Welcome to the 8th Annual Institute for Engineering in Medicine (IEM) Conference!

As you know, the Mission of IEM is to turn science and engineering into medical practice. We fulfill this mission by fostering collaborations between engineering and biomedical faculty at the University of Minnesota and between University faculty and industrial colleagues.

We have the privilege to represent more than 290 IEM faculty members from over 85 academic departments on campus, along with their students and collaborators.

Today’s event opens with welcome remarks from the Dean of the Medical School and the Dean of the College of Science and Engineering followed by overviews of IEM from IEM leadership and an acknowledgement of key industrial partners in IEM’s COVID-19 Response. The Conference will continue with keynote talks by two distinguished speakers.

This year, IEM is making a change to our annual poster competition. First, the “posters” will actually be slide presentations to fit with our virtual format. Second, the presentations will take place in a collaboration-building framework. Four Junior Investigators will present their work to each other and to one or more faculty facilitators. Feedback and discussion will primarily be focused on developing proposals for multi-lab projects that will be eligible for IEM funding.

This Conference is designed to offer rich opportunities to learn about cutting-edge research, IEM support mechanisms, IEM professional education and outreach activities, and IEM’s Inspire program. We hope that you enjoy the event, and we look forward to your continued interest and support. Please contact us at iem@umn.edu with ideas for improving IEM. Together, we will make a difference in tomorrow’s medicine and healthcare through engineering innovation.

David Odde, Ph.D. (2020 IEM Annual Conference Chair)
Medtronic Endowed Associate Director, Strategic Research Initiatives, Institute for Engineering in Medicine

Paul Iaizzo, Ph.D. (2020 IEM Annual Conference Chair)
Medtronic Endowed Associate Director, Professional Education and Outreach, Institute for Engineering in Medicine

John Bischof, Ph.D. (2020 IEM Annual Conference Co-Chair)
Director, Institute for Engineering in Medicine
ABOUT IEM
The Institute for Engineering in Medicine is an interdisciplinary organization that creates and supports research collaborations between engineers, scientists, and medical professionals at the University of Minnesota and the wider medical industry. IEM also supports numerous educational opportunities to high school, undergraduate, and graduate-level students. With over 275 affiliated researchers representing 85 departments across the Twin Cities campus, IEM provides University faculty, students, and external partners with world-class resources to drive innovation in medicine and to find solutions for the great medical challenges of today and tomorrow.

ORGANIZATION
The new IEM Organizational Chart below captures the broad vision for the Institute’s engagement with the University, industry, and students in grades 6–12. The opening talks from IEM leadership are primarily dedicated to explaining the programs at the bottom level of this chart.
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SECTTRA, Department of Computer
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Vice Chief, Division of Cardiothoracic
Surgery

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Director, Quality Engineering, Abbott

Dale Wahlstrom
Founder and CEO, ACT3, LLC Life
Science Consulting

Adrienne Watson, Ph.D.
Vice President, Research and
Development, Recombinetics
9:00 - 9:15 am  Welcome Remarks
Jakub Tolar, M.D., Ph.D.
Dean of the Medical School and Vice President for Clinical Affairs

Mostafa Kaveh, Ph.D.
Dean, College of Science and Engineering

9:15 - 9:35 am  OVERVIEW OF INSTITUTE FOR ENGINEERING IN MEDICINE
John Bischof, Ph.D.
Director, Institute for Engineering in Medicine

9:35 - 9:55 am  OVERVIEW OF IEM STRATEGIC RESEARCH INITIATIVES
David Odde, Ph.D.
Medtronic Endowed Associate Director, Strategic Research Initiatives, Institute for Engineering in Medicine

9:55 - 10:15 am  OVERVIEW OF IEM PROFESSIONAL EDUCATION AND OUTREACH
Paul Iaizzo, Ph.D.
Medtronic Endowed Associate Director, Professional Education and Outreach, Institute for Engineering in Medicine

10:15 - 10:35 am  OVERVIEW OF INSPIRE PROGRAM
Rhonda Franklin, Ph.D.
IEM Co-Director of Inspire Program

