate, ATBs)
- Materials’ recycling, reuse, and renewal (RAP, RCA)
- Sustainable materials and resilient infrastructure adapting to climate change and extreme events

Economic and Effective Solutions to Transportation Infrastructure Needs
- Pavement design, testing, and evaluation
- Pavement preservation, repair and rehabilitation
- Non-destructive testing
- Pavement management
- Environmental sustainability in life cycle of transportation infrastructure

Liu’s research focuses on understanding and application of crucial and more environmentally conscious materials, and economic and effective solutions (design, construction, and preservation strategies) to transportation infrastructure needs

Keywords
- Asphalt cement, hot-mix asphalt, aggregate, cementitious materials, paving interlayers, recycling, pavement design and testing, preservation, repair and rehabilitation, non-destructive testing, transportation infrastructure, pavement management, life cycle, environmental sustainability

Recognitions
- Three times of “Best Paper Award”, 2014, 2016, 2017
- 2016 Engineer of the Year, Alaska Society of Professional Engineers Fairbanks Chapter
- 2011 & 2015 ASCE Outstanding Reviewer
- 2013 IACIP Outstanding Service Award

Funding
- USDOT, AKDOT&PF, Caltrans, PacTrans, local government, industry

Jenny Liu, Ph.D., P.E.
Associate Professor
Civil, Architectural & Environ. Eng.
Email:
Phone:

CEC Research
Resilient Critical Infrastructure Systems

Planning Models and Tools
• Characterization of socio-critical systems interdependence
• Resiliency Risk and Uncertainty Calculation Tools.

Visualization and Data Acquisition Modeling
• Social Network Data Analytics
• Visualization and High Performance Computing Tools

Extreme Event Restoration Prioritization Modeling
• Systems Architecture of Complex, Resilient Systems
• Resource Allocation Modeling and Tools

Resilience Protocols
• Decision analysis frameworks planning
• Data Analytics and Informatics Ontologies

PoC: Suzanna Long, Ph.D. P.E.M., Professor and Department Head, Engineering Management & Systems Eng.
longsuz@mst.edu;
http://emse.mst.edu/facultystafffacilities/emsefaculty/index.html

Funding
• US Department of Transportation, Federal Highway Administration, National Science Foundation, U.S.
Department of Energy, U.S. Geological Survey, Missouri Department of Transportation, USACE.

Use Complex Adaptive Systems Theory to develop community planning tools for Smart, Resilient Systems

Keywords
• Resilient Systems; Geospatial Data Analytics; 3DEP Modeling; Interdependent Critical Infrastructure Systems; Disaster Restoration Modeling

Recognitions
• Award: Missouri S&T Woman of the Year, 2016.
• Award: University of Missouri President’s Award, 2013.
• Award: AASHTO High Value Research Project Winner, 2012.
• Fellow: ASEM.
Cement and Concrete Fundamentals
- Thermodynamics and Hydration Kinetics of Multi-Component Cementitious Materials
- Multi-scale Characterization and Modeling of the Microstructure and Properties of Concrete

Novel Materials for Sustainable Infrastructure
- Phase Change Materials for Thermal Insolation in Building Envelops, Thermal Crack Control in Massive Concrete, and Thermal Distresses Mitigation of Pavement
- Bacterial Carbonate- and Silicate-Precipitation in Concrete
- High-performance Construction/Repair Materials

Functional Composites
- Inorganic/organic interpenetrated composites
- Polymer Modified Chemically-Bonded Phosphate Ceramic Coating for Corrosion Protection of Steel Reinforcement in Concrete Structures

Sensing and Monitoring
- Piezoelectric and fiber-optic sensing: cracking, strain, temperature; applications of fiber-optic Raman/pH probe.

