PRESIDENT'S EXCELLENCE FUND SYMPOSIUM

April 4, 2019 • Walter and Leonore Annenberg Presidential Conference Center

IMAGINATION IMPACT
ENERGY
EXCELLENCE RESEARCH INNOVATION
CREATIVITY
DISCOVERY

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The President's Excellence Fund, established in October 2017 by President Michael K. Young, is a 10-year, $100 million initiative designed to further Texas A&M University's commitments to the three pillars of advancing transformational learning; enhancing discovery and innovation; and expanding impact on our community, state, nation, and world.

PROGRAM

APRIL 4, 2019 • *Frymire Auditorium*
Walter and Leonore Annenberg Presidential Conference Center

10:30	**INTRODUCTIONS** **Mark A. Barteau** *Vice President for Research* **VIDEO WELCOME MESSAGE** **President Michael K. Young** **KEYNOTE SPEAKER** **Cecilia Conrad** *Managing Director* MacArthur Foundation **“Inspiring Creativity and Bold Solutions”**
12:00	**Lunch Break, Lobby**
12:00	**T3 Poster Session, 1101 B and C**
1:30	**Interdisciplinary Research Evaluation Team (IDRET)** *Michael Beyerlein*
1:50	**“Point-of-Care Diagnosis and Monitoring of Respiratory Disease Through Exhaled Breath Analysis”** *Ricardo Gutierrez-Osuna* College of Engineering
2:10	**“CRISPR Gene Editing for Healthier Foods and Improved Crop Resilience”** *Michael Thomson* College of Agriculture and Life Sciences
2:30	**“Autonomous Material Discovery and Manufacturing via Artificial Intelligence”** *Satish Bukkapatnam* College of Engineering

2:50 **"Mastering Friction to Reduce Current and Future Energy Demands"**
James Batteas
College of Science

3:10 **Break**

3:30 **"Monitoring Rapidly Changing Arctic Ecosystems using High-Resolution Satellite-Based Datasets and Artificial Intelligence"**
Julie Loisel
College of Geosciences

3:50 **"Multi-Functional and Sustainable Materials for 3D-Printing Environmentally Adaptive Resilient Buildings"**
Zofia Rybkowski
College of Architecture

4:10 **"Novel Approaches to Stem Cell Manufacture"**
Carl Gregory
College of Medicine

4:30 **"Pathways to Sustainable Urban Water Security: Desalination and Water Reuse in the 21st Century"**
John Tracy
College of Engineering

4:50 **Closing Remarks**
Mark Barteau

X-GRANTS

An interdisciplinary research program that is part of the ten-year, $100 million President's Excellence Fund. The first year provided $7 million funding to faculty-researchers to stimulate and support innovative interdisciplinary research. This program is open to all faculty, researchers, and staff at Texas A&M University, Texas A&M University-Galveston, Texas A&M University-Qatar, TEES, TEEX, AgriLife Research, AgriLife Extension, and TTI.

Point-of-Care Diagnosis and Monitoring of Respiratory Disease Through Exhaled Breath Analysis

Ricardo Gutierrez-Osuna, *Gerard Coté, Nicolaas Deutz, Sherecce Fields, Roozbeh Jafari, Pao Tai Lin, Svetlana Sukhishvili, Xiaohui Xu*

Respiratory diseases are a major burden for public health. It is estimated that the two most prevalent respiratory diseases, chronic obstructive pulmonary diseases (COPD) and asthma, each affect 200 million people worldwide. Exhaled breath analysis offers promise as a real-time and non-invasive diagnostic technique, particularly as a noninvasive screening mechanism. However, most tools to monitor respiratory disease measure only one specific chemical or biomarker in exhaled breath, or rely on analytical instruments (gas chromatography/mass spectrometry) that are expensive and difficult to operate. Thus, there is a need for new sensing technologies for exhaled breath analysis that are low cost, easy to operate, and can monitor multiple biomarkers simultaneously. To address this need, we propose to develop the technology for a new generation of devices that we have called Breath on-a-Chip Spectrometers (BoCS). The device will have the form factor of a “pod,” and will consist of a mouthpiece (to sample breath), the sensing elements, and wireless communication capabilities to a smartphone. The device will have sensing capabilities comparable to those of analytical instruments (i.e., ability to detect 10s–100s of analytes) at a fraction of the cost of existing sensor-based single-analyte detectors.