Christopher Pennell, Ph.D.
IEM Co-Director of Inspire Program

10:35 - 10:45 am  BREAK
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<td><strong>Distinguished Keynote Talk</strong></td>
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<td>DEVELOPING ELECTROCEUTICALS THROUGH THE MINNESOTA CONSORTIUM FOR AUTONOMIC NEUROMODULATION (MCAN)</td>
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<td>John W. Osborn, Ph.D.</td>
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<td>11:15 - 11:45 am</td>
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<td>ENGINEERING CELLS AND MICROSYSTEMS TO STUDY MECHANOBIOLOGY</td>
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<td>Professor of Mechanical Engineering, BioMolecular Science and Engineering, and Molecular, Cellular and Developmental Biology; Director, Center for Bioengineering, University of California Santa Barbara</td>
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<td>11:45 am - 12:00 pm</td>
<td><strong>RECOGNITION OF NEW INDUSTRIAL FELLOWS AND “COVID HERO” INDUSTRIAL PARTNERS IN IEM’S COVID-19 RESPONSE</strong></td>
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<td>1:00 - 2:00 pm</td>
<td><strong>VIRTUAL STUDENT POSTER SESSION AND PRESENTATIONS</strong></td>
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JOHN W. OSBORN, PH.D.
Professor, Department of Surgery; Director, MCAN, University of Minnesota Medical School

Dr. Osborn received his Ph.D. in 1986 in physiology from the Medical College of Wisconsin, where he studied the neurohumoral mechanisms of hypertension. He then went to Johns Hopkins School of Medicine for a post-doctoral fellowship in biomedical engineering, where he focused on spinal level control of the sympathetic nervous system. While at Johns Hopkins, he received a 5-year NIH R29 grant (FIRST award) to study mechanisms and treatment of autonomic hyperreflexia in spinal cord injury. Dr. Osborn joined the faculty at the University of Minnesota in 1988, was promoted to Professor in 1997, and was appointed the Marvin and Hadassah Bacaner Endowed Chair in Cardiovascular Physiology in 2002. In 2019, Dr. Osborn moved to the Department of Surgery to establish a national research center in autonomic neuromodulation. Dr. Osborn has studied the relationship between sympathetic nervous system activity and hypertension throughout his career. His earlier studies focused on central nervous system pathways and hypertension. More recently, he has shifted his focus to understanding the role of peripheral organ-specific sympathetic pathways in the pathogenesis of cardiometabolic disease, with the long-term goal of developing device-based neuromodulation therapies. He served on the 2019 National, Heart, Lung, and Blood Institute Task Force “Hypertension: Barriers to Translation.” He has published 115 papers and his research has been continuously funded by the National Institutes of Health since 1988.
Dr. Pruitt recently moved to the University of California Santa Barbara to become Professor of Mechanical Engineering and Biomolecular Science and Engineering to help build a new Bioengineering program and department. Before that, she was on the faculty at Stanford University from 2003-2018 in Mechanical Engineering and Bioengineering, where she led the Stanford Microsystems Lab focused on small-scale metrologies for interdisciplinary micro-mechanics applications. Beth earned her B.S. in mechanical engineering from the Massachusetts Institute of Technology, where she was in the Navy ROTC program. She subsequently earned her M.S. in Manufacturing Systems Engineering from Stanford University then served as an officer in the U.S. Navy. Her first tour of service was at the engineering headquarters of the Navy nuclear programs, and her second tour was as an instructor teaching Systems Engineering at the U.S. Naval Academy. After her Navy service, Dr. Pruitt earned her Ph.D. in Mechanical Engineering supported as a Hertz Foundation Fellow at Stanford University with research advancing microtechnology and small-scale metrologies for force measurements. Dr. Pruitt was a postdoctoral researcher at the Swiss Federal Institute of Technology Lausanne working to advance the use of polymers in microdevices and a visiting professor in the Lab for Applied Mechanobiology in the Department of Health Sciences and Technology at ETH, Zurich. She has been an NSF CAREER Award, a DARPA Young Faculty Award, and a Denice Denton Leadership Award, and she is a Fellow of the ASME and AIMBE.
**Poster Session Breakout Rooms**