PoC: Hongyan Ma, Ph.D.
Assistant Professor
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Multi-scale Modeling Enables More Accurate Service Life Prediction
Novel Materials Enhances Sustainability of Infrastructure

Keywords
- Sustainability; Novel/Smart/Functional Materials
- Cement Chemistry; Microstructure; Transport Properties; Multi-scale Modeling
- Phase Change Materials; Bacterial Mineral Precipitation; MPC
- Inorganic Composites; Anti-Corrosion Coating
- Piezoelectric; Fiber-Optic; Chemical Sensing
DEPARTMENT OF COMPUTER SCIENCE

Cyber Security & Machine Learning in Mobile and IoT Networks

Security and Risk Assessment in Sensor Cloud Computing
- Risk Assessment in Sensor Cloud Computing
- Data Security and Assess Control in Cloud Computing
- Cloud-assisted Cyber Physical System and Security

Content Management and Security in Delay-Tolerant networks
- Situational-awareness in Delay-tolerant Networks
- Task scheduling in UAV Networks
- Ride-sharing and Transport Management for Smart City Applications
- Mobile Data Management

Machine Learning and Big Data Management
- Machine learning for anomalies and malicious activities
- Machine learning for Big data management

Blockchain
- Access control and security in Blockchain

PoC: Sanjay Madria, Distinguished Professor
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Funding Agencies
- National Science Foundation (NSF), and NIST
- Boeing, Honeywell and Oak Ridge National Lab
- Air Force Research Lab, ARL, ARO
- Department of Education

Keywords
- #Sensor Cloud, #Risk Assessment, #Mobile Data Management, #Cloud Security, #Delay-tolerant Networks, #Machine Learning, #Blockchain

Recognitions
- Awards: Five IEEE Best Paper Awards, Six Faculty Research Award, NRC and AFRL Fellowships
- Pub.: 275+ journal and conference publications and 2 books
- Service: PC Chair, General Chair, Steering committee members, Associate editors
Infrastructure Renewal and Sustainable Materials for Structural Engineering Applications

Structures / High Performance Concrete Materials
- High strength concrete (HSC), High strength-self consolidating concrete (HS-SCC), Ultra high performance concrete (UHPC), High volume fly ash concrete (HVFAC).

Fiber-Reinforced Polymers (FRP) in Structural Applications
- FRP, Fiber reinforced cementitious matrix (FRCM), Steel reinforced polymers (SRP), Hybrid composite systems.

Structural Health Monitoring and Load Testing of Bridges
- Use and implementation of sensors for monitoring and load testing including vibrating wire strain gauges, themistors, LIDAR, and high precision surveying systems.

Structural Hardening and Blast Mitigation
- Development of systems for blast mitigation and structural hardening.

Keywords
- #HPC, #HSC, #HS-SCC, #UHPC, #HVFAC, #FRP, #FRCM, #SRP, #SHM, #Blast Mitigation, #Infrastructure Renewal, #Rehabilitation.

Press
- Award: Inter. Inst. For FRP in Construction Fellow, 2018.
- Award: Outstanding Elsevier Reviewer Award, 2018.
- Award: Chi Epsilon Honor Beta Chapter Member, 2017.
- Award: National AEI Outstanding Educator Award, 2016.
- Society Fellow: ACI, ASCE, IIFC, TMS.

PoC: John J. Myers, Ph.D. P.E., Associate Dean, College of Engr. and Computing
Professor of Civil, Arch. and Envr. Engr
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Funding
- US Department of Transportation, Federal Highway Transportation, Missouri Department of Transportation, National Science Foundation, Air Force Research Laboratory, Department of Homeland Security, Army Research Laboratory.

Use of advanced composites for rehabilitation and new material development for sustainable construction
Dr. Monday U. Okoronkwo
Assistant Professor
Chemical and Biochemical Engineering

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Phone: (573) 341-4349
210R Bertelsmeyer Hall
Website: www.susmatlab.com

Education:

- PhD Chem, University of Aberdeen, UK

Research Interests:

Chemistry of Materials for Sustainable Infrastructure, Energy and Environment

Dr. Okoronkwo’s research efforts are directed towards understanding the composition-structure-processing-property relationship of materials, and the application of a combined computational and experimental approach to design, synthesize and develop new materials that deliver improved performance and sustainability. His research thrust areas include:

