2021 UNIVERSITY TECHNOLOGY SHOWCASE

APRIL 29,2021

Hosted by CEIS and the Data Science CoE at the University of Rochester

"Exploring the future of high-tech work and our region's role in building the future, from economic development initiatives to creating enabling technologies"

Mark F. Bocko, CEIS

◇ ◇ ◇ **Welcome** ◇ ◇ ◇

2021 University Technology Showcase

"Rochester in the Future of High-Tech Work"

Sponsored by

CEIS and the Center of Excellence in Data Science

With support from NYSTAR (a division of Empire State Development)

Mujdat Cetin, CoE DS

AGENDA

1:00 P.M. Welcome from Center Directors Mark Bocko and Mujdat Cetin

1:05 P.M. Welcoming remarks from Assemblymember Harry Bronson

1:10 P.M. "The Future of the American City: Superstars, Supercommutes, and Super Convenience" - Derek Thompson, The Atlantic
Followed by Q&A with Mr. Thompson

2:00 P.M. "The "Remote Work Revolution's" impact on economic development strategy" - Joseph Stefko, ROC2025

2:20 P.M. "Immersive Communications, a Game Changer for Remote Work" - Dave Horan (CTO), Immersitech

2:40 P.M. Additional Q&A for ROC2025 and Immersitech

2:50 P.M. Remo Instructions/Tech Support for Attendees

2:50 P.M. Open Poster Session/Exhibitor Tables

Event hosted by the Center for Emerging & Innovative Sciences and the Center of Excellence in Data Science at The University of Rochester with support from FuzeHub

Welcome

Dear Colleagues,

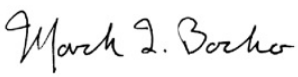
We are delighted to welcome you to the 20th annual University Technology Showcase co-sponsored by the Center for Emerging and Innovative Sciences (CEIS) and the Center of Excellence (CoE) in Data Science, two New York State funded Centers at the University of Rochester.

The purpose of this annual event is to facilitate connections among industry professionals and academic researchers interested in biomedical technology, data science, optics, imaging, photonics, sensors, acoustics, and materials. This year's virtual event will feature a plenary session focused on the future of high-tech work and the role our region can play in it. This will be followed by a virtual poster session featuring a sample of the ongoing high-quality applied research at the University of Rochester and the Rochester Institute of Technology. Attendees will be able to "stop by" any of the posters and chat with the presenters, somewhat similarly to an in-person poster session. We hope that discussions in this event will lead to continued interactions that will enable companies to tap into the wealth of technology and expertise available at our institutions of higher education to create regional job growth and economic expansion.

This year's event will start with a great lineup of speakers. Our keynote speaker, Derek Thompson, staff writer for The Atlantic and host of the popular podcast Crazy/Genius, will talk about "The Future of the American City: Superstars, Supercommutes, and Super Convenience". This is especially relevant to the future of our region as tech companies become less centralized in the post-pandemic world and we explore new ways to attract supercommuters and companies to the region. Our other speakers, Joe Stefko from ROC2025, will talk about local efforts to attract "supercommuters" and high tech companies to our region, and Jim Poore and Dave Horan from Immersitech will talk about their company's work to create immersive audio technologies that make remote interactions more effective and engaging.

The technology showcase is one of the ways that CEIS and the CoE in Data Science work to foster industry-university collaboration and technology transfer. We provide NYS matching funds for company-sponsored research at our local universities, and also provide full funding for industry-academia collaborations (without the requirement of company sponsorship) through the CoE. We sponsor workshops and seminars that bring people from industry and academia together to discuss opportunities for technology-driven economic development. Please feel free to contact us to learn more about these efforts and to discuss ways that CEIS and the CoE in Data Science can help your enterprise.

Warm Regards,



Mark Bocko, PhD
Director, CEIS

Mujdat Cetin, PhD
Director, COE in Data Science

University Technology Showcase Speakers

"The Future of the American City: Superstars, Supercommutes, and Super Convenience" - Derek Thompson, Staff Writer at The Atlantic

Derek Thompson is a staff writer at The Atlantic, where he covers economics and culture. He is the founder and host of the podcast Crazy/Genius, which won the 2020 Publisher Podcast Award for best podcast of the year and the author of the national bestseller *Hit Makers: How to Succeed in an Age of Distraction*, which was named the 2018 Book of the Year by the American Marketing Association. Derek lives in Washington, D.C.

"The "Remote Work Revolution's" impact on economic development strategy" - Joseph Stefko, President and CEO of ROC2025