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Molecular mechanism of sudden cardiac death in malignant hyperthermia
Neeta ADHIKARI, Bong Sook Jhun, Jin O-Uchi; UMN
ZOOM #5 - EGGEN, Michael; IAIZZO, Paul

Automated microinjection system for microorganisms
Andrew ALEGRIA, Amey Joshi, Benjamin Auch, Kanav Khosla, Daryl Gohl, John Bischof, Suhasa Kodandaramaiah; UMN
ZOOM #12 - SMANSKI, Michael

Probing quinine-based polyplex intracellular delivery using raman microscopy
Ariel ALPERSTEIN, Craig Van Bruggen, Theresa Reineke, Renee Frontiera; UMN
ZOOM #4 - DUTTON, James

Decoding cognitive effort from distributed brain networks
Sandeep AVVARU, Keshab K Parhi (Dept. of Electrical and Computer Engineering), Alik S Widge (Dept. of Psychiatry); UMN,
Nicole R Provenza, Brown University School of Engineering
ZOOM #6 - GHOSE, Geoffrey

Frequency-dependent spike-pattern changes in motor cortex during thalamic deep brain stimulation
Edward BELLO, Filippo Agnesi, Yizi Xiao, Joan Dao, Matthew D. Johnson; UMN
ZOOM #14 - WIDGE, Alik

Easy-to-use wearable intra-oral and intra-nasal devices for COVID-19 patient sampling
Sunil Kumar BODA; 1 - Maria S. Barrera; 2 - Louis Mansky; 2 - Conrado Aparicio; 1 - 1 MDRCBB – Minnesota Dental Research
Center for Biomaterials and Biomechanics, UMN - 2 Institute for Molecular Virology, UMN
ZOOM #16 - YANG, Suo

In vitro investigation of NK/cancer cell interactions in metastasis
Heather BOMBERGER, Behiye Kodal (Dept. of Medicine); Martin Felices (Dept. of Medicine); David K. Wood (Dept. of BME); UMN
ZOOM #1 - AKSAN, Alptekin

Analysis of local field potentials recorded from directional deep brain stimulation leads in the subthalamic nucleus
AnneMarie BRINDA, Alex M. Doyle (Neuroscience); Madeline Blumenfeld (BME); Jordan Krieg (BME); Joseph S. R. Alisch (BME); Chelsea Spencer (BME); Emily Lecy (BME); Kelton Wilmerding (BME); Adele DeNicola (Neurology); Luke A. Johnson (Neurology); Jerrold L. Vitek (Neurology); Matthew D. Johnson (BME); UMN
ZOOM #14 - WIDGE, Alik

Recapitulating the metastatic cascade: in vitro model to study multimodal breast cancer cell migration
Elizabeth CRIST, Kaylee Schwertfeger (Dept. of Laboratory Medicine and Pathology), David Wood (Dept. of Biomedical Engineering); UMN
ZOOM #1 - AKSAN, Alptekin
Using bioorthogonal, strain-promoted click chemistry to engineer a keratinocyte-specific dental implant coating for hemidesmosome upregulation
David DE JONG, Alexandra Kobe; Nicholas Fischer; David De Jong, Conrado Aparicio; Minnesota Dental Research Center for Biomaterials and Biomechanics, UMN

A deep sequence-function platform identifies more potent antimicrobial protein variants
Matthew P. DEJONG; Katharina A. Fransen; Seth C. Ritter; UMN

A closed-loop set-up for inducing clusters in neuronal populations
Sadegh FARAMARZI, Theoden I. Netoff; UMN

Manipulating the matrix: using nature’s toolkit to direct cell responses for percutaneous devices
Nicholas FISCHER, Conrado Aparicio; UMN

When will nanowarmed organs crack? A preliminary 1-D model
Lakshya GANGWAR, Joseph Kangas, Zonghu Han, Michael Etheridge, John Bischof; UMN

Automatic 2D segmentation of chronic subdural hematoma from a head CT scan
Atishya GHOSH, Dr. Uzma Samadani, Dr. Yuk Sham; UMN

Enhanced maturation of human pluripotent stem cell derived cardiomyocytes with co-culture epicardial cells
Sophie GIVENS, Brenda Ogle; UMN

