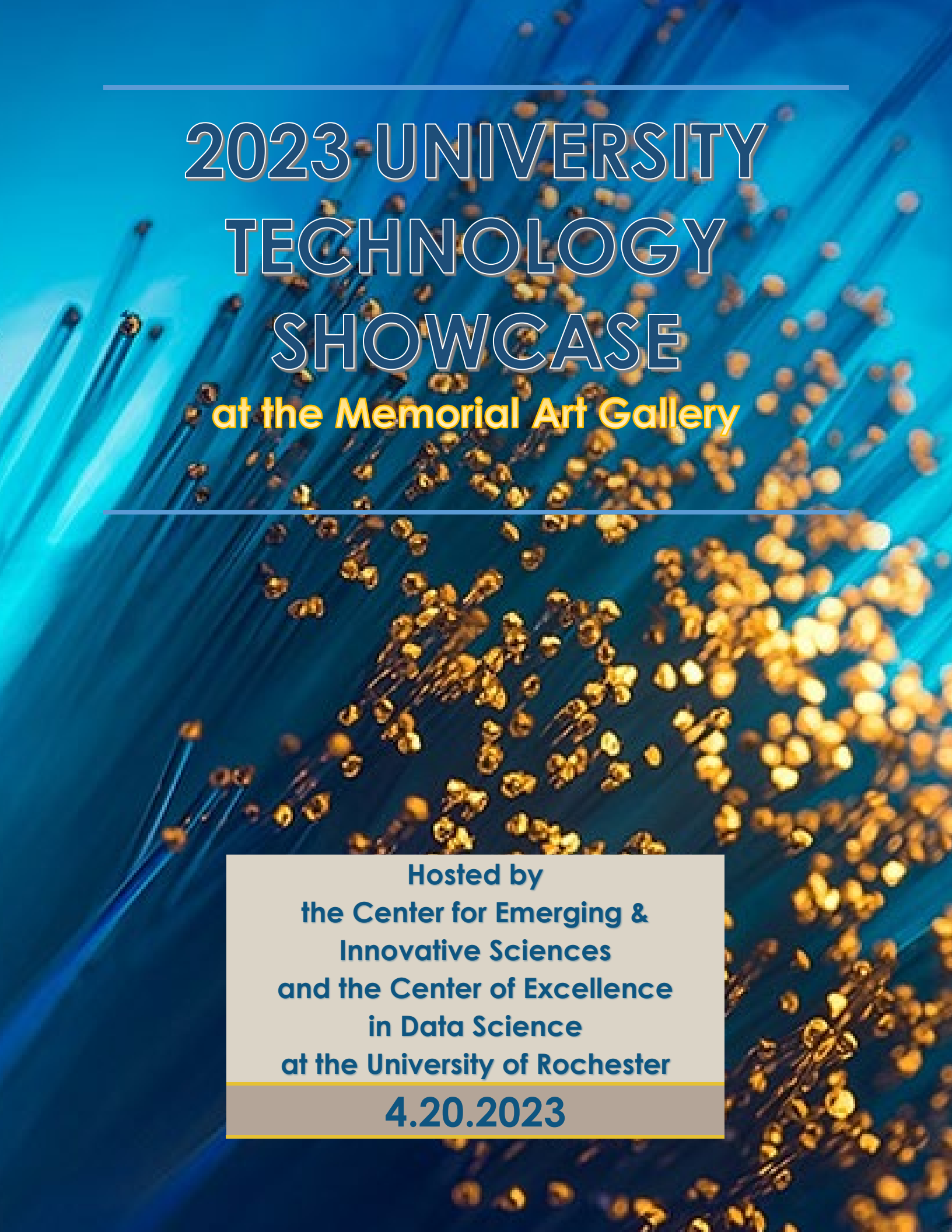


2023 UNIVERSITY TECHNOLOGY SHOWCASE

at the Memorial Art Gallery

Hosted by
the Center for Emerging & Innovative Sciences
and the Center of Excellence in Data Science
at the University of Rochester

4.20.2023

WELCOME

Welcome to the 2023 University Technology Showcase. This annual event is co-sponsored by the Center for Emerging and Innovative Sciences (CEIS) and the Center of Excellence (CoE) in Data Science, at the University of Rochester. We are very pleased to host this year's Showcase at the Memorial Art Gallery for a second year. Our goal is to encourage industry professionals and academic researchers to find new connections that will lead to fruitful collaborations and technology transfer all with the goal of contributing to economic growth in New York State. Industry and University representatives working on a wide range of technology areas will be represented this year, including semiconductors and electronics, biomedical, data science, optics, imaging, photonics, sensors, acoustics, materials, energy, and others.

