Thursday, February 9, 2023 | 3:00 pm – 4:30 pm Eastern

Virtual participation via Microsoft Teams

[Meeting Link](#)

Meeting ID: 272 738 345 046 Passcode: fJ9mQ2

<u>Agenda</u>

All times are EASTERN U.S. time zone

3:00 pm	**Welcome and Summary of Meeting Objectives**	**T. G. Guzik**
3:02 pm	**NASA Autonomous Systems Laboratory at Stennis Space Center**	**Anne Peek**
3:07 pm	**Introduction to EPSCoR and the NASA EPSCoR Program**	**T. G. Guzik**

The remainder agenda items are flash talk presentations by jurisdiction researchers to illustrate capability and relevance to SSC research priorities.

3:20 pm **Intelligent Integrated System Health Management (ISHM) for Ground and Space Applications:**

Leveraging "Digital Twining" to Enhance System Health Monitoring

Farzad Ferdowsi (LA)

Structural Integrity Monitoring System using Autonomous Unmanned Aerial and Ground Vehicles

Han-Gyu Kim (MS)

A Graph-Based Architecture for Anomaly Detection on The Edge

Davide Guzzetti (AL)

Lithium-Ion Batteries Online Health Assessment and Health-Aware Environment-Aware Charge and Discharge Control

Jaber Abu Qahouq (AL)

Intelligent Integrated System Health Monitoring and Fault-Tolerant Operation for Electric Propulsion Drivetrain Systems

Jiangbiao He (KY)

Integrated AI-based Deficiency in Control Systems

Md Tamjidul Hoque (LA)

Q&A (8 minutes)

3:40 pm   **Advanced Propulsion Test Technology Development and Test Instrumentation:**
A New Pathway for Prediction of Thermal Fluid Behaviors

Joonsik Hwang (MS)

Fluid-Structure Interaction and Fatigue Study of Vortex-Induced Vibration in
Thermowells Subjected to Liquid Nitrogen Flow

Youssef Hammi (MS)

Experimental characterization of cavitating flow in liquid rocket propellants

Shyam Menon (LA)

Testing instrumentation and techniques for advanced rocket propulsion
system   **Seokwon Cho (MS)**
Q&A (8 minutes)

3:56 pm   **Ten-minute break in virtual meeting. Resume at 4:06 pm eastern.**

4:06 pm   **Autonomous Operations Capability for Ground and Space Applications:**
Autonomous Planetary Construction Using ISRU-based Robotic Large-scale 3D
Printing   **Ali Kazemian (LA)**

Autonomous Robotic Walking Machines for Surface Exploration & ISRU

Pierre Marc Larochelle (SD)

Incremental Learning with Knowledge Distillation for Autonomous Rover
Terrain Characterization   **Jingdao Chen (MS)**

Enabling Cislunar Spacecraft Autonomy Using Learning-Based Algorithms and
Convex Optimization   **Ehsan Taheri (AL)**

Cloud-Assisted Autonomy for Artemis Missions   **Nan Li (AL)**

Energy storage systems for operation in extended temperature range (-60 to
+60 °C)   **Ramakrishna Podila (SC)**

Self-Organizing Distributed Antenna Arrays for Reach-back and Sensing

Soura Dasgupta (IA)

Run-Time Trade Space Analysis for Autonomous Surface Operations

Yu Gu (WV)

Q&A (8 minutes)

4:30 pm   **Adjourn Meeting**

Speakers for the 2023 NASA EPSCoR Virtual Research Discussions with Stennis Space Center
in order of appearance

T. Gregory Guzik

T. Gregory Guzik is the Director of the Louisiana Space Grant / NASA EPSCoR program. His scientific career has focused on astrophysical energetic particles including large class cosmic ray balloon instruments launched as long duration balloon flights in Antarctica, heavy ion particle accelerator experiments, cosmic ray instruments on-board satellites, and is part of an international collaboration working with the CALET high energy cosmic ray instrument on-board the International Space Station. Dr. Guzik has been directly involved with Space Grant and NASA EPSCoR for close to 20 years including developing and managing both entry-level and advanced experiential student ballooning programs. Dr. Guzik currently serves as the Chair of the NASA EPSCoR Caucus.

Anne Peek
Center Chief Technologist
Office of Technology, Policy, and Strategy

Anne Peek began her NASA career as a research microbiologist at Stennis Space Center. During her tenure she has held a series of technical leadership positions in applied sciences, technology development, environmental management and remote sensing.

In January 2022, Peek was selected as the Center Chief Technologist. This position is aligned with the NASA Office of Technology, Policy and Strategy (OTPS).