Subject-specific computational models of deep brain stimulation for targeting within and around the subthalamic nucleus
Mojgan GOFTARI, Jiwon Kim (Dept. of Chemical Engineering), Megan Schmidt (Dept. of Biomedical Engineering), Remi Patriat (Dept. of Radiology/CMRR), Elliot Johnson (Dept. of Neurology), Edgar Peña (Dept. of Biomedical Engineering), Jerrold L. Vitek (Dept. of Neurology), Lauren E. Schrock (Dept. of Neurology), Noam Harel (Dept. of Radiology/CMRR), Scott E. Cooper (Dept. of Neurology), Matthew D. Johnson (Dept. of Biomedical Engineering); UMN

Objective surgical skill evaluation and unconscious bias
Mark GOTTHELF, Tim Kowalewski; UMN
Clinical documentation of sacral nerve modulation testing and parameters across patient diagnoses and therapeutic goals: opportunities for improved quantification
Kate HANSON, Nissrine Nakib, Cynthia Fok, John Fischer, Ranveer Vasdev, Dwight Nelson; UMN
**ZOOM #2 - BARDOT, Dawn; BELANI, Kumar**

Technology to realize body MRI at ultra-high field
Xiaoxuan HE, Arcan Ertürk, Andrea Grant, Xiaoping Wu, Russell L. Lagore, Lance DelaBarre, Yigitcan Eryaman, Gregor Adriany, Edward J. Auerbach, Pierre-Francois van de Moortele, Kamil Ugurbil, Gregory J. Metzger; Center for Magnetic Resonance Research, UMN
**ZOOM #2 - BARDOT, Dawn; BELANI, Kumar**

Visualization of lead extraction from fixed human hearts
Mikayle HOLM, Paul Iaizzo, UMN. Pierce Vatterott, United Heart. Michael Eggen, Medtronic
**ZOOM #13 - WHITMAN, Teri; TRANQUILLO, Bob**

Characterization of antigen presentation and T cell response in different focal therapeutic conditions
Minhan JIANG, Qi Shao, Stephen O’Flanagan, Joseph Vallin, Samira Azarin, Brandon Burbach, Yoji Shimizu and John Bischof; UMN
**ZOOM #15 - WOOD, David**

Therapeutic ultrasound for modulation of the inflammatory reflex
Claire KAISER, Daniel Zachs, Rachel Graham, Hubert Lim; UMN
**ZOOM #4 - DUTTON, James**

Optimization of the alamarblue viability assay for rat kidney slices
Marie Christina KELLER, Anirudh Sharma (Dept. of Mechanical Engineering, Dept. of Biomedical Engineering), Bat-Erdene Namsrai (Dept. of Surgery), Michael Etheridge (Dept. of Mechanical Engineering, Dept. of Biomedical Engineering), Erik Finger (Dept. of Surgery), John Bischof (Dept. of Mechanical Engineering, Dept. of Biomedical Engineering); UMN
**ZOOM #10 - OGLE, Brenda**

A perfusion bioreactor system for improved cardiac modeling
Elizabeth KOMOSA, Bhushan Mahadik, University of Maryland, Center for Engineering Complex Tissues. John P. Fisher, University of Maryland, Center for Engineering Complex Tissues. Brenda M. Ogle, UMN
**ZOOM #13 - WHITMAN, Teri; TRANQUILLO, Bob**

Iron oxide loaded polymer scaffolds for non-invasive hyperthermic treatment of infiltrated cells
Tiffany LAM, Alyssa Moy (Dept. of Chemical Engineering and Materials Science), Hak Rae Lee (Dept. of Chemical Engineering and Materials Science), Qi Shao (Dept. of Mechanical Engineering), John C. Bischof (Dept. of Mechanical Engineering), Samira Azarin (Dept. of Chemical Engineering and Materials Science); UMN
**ZOOM #11 - POMERANTZ, William**

Extended yeast surface display linkers enhance the enrichment of ligands in direct mammalian cell selections
Patrick S. LOWN, Jessy J. Cai; Seth C. Ritter; Jacob J. Otolski; Ryan Wong; and Benjamin J. Hackel; Dept. of Chemical Engineering and Materials Science, UMN
**ZOOM #12 - SMANSKI, Michael**
Stabilization and preservation of nucleic acids at room temperature
Advitiya MAHAJAN, Alptekin Aksan, Mechanical Engineering, UMN
ZOOM #11 - POMERANTZ, William