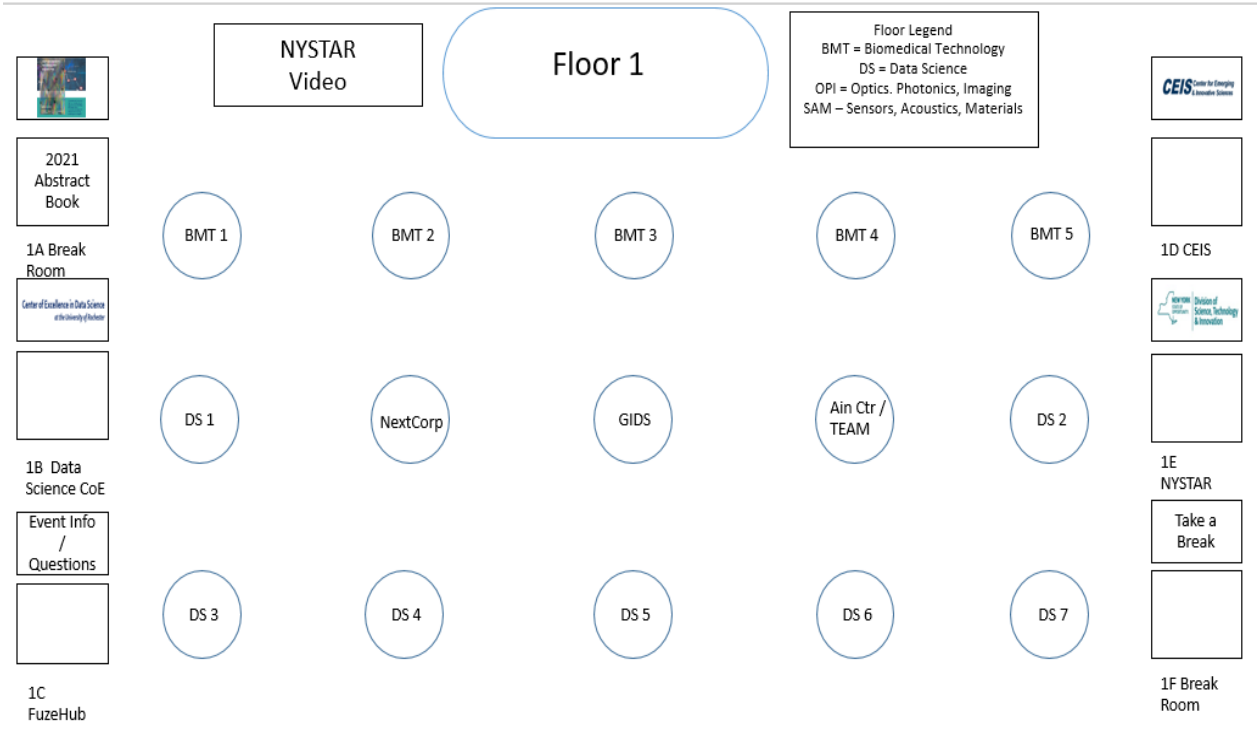
Joseph Stefko is President & CEO of ROC2025, the alliance of economic development organizations established in 2019 to lead a $20 million coordinated capacity-building investment strategy focused on accelerating regional growth in Greater Rochester. He previously spent nearly 20 years with Rochester-based CGR, including seven as President & CEO, overseeing the consultancy's industry-leading work in government and education, economics and public finance, health and human services, and nonprofits and communities. From 2003-08 he served on senior staff of the emergency fiscal control board appointed by New York State to monitor

the finances of the City of Buffalo and Buffalo Public Schools. During his tenure, the board's guidance contributed to more than $230 million in savings and created a strong foundation for the city's revitalization. A Buffalo native, he holds B.A., M.A. and Ph.D. degrees from the University at Buffalo, SUNY.

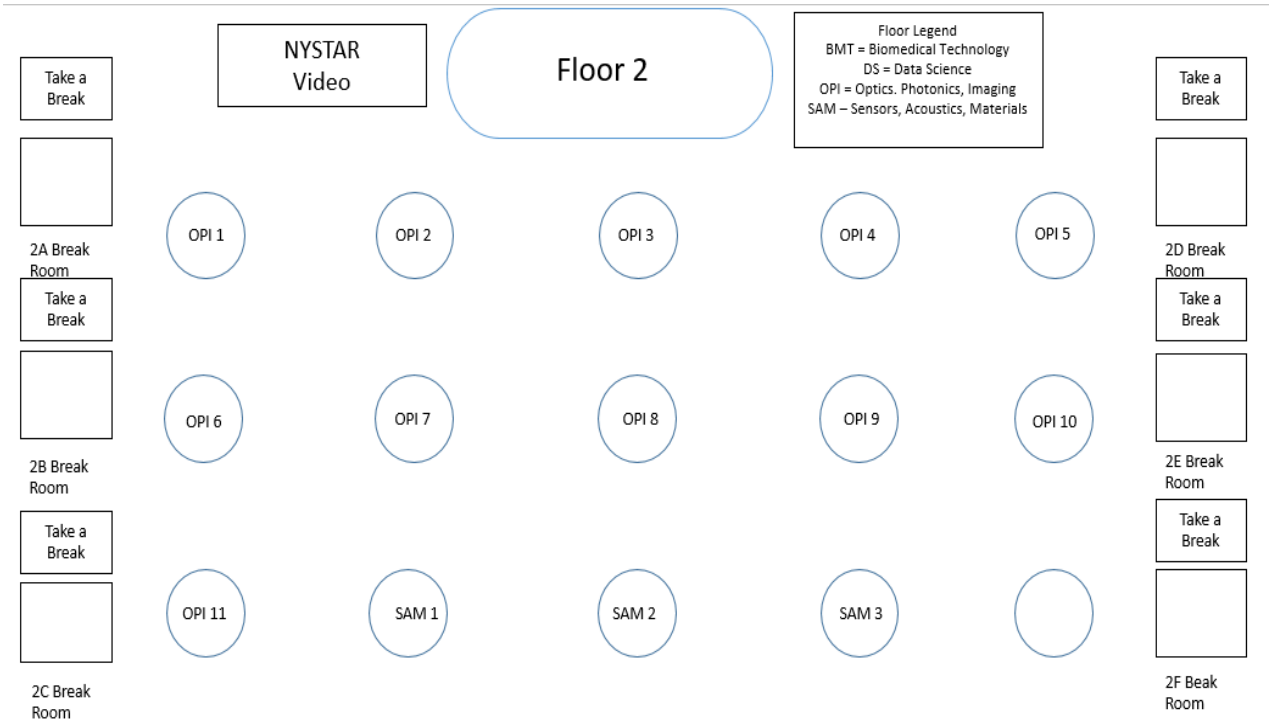
"Immersive Communications, a Game Changer for Remote Work" - Jim Poore (CEO) and Dave Horan (CTO), Immersitech

Jim Poore, CEO & Co-Founder - Jim has over 20 years' experience including senior executive roles in global product management, M&A, customer experience and product development for global communication technology leaders including Level 3 Communications, Global Crossing Ltd., Silicon Graphics/Cray Research and Soleo Communications. Jim has successfully developed and launched dozens of advanced communication products during his career, delivering profitable revenue with an emphasis on great customer experiences.