From 2013 to 2022, Peek served as the Center Director's Chief of Staff and managed legislative affairs, leading the development and execution of legislative strategy for the Center. Prior to these roles she led execution of NASA's Gulf of Mexico Initiative, leveraging remote sensing capabilities to address key coastal issues. Following the Deepwater Horizon oil spill, Peek built successful coalitions with government, academia, and private sector interests to support spill response and coastal restoration activities. In addition, she was a contributor to the Mississippi state coastal restoration plan, as well as the regional economic assessment conducted by the International Economic Development Council. Peek subsequently led development of the strategic framework for the National Oceans and Applications Research Center. The concept was adopted by the state of Mississippi as a model for coastal restoration and economic recovery.

Peek served as a NASA legislative fellow on Capitol Hill in the office of U.S. Senator Trent Lott of Mississippi. She advised the senator and his staff on science and technology policy during the one-year assignment. Peek was awarded NASA fellowships to the Senior Executive Fellows Program at the Harvard Kennedy School of Government, and to the Institute of Managerial Leadership at the University of Texas McCombs School of Business. She holds Bachelor of Science and Master of Science degrees in biology from the University of Southern Mississippi and pursued doctoral studies in environmental microbiology at Louisiana State University. She and her husband reside in Covington, Louisiana.

Farzad Ferdowsi

Farzad Ferdowsi, Ph.D., is an Assistant Professor in the Department of Electrical & Computer Engineering and also a faculty member of UL's Energy Efficiency and Sustainable Energy Center (EESE) within the Energy Institute of Louisiana (EIL). Ferdowsi received his PhD from Florida State University in 2016 and was a Research Associate/Lecturer at LSU from 2017 to 2018 before he joined UL Lafayette in Aug 2018. He is currently a full member of the College of Engineering Graduate Faculty. He served on the faculty senate for 2020-21 and 2021-22 AYs. Ferdowsi is actively involved in research and is currently supervising four (3) PhD and two (2) MS students. He has secured over $2M of external funds since 2018 as a PI and Co-PI on several research projects. Ferdowsi's research interests include smart and connected energy systems, energy efficiency, and energy resilience.

Han-Gyu Kim

Han-Gyu Kim is an Assistant Professor in the Department of Aerospace Engineering at Mississippi State University (MSU). His research expertise is in advanced composite materials and structures for hypersonic vehicles, multiscale and multi-physics modeling, structural dynamics, fracture mechanics, fatigue and nondestructive damage evaluation. For hypersonic vehicle design, he has been collaborating with the Air Force Research Lab at the Wright-Patterson Air Force Base for the last eight years. Dr. Kim is currently working with the NASA Glenn Research Center to develop an efficient experimental framework and a high-fidelity damage model for composite structures. His recent effort is focused on developing a structural integrity monitoring system using autonomous unmanned aerial vehicles (UAVs) in collaboration with Raspet Flight Research Laboratory at MSU. For this project, Dr. Kim is employing the latest sensing systems and UAVs such as a LiDAR system RIEGL VUX-240 (link), a motion capture system with twelve Primex 41 sensors (link), aerial cameras iXM 100MP (link), and UAVs Teros-C (link) and TigerShark-XP (link). For UAV application, he developed a maneuverable 3D digital image correlation technique which does not require a spatial calibration process.

Davide Guzzetti

Dr. Davide Guzzetti is an assistant professor in the Department of Aerospace Engineering at Auburn University. His research group has experience with a variety of optimization tools (e.g., gradient-based, indirect, machine learning, and population-based meta-heuristics) that are employed in mission analysis and development of spacecraft autonomy. The group is also actively engaged in Pre-Phase A and Phase A feasibility studies for space missions. Dr. Guzzetti operates a room-scale, free-roaming VR facility that is organically integrated with system engineering, spacecraft autonomy, immersive analytics, and mission design research. Dr. Guzzetti's program has been supported by NASA, AFRL, and private companies. Dr. Guzzetti has been recognized as a NIAC 2020 fellow, an Auburn University Outstanding Graduate Student Mentor, and an alumnus of the Italian honor society Alta Scuola Politecnica. He is also a current member of the Space Flight Mechanics Committee of the American Astronautical Society. He obtained a Ph.D. in astrodynamics from Purdue University in 2016 and holds a Master's degree in space engineering from Politecnico di Milano, Italy.

Jaber Abu Qahouq

Jaber Abu Qahouq is a Professor of Electrical and Computer Engineering at The University of Alabama (UA). He's the director of The Energy and Power Electronics Systems and Devices Laboratory. Dr. Jaber's main current research focus is in power electronics and energy systems field including architectures, controls, circuits/electronics topologies, energy storge systems management, electric vehicles, renewable energy systems, health diagnosis and prognosis, and wireless power transfer, among others. Dr. Jaber applies his expertise in power electronics and energy systems to wide range of applications.