CRISPR Gene Editing for Healthier Foods and Improved Crop Resilience

Michael Thomson, Aniruddha Datta, Libo Shan, *Joseph Awika, Ping He, Jean-Philippe Pellois, Charles Johnson, Marco Molina Risco, Mayra Molina, John Mullet, Xiaoning Qian, Keerti Rathore, Sakiko Okumoto, Endang Septiningsih, Yang Shen, Byung-Jun Yoon*

A new generation of crop improvement technologies is needed to meet future challenges in developing more nutritious foods and climate-resilient crops. Genome editing using CRISPR technology offers an unprecedented opportunity to rapidly characterize and deploy key genes and alleles for crop improvement; however, current methods are slow and labor intensive. If high-throughput pipelines for data analysis and crop genome editing can be developed, it would present a game-changer in agriculture. The goal is to combine proficiency in plant genome editing and trait characterization from the College of Agriculture and Life Sciences with computer science expertise from the College of Engineering to develop integrated solutions for high-throughput genome editing in crop plants. This project will test a series of breakthrough technologies that have the potential to greatly increase the power and efficiency of crop gene editing, while establishing a collaborative platform called the "CRISPR Crops Initiative" to provide a focal point for crop gene editing activities at Texas A&M. The successful completion of this two-year pilot project will lead to the following products: (1) an efficient bioinformatics pipeline to identify and prioritize specific genetic pathways, gene targets, and allelic enhancements; (2) a high-throughput gene editing workflow with a novel CRISPR-reagent delivery system; and (3) high-priority target trait editing initiated for several key traits.

Autonomous Material Discovery and Manufacturing via Artificial Intelligence

Satish Bukkapatnam, Raymundo Arroyave, Jianhua Huang, Ibrahim Karaman, Bani Mallick, Panganamala Kumar, Yu Ding, *Douglas Allaire, Joseph Ross, Dimitris Lagoudas, Xiaoning Qian, Ravi Sen*

The objective of this planning project is to investigate a radically new, multi-fidelity active learning theory based on combining disparate knowledge disciplines (data science and control theory) to build an autonomous materials discovery framework—the Autonomous Materials Scientist (AMS)—capable of exploring complex materials spaces. AMS aims to capture a materials scientists' intuition and expertise to adaptively fuse diverse data sources (including prior knowledge) materials theories, experimental observations (which often include surprises), and simulations; autonomously generate, pivot, and test parallel and competing hypotheses; and execute complex physical and simulation experiments to discover the materials composition and manufacturing recipe to meet or enhance the functionality. As part of the planning grant, AMS will initially drive the discovery of a new class of functional alloy materials with transformative potential. Our ultimate goal is to have AMS serve as a platform facility (materials-agnostic) to accelerate materials and manufacturing process discovery for various applications and serve as a proving ground to demonstrate interdisciplinary ideas that bring together a broad spectrum of colleagues and research groups across campus engaged in materials, data science, AI, and manufacturing pursuits.

Mastering Friction to Reduce Current and Future Energy Demands

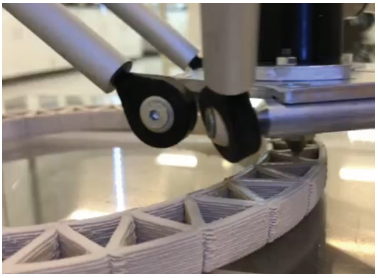
James Batteas, Jonathan Felts, M. Cynthia Hipwell, George Pharr, Karen Wooley*, Sarbajit Banerjee, Michelle Brenckman, Melissa Grunlan, Richard Lester, Hong Liang, Micah Green, Miladin Radovic, Andreas Polycarpou, Xiaofeng Qian*

Currently almost 20 percent of the world's energy consumption comes from overcoming friction in machines. This aggregate energy loss has a significant economic impact on all industrialized countries making this a fundamental challenge from the standpoint of infrastructure and sustainability. Fundamental research in the area of tribology (the study of friction, lubrication, and wear) however, has now advanced to the point where solutions are within our grasp, specifically through the development of measurement tools that are shedding light on the atomic scale mechanisms that underpin how to control friction, that can guide the development of new materials to accomplish friction reduction. This pilot project's aim is to establish Texas A&M as a leading entity in the United States to tackle this global challenge. At its core, our research is poised to proffer significantly improved efficiencies in the generation and usage of energy, one of society's most fundamental needs. These developments, however, are not limited to solving challenges in energy loss in machines, but also allow us to address the ubiquitous problems associated with friction and wear that impact other high technology sectors ranging from healthcare (e.g., biomedical implants) to micro- and nano-scaled technologies that are seeing rapid growth through the internet-of-things.

Monitoring Rapidly Changing Arctic Ecosystems using High-Resolution Satellite-Based Datasets and Artificial Intelligence

Julie Loisel, Andrew Klein, Zhangyang Wang, *Michael Bishop, David Cairns, Anthony Fillippi, Cristine Morgan, Oliver Frauenfeld, Anita Rapp, Zenon Medina-Centina*

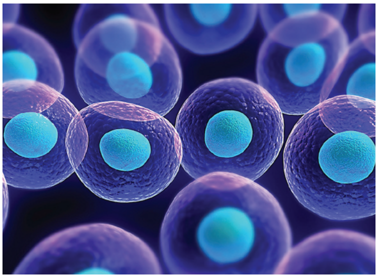
Big Data coupled with new data analytics are already engendering paradigm shifts across disciplines and disrupting how research is conducted. There have been recent breakthroughs in satellite technology that make it possible to obtain daily to sub-weekly high-resolution imagery of the entire planet. Our pilot project explores the use of artificial intelligence to analyze this large volume of high spatial and high temporal resolution satellite-based images from the Arctic. Our main goal is to generate the first reliable Holarctic map of permafrost-affected ecosystems and address fundamental research questions pertaining to Arctic science. We will combine novel satellite-based datasets (from PLANET) with emerging computational and information technologies such as machine learning and artificial intelligence to monitor and document rapid changes in permafrost soils and their associated greenhouse gas emissions across the Arctic landscape. This project brings together a multidisciplinary team with the technological tools and domain expertise required to explore the feasibility, application, and potential use for this emerging technique. This novel approach has the potential to transform global ecosystem monitoring and advance Texas A&M's leadership role in science and technology, in addition to broadening our strong institutional relationship with NASA.