Dave Horan, CTO - Dave leads our engineering team with a background in web development, database system architecture, and enterprise project/infrastructure management for companies such as Paychex, Kodak Alaris, and Oracle. Throughout his career, he has been able to bridge complex technical and business requirements to enable the successful completion of key projects with an eye toward successful day-to-day operations.



University Technology Showcase – Remo Event Layout



University Technology Showcase Participating Organizations

T1 NextCorps
T2 Goergen Institute for Data Science at the University of Rochester
T3 University of Rochester Ain Center for Entrepreneurship/Technical Entrepreneurship and Management (TEAM) M.S. Program

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T1 NextCorps

NextCorps (formerly known as High Tech Rochester) is a not-for-profit economic development organization and is an authorized center of the NIST funded Manufacturing Extension Partnership (MEP), a manufacturing assistance program. NextCorps Growth Services provides support in areas such as strategic planning, quality system development, sales and marketing, product development and productivity improvement to all types of manufacturers in the Finger Lakes Region. NextCorps also offers business incubation for high tech startups at Sibley Square in downtown Rochester, Luminate the world's largest accelerator for photonics, optics, and imaging, and Venture and Scale For ClimateTech for clean energy focused startups.

T2 Goergen Institute for Data Science at the University of Rochester: Industry-Academic collaborations via Data Science Capstone projects

The Goergen Institute for Data Science (GIDS) at the University of Rochester is home to interdisciplinary data science research and the interdepartmental data science academic programs. At the core of the data science curriculum for the BA/BS and MS at the University of Rochester are the capstone and practicum courses for undergraduate and graduate students, respectively. These semester-long courses emphasize a team-based learning experience where students conduct real-world analytics projects under supervision of

data science faculty using data provided by sponsoring organizations. Launched in 2016, over 45 local/regional companies and organizations have offered more than 75 projects to students. There is no sponsorship fee or funding requirement to participate in a project. Come and visit us to see recent capstone project examples and discuss how your organization can engage with us for an upcoming semester!

T3 University of Rochester Ain Center for Entrepreneurship/Technical Entrepreneurship and Management (TEAM) M.S. Program

The Ain Center for Entrepreneurship, launched in 2003, serves to identify and create new partnerships with alumni, local businesses, and non-profit organizations; coordinates and publicizes school-based experiences, including courses and signature programming; informs faculty of grant and bridging fellowship opportunities; and encourages collaboration among the schools engaged in entrepreneurship education at the University of Rochester and the greater Rochester community. The Center is committed to its mission of generating and transforming ideas into enterprises that create economic or social value.

The Center also administers a multidisciplinary engineering and business graduate program: the Master of Science in Technical Entrepreneurship and Management (TEAM). TEAM offers students the opportunity to immerse themselves in a technical concentration of their choice while receiving a strong foundation in entrepreneurial management. Through a fast-paced curriculum at the Hajim School of Engineering & Applied Sciences and the Simon Business School, students can complete the 33-credit program in a year. A three-semester option, which includes a summer internship, and part-time study are also available. TEAM students also have access to comprehensive career placement programming and staff.

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Michael Klaczko[1], Baturay Ozgurun[2], Brian Ward[3], Jonathan Flax[4], James McGrath[2]*
[1]Department of Chemistry, University of Rochester, Rochester, NY; [2]Department of Biomedical Engineering, University of Rochester, Rochester, NY; [3]Department of Microbiology and Immunology, University of Rochester Medical Center, Rochester, NY; [4]Department of Urology, University of Rochester Medical Center, Rochester, NY

BMT 2 Estimation of Integrated Ultrasonic Backscatter in Murine Tendon to Non-invasively Characterize Collagen Fiber Organization

Sarah E. Wayson[1,2], María Helguera[3], Todd Jackson[4], Jim Chwalek[4], Denise C. Hocking[5], Diane Dalecki[1,2]
[1]Department of Biomedical Engineering; [2]Rochester Center for Biomedical Ultrasound, University of Rochester, Rochester, NY; [3]Rochester Institute of Technology, Rochester, NY; [4]Imaginant Inc., Rochester, NY; [5]Department of Pharmacology and Physiology, University of Rochester Medical Center, Rochester, NY

BMT 3 Super-Resolution Ultrasound Method for Transcranial Brain imaging

Jovan Mitrovic[1], Narges Mohammadi[1,] Zeljko Ignjatovic[1],William J. Sehnert[2]
[1]University of Rochester, Rochester, NY, [2]Carestream Health, Rochester, NY

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Eleni Patelaki[1,2], Karlo J. Lizarraga Mendoza[3], John J. Foxe[2], Edward G. Freedman[2]
[1] Department of Biomedical Engineering, University of Rochester; [2] The Cognitive Neurophysiology Laboratory, The Del Monte Institute for Neuroscience, Department of Neuroscience, University of Rochester School of Medicine and Dentistry; [3] Movement Disorders Unit, Department of Neurology, University of Rochester School of Medicine and Dentistry, Rochester, NY

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Narges Mohammadi, Marvin M. Doyley, Mujdat Cetin
University of Rochester, Rochester, NY

DATA SCIENCE

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Rochester Data Science Consortium, University of Rochester, Rochester, NY

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University of Rochester, Rochester, NY

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[1]Rochester Data Science Consortium, University of Rochester, Rochester, NY; [2]Measures for Justice, Rochester, NY

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Simon Business School, University of Rochester, Rochester, NY

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Egor Kudriavtcev, Anastasia Lebedeva , Mitchell J. Lovett
Simon Business School, University of Rochester, Rochester, NY

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Eduardo Martínez-Enríquez, Alberto de Castro, Susana Marcos
Instituto de Óptica "Daza de Valdés", CSIC, Madrid, Spain

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Meiting Song
The Institute of Optics, University of Rochester, Rochester, NY