JiangBiao He

JiangBiao He is a tenure-track Assistant Professor and the endowed L. Stanley Pigman Faculty Fellow in the Department of Electrical and Computer Engineering at the University of Kentucky. He obtained his Ph.D. in Electrical Engineering from Marquette University, Wisconsin. He has worked in multiple large industry R&D centers, most recently as a Lead Engineer at GE Global Research in Niskayuna, New York. Prior to joining GE in 2015, Dr. He was employed with Rockwell Automation as a power electronics engineer, focusing on the product development of regenerative servo motor drives. He was also employed with Eaton Corporate Research & Technology in 2013 working on high-efficiency SiC power converters. Dr. He's research interests over the past 15 years include high-performance power electronics and motor-drive systems, and the related online health monitoring. He is the author/coauthor of more than 125 peer-reviewed technical papers and 10 U.S. patents on these topics.

Md Tamjidul Hoque

Md Tamjidul Hoque is an Associate Professor of Computer Science at UNO. He is the Director of the BML Lab and Coordinator for the Machine Learning (ML) and AI Concentration as well as Graduate Certificate in ML & AI. His research expertise is at the Deep/Machine Learning Modeling and Algorithm Designing, Computer Vision, Natural Language Processing (NLP), Autonomy, Unmanned Aerial/Surface/Underwater Vehicle, Big data and Data Science, Bioinformatics and Evolutionary Computation. Since 2004, Dr. Hoque's primary focus of his research is to develop integrated machine learning solutions and research tools toward Intellectual Property Data Analysis and Decision Support Using Advanced Text Analytics (for NASA/SSC), Prediction of Increased Risk Based on Available Safety, Quality and Maintenance Data (for NASA/SSC), Drone Image based Levee Fault Detection and System Integrity and Health Monitoring (for USACE), AI-Based Identification of Deficiencies in Flood Control Systems (Azure/Microsoft), Machine Learning for Flight Terminal Procedure Chart Change Detection for Possible Threat (for NRL), and techniques for large-scale biomedical research towards predictive health analytics. .

Dr. Joonsik Hwang

Joonsik Hwang is an Assistant Professor in the Department of Mechanical Engineering and Center for Advanced Vehicular Systems (CAVS) at the Mississippi State University. Before joining Mississippi State University, he had a post-doctoral fellowship at Sandia National Laboratories (Combustion Research Facility, Livermore, CA). He received his B.S. (2011), M.S. (2013), and Ph.D. (2017) degrees all in Mechanical Engineering at Korea Advanced Institute of Science and Technology (KAIST). His primary research specialization is in high-speed optical diagnostics of reactive thermal flows, advanced combustion strategy, Artificial Intelligence (AI) guided modeling and Computational Fluid Dynamics (CFD) simulation. He is leading various experimental/computational studies on thermal fluids at Advanced Propulsion and Spray (APS) Lab (https://apsl.me.msstate.edu/). The lab is equipped with high-pressure, high-temperature combustion vessel, high-speed camera, optical components (laser, lens, mirror, LED etc.), and a computational cluster.

Dr. Youssef Hammi

Dr. Youssef Hammi is currently an Associate Professor at the Mechanical Engineering Department and held positions as an Associate Research Professor at the Center for Advanced Vehicular Systems at Mississippi State University. Dr. Hammi's research activities of particular interest encompass macromechanical/micromechanical constitutive modeling, inelastic behavior, damage, failure, fracture, fatigue, computational mechanics, discrete elements (DEM), user elements (UEL), Coupled Eulerian Lagrangian (CEL), finite element analysis (FEA), and Fluid-Structure Interaction (FSI). In a recent NASA project, Dr. Hammi performed two-way fluid structure interaction (FSI) simulations in ANSYS to simulate the flow around thermowells and its mechanical response. Stress distributions from the FSI simulations were then used to perform a fatigue analysis in the SIMULIA software fe-safe to evaluate the internal causes of failures due to fatigue. In fatigue analysis, bench-scale cryogenic fatigue testing at liquid nitrogen temperatures from the literature will be used to determine the fatigue properties of 304L and 316 stainless steel materials. Dr. Hammi is also interested and currently working in simulations using open-source FSI software.