This year's event will feature a keynote panel session on the growth of the semiconductor industry in New York State and its impact on other related sectors of the New York State economy. The panelists include Representative Harry Bronson - member of the New York State Assembly, Laura Fox O'Sullivan - Finger Lakes Regional Director, Empire State Development, Christopher Zeltmann - Regional Director in the Office of US Senator Chuck E. Schumer, Karl Hirschman – Director of Microelectronic Engineering at the Rochester Institute of technology, Eric Bohannon – Lead Analog Engineer at Advanced Micro Devices, and Matt Hurlbutt - President and CEO of Greater Rochester Enterprise. We are looking forward to a stimulating discussion.

The day will kick off with the second annual Western New York Augmented and Virtual Reality (AR/VR) Mini-Conference. This event is organized and co-chaired by PhD students from the AR/VR PhD training program at the University of Rochester. Bringing together AR/VR researchers and professionals, the mini conference will feature talks on immersive technologies by leading experts from industry and academia, as well as brief PhD student research introductions. This event also will be streamed live to allow remote participation.

New to the Showcase this year will be a networking and "speed dating" session to bring together regional company representatives university researchers to briefly share their interests and explore potential areas for future collaboration.

The afternoon keynote panel session will be followed by poster presentations from 3-5 pm to give an opportunity for more in-depth discussions. Please also make sure to vote for your favorite posters – there will be $1000 in cash prizes awarded to the top choices.

We hope that everyone will enjoy spending the day in the beautiful surroundings of the Memorial Art Gallery and take full advantage of the opportunity to make new connections in the planned sessions and during the informal lunch gathering. It is our hope that this event will encourage university-industry interactions that will enable companies to tap into the wealth of technology and expertise available at our institutions of higher education to contribute to regional job growth and economic expansion.

Both CEIS and the CoE in Data Science provide NYS matching funds for company-sponsored research at NY universities. The CoE in Data Science also provides full funding for industry-academia collaborations without the requirement of company sponsorship, and it funds student internships at small companies and startups in NY. Please feel free to contact us to learn more about these programs 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

AGENDA

8:00 AM – Coffee and Registration

8:30-10:30 AM - WNY AR/VR Mini-Conference

8:30-8:55 - **Erin S. Baylor** (Director of Simulation lab in Sch. of Nursing)"Utilizing VR Simulations to Promote Clinical Decision-Making in Nursing Students"

8:55-9:20 - **Susan Lakin** (Director of Frameless Labs at RIT) "Artists and filmmakers leveraging virtual and augmented reality for social impact"

9:20-9:45 - **Anton Jeran Ratnarajah** (Univ. Maryland) (virtual) "Real-time interactive audio rendering for AR/VR application"

9:45-10:10 - **Robert Schultz** (Vice President of Advanced Optics Vuzix Corporation) "Designing and Producing Waveguide Optical Systems"

10:10-10:30 - **Lightning Talks** – Ph.D. NRT Trainees: Qinqin Xiao, Neil Zhang, Ali Vosoughi, Pei Xiong and Yiwen Fan

10:45 AM-12:15 PM - Business/Faculty Networking Pitches

12:15-1:15 PM – Lunch

1:30-3:00 PM - Keynote Speaker Panel

Assemblymember Harry Bronson, Chair of the Committee on Economic Development, Job Creation, Commerce and Industry
Matt Hurlbutt - President and Chief Executive Officer at Greater Rochester Enterprise (GRE)
Chris Zeltmann, Regional Director of U.S. Senator Charles E. Schumer's Rochester Finger Lakes Office
Laura Fox O'Sullivan, Finger Lakes Regional Director, Empire State Development
Karl D. Hirschman, Micron Professor of Microelectronic Engineering in the Electrical & Microelectronic Engineering Department at RIT
Eric Bohannon, Lead Analog Engineer at Advanced Micro Devices

3:00 - 5:00 PM – Open Poster Session/ Exhibitor Tables in Ballroom
(please check out the posters and vote before 4:00 – ballot may be found in your registration packet)