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Juniyali Nauriyal, Meiting Song, Marissa Granados-Baez, Yi Zhang , Jaime Cardenas
University of Rochester, Rochester, NY

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Margaret Flaum, Thomas Brown
The Institute of Optics, University of Rochester, Rochester, NY

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Judith Pipher, William Forrest, Craig McMurtry, Greg Zengilowski, Nick Reilly, Meghan Dorn
Department of Physics & Astronomy, University of Rochester, Rochester, NY

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Bruno Artacho, Andreas Savakis
Rochester Institute of Technology, Rochester, NY

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Debamitra Chakraborty[1,2], Roman Sobolewski[1,2,3]
[1]Materials Science Graduate Program, University of Rochester, Rochester, NY; [2]2Laboratory for Laser Energetics, University of Rochester, Rochester, NY; [3]Department of Electrical and Computer Engineering, University of Rochester, Rochester, NY

OPI 8 Dual wavelength phase shifting interferometry on hydrogels

Yiyang Wu, Wayne H. Knox
The Institute of Optics, University of Rochester, Rochester, NY

OPI 9 BRIM: Bistable Resistively-Coupled Ising Machine

Richard Afoakwa, Yiqiao Zhang, Uday Kumar Reddy Vengalam, Zeljko Ignjatovic, Michael Huang
Department of Electrical and Computer Engineering, University of Rochester, Rochester, NY

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Eli Powell, Vaishali Kanyan, Kush Benara, Hector Rubio, Karl D. Hirschman
Thin Film Electronics Group, Microsystems Engineering, Rochester Institute of Technology, Rochester, NY

OPI 11 Evaluation of a Charge Injection Device for Use in Extreme Contrast Ratio Astronomical Imaging

Alexis Irwin[1], Zoran Ninkov[1], Suraj Bhaskaran[2]
[1]Rochester Institute of Technology, Center for Imaging Science, Rochester, NY: [2]Thermo Scientific—Cameras and Imagers, Liverpool, NY

SENSORS, ACOUSTICS, MATERIALS

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Stephen Roessner, Michael C. Heilemann, and Mark F. Bocko
Department of Electrical and Computer Engineering, University of Rochester, Rochester, NY

SAM 2 One-class Learning Towards Synthetic Voice Spoofing Detection

You Zhang[1], Fei Jiang[1,2], Zhiyao Duan[1]
[1]University of Rochester, Rochester, NY; [2]Beijing Institute of Technology, Beijing, China

SAM 3 Ultra-Thin Glass for Advanced Semiconductor Packaging

Aric Shorey
Mosaic Microsystems, Rochester, NY

University Technology Showcase Poster Session

BIOMEDICAL TECHNOLOGY

BMT 1 Rapid detection of intact SARS-CoV-2 viral particles using silicon Nanomembranes

Michael Klaczko[1], Baturay Ozgurun[2], Brian Ward[3], Jonathan Flax[4], James McGrath[2]*
[1]Department of Chemistry, University of Rochester, Rochester, NY; [2]Department of Biomedical Engineering, University of Rochester, Rochester, NY; [3]Department of Microbiology and Immunology, University of Rochester Medical Center, Rochester, NY; [4]Department of Urology, University of Rochester Medical Center, Rochester, NY

The SARS-CoV-2 pandemic has revealed the need for rapid and inexpensive diagnostic testing to enable population-based screening for active infection. Neither standard diagnostic testing, the detection and measurement of viral RNA (via polymerase chain reaction), or serological testing (via enzyme-linked immunosorbent assay) has the capability to definitively determine active infection. The former due to a lack of ability to distinguish between replicable and inert viral RNA, and the latter due to varying immune responses (ranging from latent to a complete lack of immune response altogether). Despite many companies producing rapid point-of-care (POC) tests, none will address the global scale of testing needed and few help to combat the ever-growing issue of testing resource scarcity. Here we discuss our efforts towards the development of a highly manufacturable, microfluidic sensor that instantly indicates active viral infection status from ~ 40 µL of nasal mucus or phlegm and requires no external power. The device features a biotin functionalized silicon nanomembrane within an acrylic body containing channels and ports for sample introduction and analysis. Virus capture and target confirmation are done using affinity-based capture and size-based occlusion respectively. Modularity of the device is proven with bead and vaccinia virus capture as we work towards testing with both pure SARS-CoV-2 virus and human samples. With success on all fronts, we could achieve an inexpensive POC diagnostic which can determine an individual's infection status, aiding containment efforts in the current and future pandemics. In addition to direct viral detection, our method can be used as a rapid POC sample preparation tool that limits the application

of PCR reagents to those samples which already display viral size and antigen-based positivity through our device.

BMT 2 Estimation of Integrated Ultrasonic Backscatter in Murine Tendon to Non-invasively Characterize Collagen Fiber Organization

Sarah E. Wayson[1,2], María Helguera[3], Todd Jackson[4], Jim Chwalek[4], Denise C. Hocking[5], Diane Dalecki[1,2]

[1]Department of Biomedical Engineering; [2]Rochester Center for Biomedical Ultrasound, University of Rochester, Rochester, NY; [3]Rochester Institute of Technology, Rochester, NY; [4]Imaginant Inc., Rochester, NY; [5]Department of Pharmacology and Physiology, University of Rochester Medical Center, Rochester, NY