Vibro-tactile stimulation as a non-invasive neuromodulation therapy for cervical dystonia: a case study
Arash MAHNAN, Yi Zhu, Juergen Konczak; UMN
ZOOM #8 - LUDEWIG, Paula

Porcine organ tissue property variability from in-vivo to ex-situ post freeze
Faizan MALIK, Brad Drahos (MRD Lab); Amer Safdari (MRD Lab); Kian Dabiran (MRD Lab); Matt Kubala (MRD Lab); Jack Norfleet (Army Futures Command); Tim Kowalewski (MRD Lab); UMN
ZOOM #2 - BARDOT, Dawn, BELANI, Kumar

Quantifying motor thalamic deep brain stimulation-induced gait ataxia with markerless pose estimators
Dominic MARTICORENA, AnneMarie Brinda, Matthew Johnson; UMN
ZOOM #6 - GHOSE, Geoffrey

One-dimensional simulations enable study of cerebrospinal fluid flow in complex perivascular space geometries
Mahsa MIRZAEE, Jeffrey Tithof (Dept. of Mechanical Engineering); UMN
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A porous media model of transport in the brain interstitium
Saikat MUKHERJEE, Jeff Tithof (Dept. of Mechanical Engineering); UMN
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Predicting the cellular motility of glioblastomas using in-vivo MRI
Kellen MULFORD, Mariah McMahon (Dept. of Biomedical Engineering), David Odde (Dept. of Biomedical Engineering), Christopher Wilke (Dept. of Radiation Oncology); UMN
ZOOM #15 - WOOD, David