Multi-Functional and Sustainable Materials for 3D-Printing Environmentally Adaptive Resilient Buildings

Zofia Rybkowski, Sarbajit Banerjee, Bjorn Birgisson, Manish Dixit, Negar Kalantar Mehrjardi, Arthur Schwab

Applied to large-scale structures, such as buildings, 3D-printing (additive manufacturing) is a topic of growing interest, in large part because of the urgent need to increase both productivity and safety on construction sites. However, materials currently being used are neither environmentally sustainable nor optimized for the 3D-printing process. Large numbers of buildings rapidly printed in three dimensions using concrete will exacerbate already compounding environmental challenges. We will develop and test alternative approaches to constructing the built environment. We propose an entirely new paradigm of a nanocomposite building material structured from modified clays, reinforced with natural fibers, and adhered by naturally derived binders that can be extruded to realize precisely patterned load-bearing structures. Printing with clay-derived materials will eliminate CO_2 emissions from the use of cementitious concrete, while incorporating organic materials, such as those derived from cellulosic waste, offers a potentially scalable form of carbon capture and sequestration that stabilizes carbon and is safer from leakage than current practices of injecting CO_2 into the earth. Our long-term goal is to characterize, model, and test unique materials with properties suitable for recyclable 3D-printing. This research will culminate in tested, printable singular materials that are bio-inspired, recyclable, and sustainable with a clear accounting of embodied energy costs.



Novel Approaches to Stem Cell Manufacture*

Carl Gregory, Roland Kaunas, *Daniel Alge, Ryang Lee, Kristen Maitland, Susan Woodard, Zivko Nikolov*

With an increased prevalence of chronic, inflammatory, and age-related disease, there is an unmet need to provide novel and effective therapies that cure rather than treat symptomatically. One potential approach to this challenge is to generate new cures based on cell-therapy. Cell-therapies, or cytotherapies, rely on the administration of laboratory-grown cells to promote tissue healing, regulate the immune system, and kill malignant cells. The growth of cell-therapy is clearly demonstrated by a four-fold increase in clinical trials over the last fifteen years, and the adoption of cell-based therapies for the treatment of patients with immunological disorders, bone marrow failure, and some forms of cancer. Nevertheless, there are technical issues that will impede future large scale manufacture of cytotherapeutic products as needs increase. Harnessing the skills of a multi-disciplinary Texas A&M team, and through collaborations with biomedical industries, we will develop a modern platform for therapeutic cell manufacture. The platform will incorporate several innovative technologies that improve the reproducibility, cost effectiveness, and scalability of manufacture. Our initial efforts will be directed towards the manufacture of adult mesenchymal stem cells that have the capacity to treat several diseases and tissue trauma, but the technology will be compatible with most therapeutic cell types. Our long-term goal is to develop Texas A&M as a globally recognized center for cell manufacture and a leader in training skilled personnel for the cytotherapeutic industry. This research will revolutionize virtually every facet of the cytotherapy field, positively affecting the lives of hundreds of millions of patients, while fortifying the United States cell manufacturing industry.

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originally titled: Cytotherapeutic Cell Manufacture at Texas A&M

Pathways to Sustainable Urban Water Security: Desalination and Water Reuse in the 21st Century

Wendy Jepson, *Christian Brannstrom, Gabriel Eckstein, Robert Greer, Mark Holtzapple, Kent Portney, John Tracy, Sierra Woodruff*

Desalination of seawater and brackish groundwater and wastewater reuse are seen as major technological interventions that can provide new water resources as growing global demand and climate change reduce supplies for growing urban areas. While offering new sources of water, critics highlight several impediments to their sustainable implementation and negative impacts across regions and environments. Our three-year project examines the global desalination and water reuse corporate and finance sector, analyzes the legal framework for unconventional water production across case study sites, and examines the complex water governance regimes that promote and challenge the transformation of this sector in water-stressed urban regions in Texas, California, Australia, and Israel. Our team will examine several aspects of desalination and wastewater reuse sector and socio-technical systems through a mixed methods approach designed to operate in an integrated and comparative interdisciplinary case study framework. We will develop a sectoral database as well as conduct surveys, documentary analysis, and semi-structured interviews to support systematic comparative case studies, social network analysis, and Q-Methodology.

T3

Texas A&M Triads for Transformation

An interdisciplinary seed-grant program that is part of the President's Excellence Fund. This program enables interdisciplinary teams of three faculty members (Triads) to develop long-term research and scholarship collaborations. Each year $3 million will be available to fund up to 100 Triads at $30,000 each.

POSTER SESSION IN 1101 B AND C

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