Ultrasound is a non-destructive imaging modality that allows for non-invasive monitoring of tissues following injury and in the presence of disease. There is a need to develop ultrasound systems that characterize tendon structure throughout physical therapy to optimize patient range of motion and tendon mechanical properties, while preventing tendon rupture. The objective of the present study is to develop a high-frequency quantitative ultrasound imaging technique that is system- and operator-independent to extract underlying features of tendon microstructure.
The functional capabilities of tendon are determined by its extracellular matrix structure, which is primarily Type I collagen. Healthy tendon is composed of a hierarchy of parallel collagen bundles, and this organization can be disrupted in the presence of injury or disease. The alignment of collagen fibers is a structural property that impacts tendon tensile strength. The integrated backscatter coefficient (IBC) is a quantitative ultrasound spectral parameter that estimates how strongly scatterers within a tissue reflect the interrogating pulse back to the transducer. This work tests the hypothesis that the IBC will exhibit angular-dependence in murine tendon with aligned structure, and angular-independence in murine liver with inhomogeneous structure.
Backscattered echoes from murine tail tendon and liver were acquired at varying insonification angles using a 58-MHz single-element transducer. Signal and image processing approaches were developed in MATLAB®. Time gain compensation corrected for decreased echo intensity away from the focal distance. Edge detection algorithms were used to identify tissue boundaries, and corrections for tissue absorption were implemented. IBC parametric images were computed, and the average

IBC in a region-of-interest was plotted as a function of insonification angle. The IBC was angular-dependent in tendon and angular-independent in liver. These data suggest that the IBC measured by our system can be used to detect collagen fiber alignment. This work is a foundation for future studies investigating collagen fiber alignment in the presence of injury and disease.

BMT 3 Super-Resolution Ultrasound Method for Transcranial Brain imaging

Jovan Mitrovic[1], Narges Mohammadi[1], Zeljko Ignjatovic[1], William J. Sehnert[2]
[1]University of Rochester, Rochester, NY, [2]Carestream Health, Rochester, NY

The research goal of this collaborative work is to explore and demonstrate the use of sub-MHz ultrasound frequencies in combination with super-resolution image reconstruction methods for transcranial brain imaging with sub-millimeter resolution capability. Low-frequency ultrasound allows higher penetration with a possibility of traversing skull layers with reduced losses. Before tissue imaging is commenced, the proposed method first determines an optimal excitation frequency by measuring echoes from skull layers in response to a range of frequencies (e.g., 300 kHz to 800 kHz). During the subsequent imaging procedure, the received echoes from brain tissue are then fit to the imaging model in a least-square sense penalized by a mixed L1 and L2-norm to estimate reflectance coefficients from the brain tissue and recover resolution losses due to the use of frequencies lower than those traditionally used in standard medical ultrasound. The proposed method can increase the imaging resolution up to an order of magnitude as compared to traditional B-mode ultrasound. Preliminary results show that there is a great potential in the proposed method, as it can increase the imaging resolution to accommodate the use of sub-MHz frequencies for transcranial imaging of brain tissue. This method promises to allow for the real-time ultrasound imaging of the human brain for a wide clinical impact, especially in the point-of-care diagnostics of the stroke-related hemorrhaging.

BMT 4 Utilizing the Mobile Brain-Body Imaging system to identify neural markers of response to Deep Brain Stimulation in Parkinson's Disease

Eleni Patelaki[1,2], Karlo J. Lizarraga Mendoza[3], John J. Foxe[2], Edward G. Freedman[2]
[1] Department of Biomedical Engineering, University of Rochester; [2] The Cognitive Neurophysiology Laboratory, The Del Monte Institute for Neuroscience, Department of Neuroscience, University of Rochester School of Medicine and Dentistry; [3] Movement Disorders Unit, Department of Neurology, University of Rochester School of Medicine and Dentistry, Rochester, NY

Parkinson's Disease (PD) is the fastest-growing neurological disorder worldwide. Some of the most typical manifestations of PD are the PD-related gait dysfunctions, for example shuffling, freezing, or festination. Deep brain stimulation (DBS), the most common surgical treatment for PD, despite its beneficial effects in alleviating these symptoms, can have variable outcomes on patients' gait and therefore requires fine-tuning based on each patient's individual dysfunction profile to achieve an optimal treatment scheme. To better characterize PD-related gait dysfunctions, it is important to uncover all their aspects, even those that remain masked by compensatory neural mechanisms. A well-established methodology used in the clinic to implement this is 'loading' the cognitive systems by combining walking with concurrent performance of a cognitive task. However, there is no access to the patient's brain activity during this assessment. Understanding the neuropathology underlying PD-related gait dysfunctions and identifying neural signatures of response to DBS treatment can help clinical experts design the treatment plan in a more systematic, informed, and individualized way. To this end, we utilized the advanced Mobile Brain-Body Imaging (MoBI) system to synchronously record 1) brain activity, through high-density electroencephalography, 2) 3D whole-body kinematics, through high-speed video cameras which track the position of infrared-reflective markers placed on the patient's body, and 3) behavioral performance in a response inhibition cognitive task, in one patient with implanted DBS electrodes, while he engaged in this task and walked on a treadmill at the same time. This patient's neurophysiology, kinematics and behavior were assessed both while the DBS was on, as well as while it was off. Our results indicate that activation of the DBS speeds up responses to the cognitive task, reduces stride-to-stride variability, and modulates neural activity in lateral prefrontal and parietal brain areas of the hemisphere that receives the neurostimulation, with all these changes taking effect gradually.

BMT 5 Ultrasound Elasticity Imaging Using Physics-Based Models and Learning-Based Plug-and-Play Priors

Narges Mohammadi, Marvin M. Doyley, Mujdat Cetin
University of Rochester, Rochester, NY

Ultrasound elasticity images which enable the visualization of quantitative maps of tissue stiffness can be reconstructed by solving an inverse problem. Classical model-

based approaches for ultrasound elastography use deterministic finite element methods (FEMs) to incorporate the governing physical laws leading to poor performance in low SNR conditions. Moreover, these approaches utilize fixed regularizers for various tissue patterns while appropriate data-adaptive priors might be required for capturing the complex spatial elasticity distribution.
In this regard, we propose a joint model-based and learning-based framework for estimating the elasticity distribution by solving a regularized optimization problem. We present an integrated objective function composed of a statistical physics-based forward model and a data-driven regularizer to leverage deep neural networks for learning the underlying elasticity prior. Finally, the constrained optimization problem is solved using the fixed-point proximal gradient method.