1. Materials for Sustainable Infrastructure
   - Advanced chemical admixtures for cement and concrete
   - Hydration, microstructure, and durability of cement-based materials
   - Nanotechnology and application to cement-based systems
   - Thermodynamics-based design of materials for sustainable infrastructure
   - Rheology of cement-based materials and complex fluids
   - Mitigation and control of deteriorative reactions in cement-based materials.
   - Alternative eco-efficient and resilient concretes

2. Materials for Sustainable Energy and Environment
   - Microporous, inorganic electrides, and energy materials
   - Nanocomposites and functional materials for environmental remediation
   - Waste immobilization and water treatment
   - CO$_2$ conversion and utilization

More details of Okoronkwo’s research can be found on his research group website: https://susmatlab.com/

Funding

- NSF
- Missouri S&T, and Materials Research Center Young Investigator Seed Fund
Resilient and Sustainable Geotechnical Infrastructure

Energy geotechnology and sustainability
- Physical and numerical/analytical modeling of ground-coupled thermo-hydro-mechanical processes associated with energy geotechnology.
- Ground-coupled heat exchangers and energy geostructures (energy piles, thermal tunnels etc.)
- Thermal and mechanical energy geostorage (underground thermal energy storage, compressed air energy storage)

Geotechnical earthquake engineering
- Performance of improved ground during earthquakes
- Dynamic soil-foundation-structure interaction, physical and numerical/analytical modeling of earth structures and foundations
- Dynamic response of fine grained soils
- Seismic site amplification and seismic hazard mapping
- Induced seismicity

Guneý Olgun, Assistant Professor, olgun@msu.edu

Recent Funding
- National Science Foundation: Geotechnical Engineering, NRT, NEESR, RSB, OISE
- U.S. Geological Survey: NEHRP
- U.S. Agency of International Development
- Various private companies

Keywords
#energygeotechnology #energygeostructures #energypiles #compressedairenergystorage #gshp #earthquakes #groundimprovement #resilientinfrastructure #liquefaction #seismicamplification #carbonatesands #nanoindentation
DEPARTMENT OF MECHANICAL & AEROSPACE ENGINEERING

ADVANCED ENERGY MATERIALS & SYSTEMS

ENERGY STORAGE for TRANSPORTATION
• High Energy/Power Density, Long Cycle Life, Safety
• Diagnostics, Prognostics, and Battery Management
• Next Generation Batteries

ENERGY STORAGE for STATIONARY
• Li-ion/Lead Acid/Flow Batteries for Grid Applications
• Optimal Energy Scheduling in Microgrids

ENERGY CONVERSION SYSTEMS
• Development of Novel Ferroelectric Materials
• Development of Micro Fuel Cell Systems

ADVANCED NANOMATERIALS, ADDITIVE MANUFACTURING
• Self-assembly for Nanostructures
• Nanodevices for Biomedical Applications
• Multiscale/Multiphysics Modeling/Simulation

PoC: Jonghyun Park, Assistant Professor
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Funding
• NSF CMMI, CBET, EPCN
• Department of Education
• Microgrid Consortium, UMRB, MRC, CBSE, OBI, ISC

Keywords
• #energy storage, #energy conversion, #battery, #microgrid, #nanomaterials, # fuel cell, #flow battery, #nanodevices, #self-assembly, #multiscale model, #multiphysics model

Recognitions
• NSF Innovation Corps, Entrepreneurial Lead (2013)
• Recognition by GM/UM ABCD Institute (2011)
• Outstanding Research, Hyundai Heavy Industries (2004)
Systems Analytics Laboratory

Artificial Intelligence (AI) Systems Engineering
- Deep neural networks for multi-class object detection and segmentation for robotics-empowered infrastructure inspection
- Deep neural networks for action recognition in smart manufacturing

Data/System Analytics
- Crash reporting data analytics for transportation safety enhancement
- Stochastic/statistical modeling of uncertainty

Optimization under Uncertainty
- Robust optimization and stochastic programming for renewable energy systems
- Designing and pricing of derivative products for the risk management in engineering domains