Risk assessment of the airborne transmission of COVID-19 by musicians in different settings
Sai Ranjeet NARAYANAN, Suo Yang; UMN
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Noninvasive neuromodulation using enhanced upconversion nano particle mediated optogenetics
Zahra S. NAVABI, Anoop Damodaran, Ambika Bhagi-Damodaran, Sang-Hyun Oh, Suhasa B Kodandaramaiah; UMN
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Rapid inactivation of virus aerosols by atmospheric pressure plasma
Gaurav NAYAK, Austin Andrews (Dept. of Mechanical Engineering) Ian Marabelli (Dept. of Mechanical Engineering), Hamada Aboubakr (Dept. of Veterinary Population Medicine), Sagar Goyal (Dept. of Veterinary Population Medicine), Bernard Olson (Dept. of Mechanical Engineering), Montserrat Torremorell (Dept. of Veterinary Population Medicine), Peter Bruggeman (Dept. of Mechanical Engineering); UMN
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Jacob O’BRIEN, Peter Sherman, Maureen Riedl, Benjamin Auch, Daryl Gohl, Lucy Volchanova, Suhasa B. Kodandaramaiah; UMN, Alexander Skorput, Dartmouth College
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Jacqueline PASEK-ALLEN, Zhe Gao, Anna Rudie, Rameshu Rallabandi, Jon Rainier, John Bischof; UMN
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Rapid construction of cell lines producing SARS-CoV-2 spike protein
Thu PHAN, Zion Lee, Thu Phan, Qian Ye, Min Lu, Mengdi Lou, Touraj Aligholipour Farzani, Nathaniel Talledge, Alon Herschhorn, Wei-Shou Hu; UMN
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Pathological roles of SARS-CoV-2 gene-encoded viroporins in the heart under COVID-19
Iuliia POLINA, Yugene Guo, Bong Sook Jhun, Elena G. Tolkacheva, Jin O-Uchi; UMN
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Synthetic encapsulation technology models ER downregulation during immobilization-induced dormancy
Julian PRECIADO, Tiffany Lam, Roudy Ekyalongo, Samira Azarin, Emil Lou, Douglas Yee, Alptekin Aksan; UMN
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Pegah RANJBARTEHRANI, Qi Shao, Harishankar Natesan, Satish Ramadhyani, John Bischof; UMN
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Novel mapping techniques for rotor identification
Vasanth RAVIKUMAR, Alena Talkachova; UMN
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Effects of tissue stretch and autonomic activation on quantification of low amplitude autonomous contractions in porcine bladder in-vitro
Bhaskar RAVISHANKAR, Ranveer Vasdev (Dept. of Urology; Weston Upchurch, Visible Heart Laboratories; Paul A. Iaizzo, Visible Heart Laboratories), Gerald W. Timm (Dept. of Electrical Engineering, Dept. of Urology), Dwight E. Nelson (Dept. of Urology); UMN
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Changes in motor capsule thresholds and evoked compound action potentials with STN-DBS between naive and parkinsonian states
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Mesoscale calcium imaging in freely behaving mice using a head-mounted miniaturized mesoscope
Mathew RYNES, Daniel A Surinach; Samantha Linn; Michael Laroque; Vijay Rajendran; Judith Dominguez; Orestes Hadjistamoulou; Zahra S Navabi; Leila Ghanbari; Gregory L. Johnson; Suhasa Kodandaramaiah; UMN
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Development of a biosensor for the characterization of a druggable allosteric site in the \(\beta_2\)-adrenergic receptor
Fredrik SADLER, Ning Ma (Dept. of Computational & Quantitative Medicine, Beckman Research Institute of the City of Hope), Nagarajan Vaidehi (Dept. of Computational & Quantitative Medicine, Beckman Research Institute of the City of Hope), Sivaraj Sivaramakrishnan (Dept. of Genetics, Cell Biology, and Development) UMN
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The impact of irreversible electroporation combinations with immunotherapy in stimulating anti-tumor immunity and eliminating PDA resistant barriers
Amanda SALZWEDEL, Kianna Elahi-Gedwillo, Natalie Paulson, Maija Engebretson, Emre Kihtr, Kenneth Emme, Qi Shao, Jon Bischof, Paolo Provenzano; UMN
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Multizonal prostate segmentation with convolutional neural networks: A comparison of 2D v. 3D u-nets
Sara SAUNDERS, Ethan Leng (1,2), Benjamin Spilseth (3), Neil Wasserman (3), Greg Metzger (1,2,3), Patrick J. Bolan (1,2,3). 1. Biomedical Engineering, UMN. 2. Center for Magnetic Resonance Research, UMN. 3. Dept. of Radiology, UMN
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Differential migration mechanics and immune responses of glioma subtypes
Ghaidan SHAMSAN, Chao J. Liu, Brooke C. Braman, Susan K. Rathe, Aaron L. Sarver,; Nima Ghaderi, Mariah M. McMahon, Rebecca L. Klang, Barbara R. Tschida, Joey McFarren, H. Brent Clarr, David A. Largaespada, David J. Odde; UMN. Jann N. Sarkaria, Steven S. Rosenfeld; Mayo Clinic
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Oren SOLOMON, Tara Palnitkar, Remi Patriot, Henry Braun, Joshua Aman, Michael C. Park, Jerrold Vitek, Guillermo Sapiro and Noam Harel; UMN
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AAV9-mediated delivery of NeuroD1 protects against neural degeneration following traumatic brain injury
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Modeling the transmission of virus laden aerosols within the lung airways
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**Patient-specific 3D printing for interventional planning and patient education in complex branch pulmonary artery stenosis**
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**Tyrosine phosphorylation of mitofusin 2 modulates endoplasmic reticulum-mitochondrial interactions**
Hannah THOMPSON, Michael W. Cypress, Bong Sook Jhun, Jin O-Uchi; Cardiovascular Division, Dept. of Medicine, Lillehei Heart Institute, UMN. Peng Zhang (Dept. of Medicine) Brown University

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**Cell encapsulation by agarose hydrogel enables DMSO-free cryopreservation by inhibiting ice recrystallization**
Mian WANG, Alptekin Aksan; Mechanical Engineering; UMN

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**Optimization of spinal cord stimulation using Bayesian preference learning and its validation**
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**Modeling the airborne transmission of COVID-19 under different indoor settings**
Dezhi ZHOU, Shufan Zou, UMN; Suo Yang; UMN
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