DATA SCIENCE

DS 1 Data Science Support to Pandemic Monitoring and Management

George Vigelette
Rochester Data Science Consortium, University of Rochester, Rochester, NY

Common Ground Health is the lead integration partner for Monroe County's ROC COVID pandemic-monitoring platform – a system to collect, aggregate, analyze, and disseminate pandemic surveillance data. The data is updated daily (or more often), with the goal is to provide feedback on pandemic trends to both the public health community and to the broader community at large. The PI and Common Ground propose a data analytics platform approach to meeting the objectives – developing a research prototype that can ingest, normalize, store (database), and serve back the data to a data science pipeline and/or analyst system, and a prototype data science pipeline that implements time-series analytics and anomaly detection.

DS 2 An Efficient Preprocessing Method to Combine Distinguishers for Improved Side-Channel Attacks

Soner Seckiner, Selcuk Kose
University of Rochester, Rochester, NY

The security and privacy of modern computing devices have become an important design metric with the unprecedented increase in the amount of personal information stored in the digital domain. Side-channel attacks have been demonstrated to be one of the primary threats for the security and privacy of these devices. Understanding the working principles of side-channel attacks has therefore become an important research problem. An efficient preprocessing technique is proposed in this work for an attack scenario where the amount of time to collect physical leakage and access to the device is limited. The proposed preprocessing technique utilizes different side-channel distinguishers to decrease the required number of physical leakage measurements for a given success rate by enhancing the quality of the leakage signal. Two commonly used distinguishers, Pearson correlation and mutual information, are combined in this work. The success rate of the proposed attack framework outperforms the conventional single distinguisher side-channel attacks by 33% and 30% for unmasked AES and masked AES, respectively.

DS 3 Name parser and homeless shelter address detector

Yue Zhao[1], John Handley[1], Sema Taheri[2], David Kilmer[2]
[1]Rochester Data Science Consortium, University of Rochester, Rochester, NY; [2]Measures for Justice, Rochester, NY

We created an accurate and robust machine learning model that parses a name into name parts, such as last name, first name, middle name, and suffix, regardless the format in which the name is entered (e.g., John Doe, First Name or Doe John). In addition, the name parser is capable of recognizing entity names such as the name of a business. We also made a homeless shelter address detector which can tell whether an address belongs to a homeless shelter.

DS 4 Anomaly Crossing: New Horizons for Cross-domain Few-shot Video Anomaly Detection

Guangyo Sun, Jing Shi, Chenliang Xu
University of Rochester, Rochester, NY

Video anomaly detection is a significant problem in video representation learning. Most existing works focus on semi-supervised learning from only normal videos; failing to

explore the pattern of the anomaly event. Also, they are commonly in specific domains such as industry and traffic, thus lacking the generalizability for other domains.
To tackle these challenges, we formulate a new task of cross-domain few-shot anomaly detection, where a large number of normal videos, a few abnormal videos, and an external video dataset in a different domain (e.g. IG-65M) are provided. Our goal is to recognize the abnormal videos in a few-shot fashion by learning from the cross-domain video dataset. We conduct self-supervised learning on plentiful normal videos to reduce the domain gap and device contextual modeling modules to explore the video context of the event. Our method for the new task significantly improved the Detection of Traffic Anomaly (DoTA) dataset compared with existing methods in video few-shot classification and cross-domain few-shot learning methods for image domain.

DS 5 Machine Learning Methods for Emotion Recognition from Brain Signals

Shadi Sartipi, Mastaneh Torkamani-Azar, Mujdat Cetin
University of Rochester, Rochester, NY

Emotion recognition based on electroencephalography (EEG) signals has been receiving significant attention in the domains of affective computing and brain-computer interfaces (BCI). Automatically extracting information about emotions could enhance human-machine interactions and assist healthcare workers and caregivers to communicate with patients suffering from expression and speech problems. EEG-based emotion recognition consists of two main stages: extracting discriminative features and performing classification. Although several deep learning methods have been proposed dealing with the emotion recognition task, developing methods that effectively extract and use discriminative features is still a challenge. In this work, we propose a novel spatio-temporal attention neural network (STANN) to extract discriminative spatial and temporal features of EEG signals by a parallel structure of multi-column convolutional neural network and attention-based bidirectional long-short term memory. Moreover, we explore the inter-channel relationships of EEG signals via graph signal processing (GSP) tools. Our experimental analysis demonstrates that the proposed network improves the state-of-the-art results in subject-wise, binary classification of valence and arousal levels as well as four-class classification in the valence-arousal emotion

space when raw EEG signals or their graph representations, in an architecture coined as GFT-STANN, are used as model inputs.

DS 6 Consumer Demand under Mail-in Rebate Promotion

Shengyu Zhu, Yufeng Huang, Mitchell Lovett, James Prinzi
Simon Business School, University of Rochester, Rochester, NY

This paper studies consumers' inter-temporal decision-making on the mail-in rebate. By leveraging panel data from a large auto service and tire retailer in the U.S. consisting of over 14 million trips made by over 6 million consumers in 3 years, we find that limited memory causes redemption slippage. In the short run, firms can save the marketing budget via mail-in rebate promotion instead of an instant discount. Nevertheless, in the long run, the churn rate goes up by 5% for consumers who fail to redeem the rebate. Our result suggests that saving the marketing budget and preventing churn is a key trade-off of mail-in rebate promotion. Based on the descriptive evidence, I propose to use a structural model approach to explore the alternative design of mail-in rebate promotion and quantify to what extent consumers foresee the redemption probability when they make the purchase.