PoC: Ruwen Qin, PhD
Associate Prof. of Engineering Management and Systems Engineering
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Funding
National Science Foundation • US Department of Transportation • US Dept. of Education

Keywords
data analytics • machine learning • uncertainty & risk modeling • stochastic programming • robust optimization • dynamic programming • human-technology interaction • manufacturing & service operations • transportation safety • energy management • financial an real derivatives • system of systems • cyber-physical systems • smart systems
Polymer Composite Materials

Research Topics

- Renewable, agricultural industrial materials
  - Develop monomers and polymers from ag resources
  - Structure-property relationships toward commercialization
- Surface modification of inorganic oxide fillers
  - Tailor filler interfaces to improve performance
  - High energy storage density low loss dielectric composites
  - Concrete: higher tensile strength, reduced ASR, 3-D print
- Biomedical polymer composite cement
  - Strong, biocompatible nanocomposite of low internal stress
- Enhanced oil recovery polymer gels
  - Design composite and polymerization chemistry
  - Low cost, state of the art tools for directing resource flow

Facilities

- Wet organic lab, Materials Research Center, NMR and other spectral characterizations, thermal analyses, dielectric and impedance characterizations, EOR analyses

Thomas P Schuman, Ph.D.
- Professor of Chemistry
- tschuman@mst.edu; 573 341 6236

Funding Sources

- Missouri and United Soybean Councils
- Office of Naval Research; U.S. Army; Dept. of Energy
- Industrial consortium (JIP) Enhanced oil recovery gels
- Cement – Concrete Associations; DOTs

Keywords

- Composites, surface modification, polymer materials design and syntheses, oil recovery

Recognitions/Significant Achievements

- State of art dielectric energy storage density, low loss
- Best paper Thermoset Resin Formulators Asso. (TRFA) meeting
- Several patent applications and commercialization processes
Dependability for Intelligent Systems

Examples of Dependability Attributes Studied
- Reliability: Probability of system remaining functional
- Availability: Percentage uptime
- Survivability: Functionality maintained after failure
- Resilience: Ability to bounce back from failure

Examples of Systems Analyzed
- Consumer electronics, smart grids, intelligent water distribution networks, autonomous vehicles, robots

Examples of Tools and Techniques Developed
- Stochastic models of dependability attributes for critical infrastructure systems
- Simulation environments that capture both the physical infrastructure and the intelligent control
- Analysis of failure propagation

PoC: Sahra Sedigh Sarvestani
Associate Professor
Dept. of Electrical and Computer Engineering
Dept. of Computer Science (courtesy)
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Keywords
- #Dependability, #Critical-Infrastructure, #StochasticModeling, #Cyber-PhysicalSystems, #Simulation, #FailureAnalysis

Recent Recognition
- Best Paper Award, International Symposium on Resilient Cyber Systems, August 2016

Funding
- Department of Education, Department of Transportation, National Science Foundation, National Security Agency, Army, Private Industry
Resilient and Sustainable Infrastructure

Behavior of Reinforced and Prestressed Concrete Structures
- Shear and Torsion of Concrete
- Design Codes for Structural Concrete
- Structural Models and Experimental Methods

Repair and Strengthening of Structures
- Advanced Composites for Structural Strengthening
- Seismic Retrofit of Bridges
- Rapid Repair of Earthquake-Damaged Structures

Evaluation of Existing Structures
- Bridge Deck Deterioration Assessment
- Earthquake-Induced Damage Assessment of Bridges

Rapid Repair Procedure

Effective Strengthening and Repair Methods are Needed to Assure the Resiliency and Sustainability of Infrastructure

Lesley H. Sneed, Ph.D., P.E., F.A.C.I.
College of Engineering and Computing
Associate Professor and
Stirrat Faculty Scholar
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Funding
- National Science Foundation, Missouri DOT, Caltrans, US Department of Transportation, Concrete Research Council, Precast/Prestressed Concrete Institute

Keywords
- #BuildingCode, #Composites, #Concrete, #Repair, #Strengthening, #StructuralEvaluation