Dr. Shyam Menon

Shyam Menon is an Assistant Professor of Mechanical Engineering at LSU. He leads the Energy and Propulsion laboratory at LSU which is engaged in a variety of investigations of multiphase flows with application to fuel-based generation of energy and propulsion power for aerospace applications. EPL has developed capabilities to investigate multiphase (gas/liquid/solid) flows at low- and high-speed and reacting- and non-reacting conditions using scaled experimental setups and non-intrusive diagnostics including laser-based techniques. Ongoing projects are looking at swirl-combustion of Sustainable Aviation Fuels (SAF) for aircraft propulsion (DOE funded), particle-laden flow interaction with material surfaces (NSF and ONR funded), shockwave interaction with liquid and nanofluid droplets, and hybrid rocket combustion studies through temperature measurements and detailed numerical simulations.

Dr. Seokwon (Alex) Cho
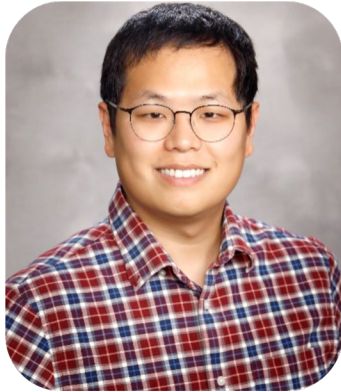
Seokwon (Alex) Cho is an assistant professor of Aerospace Engineering at Mississippi State University. He received his B.S. in Mechanical and Aerospace Engineering at Seoul National University, where he also finished his Ph.D. in 2018. In 2019, he joined University of Minnesota–Twin Cities as a postdoctoral associate and lecturer, followed by two years of service as a postdoctoral appointee at Sandia National Laboratories in Livermore, CA.

His expertise mainly focuses on experimental research and testing advanced propulsion systems. AThEnA Laboratory is competent with testing system setup, refined data acquisition & measurement, and data post-processing and analysis. The laboratory has extensively been involved in analyzing pressure, temperature, and other heat-related data in a combustion environment. AThEnA's current research focuses on the following: developing high-frequency telemetry data acquisition systems for high-speed electrical motors, developing MEMS-based heat-flux sensors for advanced thermal and propulsion systems, combustion behavior of alternative fuel (e.g., high-ethanol content) using experiments and CFD large-eddy simulations (LES) in engine application.

Dr. Ali Kazemian

Ali Kazemian is an Assistant Professor of Construction Management at LSU, also holding an adjunct position in the division of Electrical and Computer Engineering. He is the director of the LSU rəcast Lab which is focused on various aspects of robotic construction. His current research projects are focused on the process automation, quality control, and innovative printing materials for construction 3D printing (C3DP). In addition to the terrestrial applications of C3DP, he is also researching extraterrestrial C3DP for Lunar and Martian construction, with support from Louisiana Space Grant Consortium (LaSPACE). Before joining LSU, Dr. Kazemian worked as a senior R&D engineer for 3 years at Contour Crafting Corporation – a well-known robotic construction company in California. He earned a PhD degree in Civil Engineering (2018) and a Master's degree in Computer Science from USC. His research efforts so far have resulted in publication of a book, 3 book chapters, and 16 journal papers in the areas of robotic construction and advanced construction materials.

Dr. Pierre Marc Larochelle

Pierre Larochelle serves as Department Head and Professor of Mechanical Engineering at the South Dakota School of Mines & Technology. His research focuses on the design of complex robotic mechanical systems and enabling creativity and innovation in design. He has over 100 publications, holds three US patents, and serves as a consultant on robotics, automation, machine design, creativity & innovation, and computer-aided design. In 2012, at NASA's request, he created a 3-day short course on Creativity & Innovation. This course has been very well received, and he has taught it exclusively more than 30 times at NASA's various centers and laboratories across the nation to more than 600 of NASA's scientists and engineers. He currently serves as the Chair of the U.S. Committee on the Theory of Mechanisms & Machine Science and represents the U.S. in the International Federation for the Promotion of Mechanism & Machine Science (IFToMM) (2016-22). He currently serves as a founding Associate Editor for the ASME Journal of Autonomous Vehicles and Systems. He has served as Chair of the ASME Design Engineering Division (2018-2019) and the ASME Mechanisms & Robotics Committee (2010-2014), and as an Associate Editor for the ASME Journal of Mechanisms & Robotics (2013-19), the ASME Journal of Mechanical Design (2005-11), and for Mechanics Based Design of Structures & Machines (2006-13). He is a Fellow of the American Society of Mechanical Engineers (ASME), a Senior Member of IEEE, and a member of Tau Beta Pi, Pi Tau Sigma, ASEE, and the Order of the Engineer.