DS 7 Empowering your product launch decision with a conjoint study and machine learning

Egor Kudriavtcev, Anastasia Lebedeva , Mitchell J. Lovett
Simon Business School, University of Rochester, Rochester, NY

A conjoint study is a great tool for making predictions of individual preferences for non-existing product attributes. Unfortunately, this tool measures only stated preferences, which prompt different types of biases. The demand estimation of revealed preferences provides much more accurate results for existing products but cannot be used for non-existing product attributes. This work provides a hybrid method of demand estimation, which combines the information from both conjoint surveys and consumer panel purchase data. The core idea of the method lies in utilizing neural networks which are built in a structural way (NN+S approach), and further regularized and tuned for best out-of-sample prediction.

OPTICS, PHOTONICS, IMAGING

OPI 1 Eigenlenses: an eigenvectors-based model for full crystalline lens shape representation

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The crystalline lens is a sophisticated optical element that contributes with one-third of the eye's total power and that is able to change its shape for focusing near and far objects. The crystalline lens geometry is usually studied only in the optical area (central 4 to 6 mm). However, for important applications as designing and customizing solutions for cataract and presbyopia, a description of the full shape of the crystalline lens is important. In this poster, we proposed a new method for the representation of the full shape of the crystalline lens, called eigenlenses. Inspired by active shape models, we construct the eigenlenses representation from 3-dimensional optical coherence tomography images of 133 isolated crystalline lenses. The method is shown to be compact and accurate to describe the crystalline lens shape in comparison with several state of the art methods. Furthermore, we apply eigenlenses representation to: (i) the estimation of the full shape of the crystalline lens from its central part (in in-vivo optical images of the anterior segment of the eye the iris blocks the incident light and only the information through the pupil, i.e., the central part, is available), and (ii) to the generation (synthesis) of realistic full lenses of a given age.

OPI 2 Enhanced on-chip phase measurement by weak value amplification

Meiting Song
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No abstract provided

OPI 3 Single-shot, Multiple I/O Photonic Chip to Fiber Array Packaging Using Fusion Splicing

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One of the remaining challenges to achieve manufacturing scalability of silicon nanophotonic devices is a low cost, highly efficient, and mechanically robust method to optically couple multiple optical fibers to a photonic chip at once. We show a novel multiple I/O photonic packaging method for 4-fiber array using fusion splicing. We demonstrate a minimum loss of 2.0dB per facet with a variation of +/-0.1dB through a 4-fiber array.

OPI 4 Adaptive Nulling for Steep Aspheres using a Holographic Reference Surface

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Freeform optics are typically difficult to measure with interferometry because a reference surface such as a flat or a reference sphere will produce a very different wavefront from that which is produced by the optic. This causes a retrace error, where the light reflected off the reference surface does not follow the same path as the light reflected off the test surface. Our project is to create a Fizeau interferometer that uses a hologram of the surface under test as the reference surface. When the hologram is illuminated, it produces a beam that is theoretically identical to that of the surface. The source is a 532 nm doubled YAG, a green laser pointer, which operates at more than one mode. This appears in the measurement in coherence fringes, which are a pattern of visibility in the hologram itself, where some areas are exposed well and others are underexposed. The result is that the interferogram appears to have two sets of fringes, one from coherence and one from interference between the reference and test surfaces. Both sets of fringes contain information about the shape of the surface, with the coherence fringes providing a coarse surface shape and the interference fringes providing subwavelength accuracy.

OPI 5 MTF Measurements in LWIR HgCdTe Arrays for NEO Surveyor

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NEO Surveyor is a proposed mission to survey for Near Earth Objects (NEOs), asteroids whose orbits have been diverted into elliptical orbits passing near to the Earth's orbit,

as well as comets, some of which may be potentially hazardous to the Earth. The survey will be complete to 90% of objects ≥140 m in diameter in 5 years: a 140 m object could level an entire city. Diameters and velocities will be obtained. Because the temperature of these NEOs is ~300K, it is essential to survey with a 6-10 □m detector array camera. One of the critical tests is image quality. Thus, we have worked on a series of tests to measure the MTF – Modulation Transfer Function -of these arrays, and present the results here. A system's MTF can be obtained by taking the magnitude of the Fourier transform of the two-dimensional point spread function, which is the image produced when observing a perfect point source. For the detectors used here, with an 18-micron pixel pitch, producing an infinitesimally small spot with 10-□m light is not physically possible. The method in this analysis involves the slanted edge technique, where a knife-edge is placed in contact with the surface of the detector and is oriented at a slight angle with respect to the sampling sites. This method has a few advantages over other options, such as the simplicity of setting up the test target, and that it requires no corrections, while allowing for an oversampling of the response across a pixel. The MTF ranges from 0.22 at 6 □m to 0.25 at 10 □m.

OPI 6 UniPose: Unified Human Pose Estimation in Single Images and Videos

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Human pose estimation is an important task in computer vision with applications in human computer interaction, activity recognition, health, animation, and sports analysis. We present UniPose, a unified framework for human pose estimation that achieves state-of-art-results on several datasets. UniPose incorporates contextual segmentation and joint localization to estimate the human pose in a single stage, with high accuracy, without relying on statistical post-processing methods. Our ``Waterfall" Atrous Spatial Pooling module leverages the efficiency of progressive filtering, while maintaining multi-scale fields-of-view comparable to spatial pyramid configurations. Additionally, our method is extended to UniPose-LSTM for multi-frame processing and achieves state-of-the-art results for temporal pose estimation in Video.

OPI 7 Pulsed Terahertz Time Domain Spectroscopy

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Terahertz (THz) radiation is the electromagnetic wave within the frequency range of 0.3 THz to 30 THz situating itself between infrared and microwave radiation in the electromagnetic spectrum. The Pulsed THz Time Domain Spectroscopy (TDS) has emerged as a unique non-destructive tool to probe a wide variety of materials due to its sub-millimeter resolution, high signal-to-noise ratio, non-ionizing nature, and ability to show biomolecular features. We have conducted our current research to develop and investigate the viability of pulsed TDS imaging to study pancreatic ductal adenocarcinoma, which is one of the most fatal malignancies, often diagnosed with advanced disease eliminating the possibility of curative treatments. We have also demonstrated previously in our lab the use of pulsed TDS to characterize the dispersion of graphene nanoflakes, within a multiblock copolyester matrix for monitoring any nanofiller dispersion in a polymer matrix throughout the product development chain.