Recognitions
- Missouri S&T Inaugural Stirrat Faculty Scholar Award
- Missouri S&T Faculty Excellence Award (2016)
- American Concrete Institute (ACI) Fellow
- Erasmus Mundus International Fellow, SAHC Masters in Structural Analysis of Monuments and Historical Constructions
DEPARTMENT OF CIVIL, ARCHITECTURAL AND ENVIRONMENTAL ENGINEERING

Transforming Wastewater to Fresh Water

Low DO aeration strategy for mega energy saving during wastewater treatment

• Developed fundamental understanding of low DO aeration strategy for wastewater treatment, which promotes its use in all wastewater treatment plants and could save US 5 billion kWh electricity per year without capital investment

Novel technologies to simultaneously improve effluent quality and energy efficiency

• Developed intermittent MLE (iMLE) process to achieve better treatment quality at reduced energy use. This facilitate wastewater reuse and mitigates surface water eutrophication, solving a growing concern worldwide

Small systems for community and military use

• Developed novel BBR technology to be used by small community and military for wastewater reuse

PoC: Jianmin Wang, Ph.D., P.E.
Professor
Dept. of Civil, Architectural & Environ. Eng.
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(573) 341-7503

Funding

• DoD, EPRI, MDNR, USGS, industry

Wang’s research could turn wastewater treatment plants freshwater and net energy producers

Keywords

• Wastewater treatment, reuse, energy, nutrient removal, eutrophication

Recognitions

• CAPEES Best Paper Award
• Faculty Research Award
• CAPEES Distinguished Service Award
DEPARTMENT OF CIVIL ARCHITECTURAL AND ENVIRONMENTAL ENGINEERING

Advanced Multi-Functional Material Systems

Smart Materials and Mechanics
• Novel material characterization techniques
• Structural functionality and stability
• Smart and multifunctional materials processing and design

Computational Assessment and Design
• Assessment of structural behavior using computational mechanics: (a) explicit modeling, (b) equivalent modeling
• Computer aided experimental measurements
• Artificial intelligence and autonomous design

Human Factors and Engineering Functionality
• Optimization of design process considering human factors including both environmental and psychological conditions
• Structural failure prediction considering human perceptions and functionalities

PoC: Chenglin Wu, Assistant Professor, Civil Engineering, wuch@mst.edu
http://care.mst.edu/directory/profiles/wu
http://web.mst.edu/~wuch

Funding Recently Submitted or in Preparation
• NSF – Mechanics of Materials, Nano and Biomechanics

Keywords
#Smart Materials #Mechanics #Computational Design #Structural Assessment # Smart Living #Structural Instability #Engineering Design

Future Projects
• Multi-functional material systems for sensing purpose
• Advanced smart materials for durability and impact resistance
• Energy harvesting and storage devices
Advanced Methods to Characterize Soil Behavior
- Close-range photogrammetry and its applications in geotechnical engineering
- High suction tensiometer and automated laboratory measurements
- Characterization of coupled thermo-, chemo-, hydro-, mechanical behavior of multiphase geomaterials

Constitutive and Numerical Modelling of Unsaturated Soils
- Modified state surface approach for constitutive modelling of multiphase materials
- Numerical modelling of climate-vegetation-soil-structure interaction
- Slope stability and retaining walls

Other Topics
- Frozen ground engineering and permafrost
- Use of wicking fabric to mitigate frost heave and thaw weakening
- Ground improvement and erosion control

PoC: Xiong Zhang, Ph. D., P. E. Assoc. Professor zhangxi@mst.edu, 573 341-6286

Funding
- National Science Foundation
- US Department of Transportation
- Alaska DOT&PF, AUTC, CESTiCC
- TenCate Geosynthetics

Keywords
- Photogrammetry, Image Processing, Unsaturated Soils, Constitutive Modelling, Modified State Surface Approach, Slope Stability, Landslides, Ground Improvement, Slab on Expansive Soils, Wicking Fabric, Frost Heave Mitigation

Recognitions
- International Innovation Award in Unsaturated Soil Mechanics, ISSMFE
- Excellent reviewer, Canadian Geotechnical Journal