Dr. Jingdao Chen

Jingdao Chen is an Assistant Professor in Computer Science and Engineering at Mississippi State University. He received his Bachelor's degree in Electrical Engineering from Washington University in St. Louis in 2015, his Master's degree in Computer Science from Georgia Institute of Technology in 2019, and his Ph.D. in Robotics from Georgia Institute of Technology in 2021. His research interests include robotics, machine learning, artificial intelligence and computer vision. His research specialization is in deep learning-based perception of unstructured environments for robotics applications. Dr. Chen has previously collaborated with NASA JPL on a Data Science Working Group project titled CLOVER: Contrastive Learning for Onboard Vision-Enabled Robotics. The project developed a contrastive learning scheme for improving performance on downstream vision tasks for Mars rovers in a data-efficient manner. Other research capabilities include algorithms for autonomous path planning, image processing, scene understanding and mobile computing.

Dr. Ehsan Taheri

Ehsan Taheri is an Assistant Professor of Aerospace Engineering at Auburn University. He's the director of the Aero-Astro Computational and Experimental (ACE) Lab. His research expertise is at the intersection of optimal control theory, control engineering, and space and atmospheric flights. Since 2019, Dr. Taheri's primary area of activity has been on the development of rapid numerical methods for generation of spacecraft optimal impulsive and low-thrust trajectories. In addition, his research group have deployed motion-planning algorithms on embedded systems for trajectory optimization of multi-rotor unmanned aerial vehicles. The ACE Lab is equipped with an OptiTrack motion-capture system and multitude of multi-rotor vehicles and provides an experimental testbed for testing the developed guidance and motion-planning algorithms on low-cost, custom-built quad- and multi-rotor platforms.

Dr. Nan Li
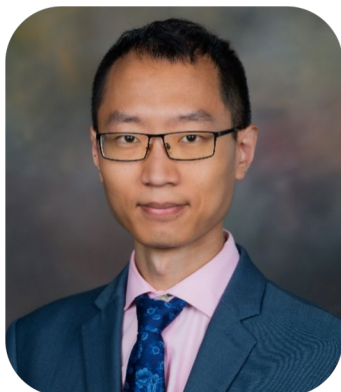
Nan Li is an Assistant Professor of Aerospace Engineering at Auburn University. His expertise and interests lie at the intersection of systems theory, optimization, and artificial intelligence. Since joining the Department of Aerospace Engineering at Auburn University, his research has focused on the theory and methods for safe autonomy, multi-agent systems, connected cyber-physical systems, and their applications for advanced mobility and space exploration. He is particularly interested in investigating new decision/control approaches and autonomous systems enabled by emerging computational paradigms including cloud computing and distributed/edge computing.

Dr. Ramakrishna Podila

Rama Podila is an Associate Professor of Physics and Astronomy at Clemson University. His lab aims to seamlessly integrate the principles of condensed matter physics, optical spectroscopy, and physiological chemistry to understand physics at the nanoscale and nano-bio interfaces. Our research efforts may be categorized into three broad themes: 1) Energy conversion and storage, 2) Nanotoxicity and nanomedicine, and 3) Quantum biophysics. In terms of energy storage, Nano-bio lab made significant strides in defect-engineered graphene supercapacitors, novel current collectors for Li-ion batteries, nanostructured Si anodes and sulfurized polymer cathodes for Li-S batteries. His work thus far has led to >70 peer-reviewed articles (>6000 citations with a H-index: 45) in high-impact journals including Nature, 3 patents, and several invited talks. His group's research has been supported through funding from NIH/NIEHS, NASA, and NSF.

Soura Dasgupta

Soura Dasgupta is an F. Wendell Miller Distinguished Professor in the Department of Electrical and Computer Engineering at the University of Iowa. His research interests include distributed sensing, control, communication, and signal processing. He was elevated to the rank of a Fellow of the IEEE in 1998, is a past Presidential Faculty Fellow (precursor to PECASE), and past Associate Editor of IEEE Transactions on Automatic Control and IEEE Transactions on Circuits and Systems II. His research as been funded by NSF, NIH, ONR, ARO and DARPA. His collaborator Professor Raghuraman Mudumbai and he have developed fundamental theory and performed experimental demonstrations that will serve as a stepping stone for the proposed research.

Dr. Yu Gu

Dr. Yu Gu (Gu) is an Associate Professor in the Department of Mechanical and Aerospace Engineering at West Virginia University (WVU). His main research interest is in improving robots' ability to function in increasingly complex environments and situations. Gu is a three-time NASA Centennial Challenge winner and a NASA NIAC Fellow. He has led the design of autonomous robots from one degree of freedom (DOF) to 55 DOF, from 50mg to 200kg, which were featured in 150 media stories. Gu also led the initiation and development of the WVU Robotics program.