OPI 8 Dual wavelength phase shifting interferometry on hydrogels

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Traditional refractive surgeries such as LASIK and PRK involve altering the corneal shapes and removing layers of tissues with 2-4 μJ laser pulses, which is highly invasive and may cause side effects including discomfort, pain, or dry eye. Hence, we develop 100x lower power and non-invasive refractive surgery procedure: femtosecond Laser-Induced Refractive Index Change (LIRIC). Successful LIRIC control on common ophthalmic materials and biological eye globes have been previously reported. Here, we introduce the dual wavelength phase shifting interferometry (PSI) on one of our primary interested materials.

OPI 9 BRIM: Bistable Resistively-Coupled Ising Machine

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Physical Ising machines rely on nature to guide a dynamical system towards an optimal state which can be read out as a heuristical solution to a combinatorial optimization problem. Such designs that use nature as a computing mechanism can lead to higher performance and/or lower operation costs. Quantum annealers are a prominent example of such efforts. However, existing Ising machines are generally bulky and energy intensive. Such disadvantages may be acceptable if these designs provide some significant intrinsic advantages at a much larger scale in the future, which remains to be seen. But for now, integrated electronic designs of Ising machines allow more immediate applications. We propose one such design that uses bistable nodes, coupled with programmable and variable strengths. The design is fully CMOS compatible for on-chip applications and demonstrates competitive solution quality and significantly superior execution time and energy.

OPI 10 IGZO TFT Backplane Integration for µLED Flat-Panel Display

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Display technologies have continuously evolved since the advent of cathode ray tube (CRT) displays in the early 1900s. Thanks to modern advancements, current display thicknesses are on the order of centimeters and their area has increased 10-fold. Modern flat panel display (FPD) systems consist of a TFT backplane that controls the filtering of a backlight or the modulation of emissive devices such as OLED or microLEDs (µLEDs). Due to their small size, µLEDs provide higher resolution and better contrast than previous display technologies, and are an active topic in FPD research and development. The primary focus of this work is the process integration of Indium Gallium Zinc Oxide (IGZO) TFTs as an active-matrix backplane for row/column addressing. A single pixel is composed of a µLED driven by an arrangement of 2 transistors and a storage capacitor. The pixels are then arrayed on a glass substrate to control monochrome and full color (RGB) displays from 1x1cm (50 x 50 pixels) up to 7.6

x 7.6cm (380 x 380 pixels). Optimization of circuit parameters considering size and scan frequency were modeled using existing TFT and µLED electrical device compact models. New process parameters and procedures were established for the hybrid integration of µLEDs with the IGZO TFT backplane. System integration with control circuitry will facilitate demonstration of a new interconnect strategy for µLED display modules.

OPI 11 Evaluation of a Charge Injection Device for Use in Wide Dynamic Range Imaging

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Charge injection devices (CIDs) are imaging sensors with the capability to perform both non-destructive and destructive readouts of many subarrays at different rates. When imaging a field, a region of interest (ROI) surrounding a bright object can be read out quickly without saturation occurring, while a ROI containing a faint object is integrated for a longer time to increase the signal-to-noise ratio of the measurement. We present initial test results for a back-thinned CID and plans to use it for wide dynamic range imaging in astronomy.

SENSORS, ACOUSTICS, MATERIALS

SAM 1 Quantifying Listener Preference of Flat-Panel Loudspeakers

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Three flat-panel loudspeakers and two conventional loudspeakers were evaluated in a blind listening test. Two of the flat-panel loudspeakers used in the test were prototypes employing both array-based excitation methods and constrained viscoelastic damping to eliminate modal resonant peaks in the mechanical response of the vibrating surface. The remaining flat-panel speaker was a commercially available unit. A set of twenty-one listeners reported average preference ratings of 7.00/10 and 6.81/10 for the conventional loudspeakers, 6.48/10 and 5.90/10 for the prototype flat-panel loudspeakers and 2.24/10 for the commercial flat-panel speaker. The results are

consistent with those given by a predictive model for listener preference rating, suggesting that designs aimed at smoothing the mechanical response of the panel lead to improved preference ratings.

SAM 2 One-class Learning Towards Synthetic Voice Spoofing Detection

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Human voices can be used to authenticate the identity of the speaker, but the automatic speaker verification (ASV) systems are vulnerable to voice spoofing attacks, such as impersonation, replay, text-to-speech, and voice conversion. Recently, researchers developed anti-spoofing techniques to improve the reliability of ASV systems against spoofing attacks. However, most methods encounter difficulties in detecting unknown attacks in practical use, which often have different statistical distributions from known attacks. Especially, the fast development of synthetic voice spoofing algorithms is generating increasingly powerful attacks, putting the ASV systems at risk of unseen attacks. In this work, we propose an anti-spoofing system to detect unknown synthetic voice spoofing attacks (i.e., text-to-speech or voice conversion) using one-class learning. The key idea is to compact the bona fide speech representation and inject an angular margin to separate the spoofing attacks in the embedding space. Without resorting to any data augmentation methods, our proposed system achieves an equal error rate (EER) of 2.19% on the evaluation set of ASVspoof 2019 Challenge logical access scenario, outperforming all existing single systems (i.e., those without model ensemble).

SAM 3 Ultra-Thin Glass for Advanced Semiconductor Packaging

Aric Shorey
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Rochester NY-based Mosaic Microsystems is pioneering a new technology for advanced packaging in the semiconductor industry. Mosaic's technology allows ultra-thin glass to be used in a variety of packaging applications including interposers, heterogeneous integration, photonics, MEMS, biosensing, and RF. This poster will explain Mosaic's temporary bonding technology and applications for 5G wireless.

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