4:15 PM – Winning posters announced

Erin S. Baylor

Specialty Director, Pediatric NP Program Director,
Simulation & Experiential Learning
Associate Professor of Clinical Nursing
University of Rochester
https://son.rochester.edu/directory/ebaylor/

Erin's journey in nursing education began in 2004, where she held multiple teaching and leadership positions within the University of Rochester School of Nursing. Erin's goal has always been to facilitate student-centric, evidence-based teaching practices that serve to prepare tomorrow's nurses, nurse practitioners, nurse educators, and clinical leaders. Developing innovative experiential learning opportunities in psychologically safe environments is at the cornerstone of her academic practice. In addition to becoming the first Director of Simulation & Experiential Learning at the University of Rochester Scholl of Nursing, she developed several new courses, the first Pediatric Acute Care NP program in NYS, and began implementing competency-based assessments using OSCEs.

Susan Lakin

Professor, School of Photographic Arts and Sciences
College of Art and Design
Director of Frameless Labs
Rochester Institute of Technology
https://www.rit.edu/framelesslabs/directory/srlpph-susan-lakin

Susan is a Professor in College the of Art and Design, and Fellow in the School of Individualized Study at Rochester Institute of Technology (RIT). She is Director of Frameless Labs, which serves to connect ideas in academia and the greater outside community of extended reality (XR) thought leaders. Building from the strength and synergy of creative and technical minds jointly focused on XR, Frameless Labs provides a dedicated center of excellence for fostering ideation in emerging immersive experiences at RIT. Lakin has a Bachelor of Fine Arts in Photography from Art Center College of Design in Pasadena, California and an MFA in Studio Art from the University of California, Santa Barbara. Working across disciplines in her photography and academic practices, her artwork has received many awards and is part of the permanent collection at the Santa Barbara Museum of Art, Oakland Museum of California, Griffin Museum of Photography, and Photography Museum of Lishui, China. Lakin teaches classes that explore the intersections of technology, music, art and design and collaborates on community projects in the nonprofit sector.

Anton Jeran Ratnarajah

Ph.D. Candidate
Dept. of Electrical & Computer Engineering
University of Maryland – College Park
https://anton-jeran.github.io/antonjeran.github.io/

Anton Jeran is a 4th year Ph.D. student at the University of Maryland, College Park advised by Professor Dinesh Manocha. His research area is broadly in audio and speech signal processing. He is also interested in building machine-learning models to create high-quality sound experience in interactive applications. Anton Jeran's current line of research is learning-based sound synthesis and propagation for AR and VR applications and audio/speech processing applications.

Robert Schultz

Vice President of Advanced Optics
Vuzix Corporation
https://www.linkedin.com/in/robert-schultz-790bb86a/

Robert has been with Vuzix for over 15 years where he heads up the optics programs. He specializes in waveguide development and holds 20+ patents related to diffractive waveguides and related systems. Robert leads the teams that support all the engineering, production, test, and system integration work related to optics done at Vuzix. He received his Master's degree from the University of Rochester and has an undergraduate degree in Physics.

Zhiyao Duan **University of Rochester**

Zhiyao Duan is an associate professor in Electrical and Computer Engineering, Computer Science and Data Science at the University of Rochester. He directs the Audio Information Research (AIR) lab. His primary research interest is computer audition, i.e., designing algorithms and systems that can understand various kinds of sounds, including music, speech, and general sounds. He is also interested in the connections between computer audition and computer vision, natural language processing, and augmented and virtual reality. He is a co-founder of Violy, a music app that provides feedback on intonation and rhythm accuracy to music instrument learners. He collaborates with IngenID, a Rochester-based company, providing speaker verification services worldwide. He welcomes discussions on collaborative research, technology licensing, and other forms of collaboration with companies and laboratories.

zhiyao.duan@rochester.edu | 585-275-5302 | http://www.ece.rochester.edu/~zduan/

Len Zheleznyak **Clerio Vision, Inc.**

The mission of Clerio Vision is to perfect the sense of sight. We use ultrafast lasers to impart diffractive optical wavefront correctors to contact lenses, intraocular lenses and directly to the cornea based on altering internal refractive index, rather than surface topography. We aim to improve patients' vision by developing (1) diffractive multifocal contact lenses for presbyopia correction, (2) novel optical designs to slow the rate of childhood eye growth and myopia progression, (3) optical touch-ups to implanted intraocular lenses, and (4) a non-invasive alternative to LASIK.

lzheleznyak@cleriovision.com | https://www.cleriovision.com

Molly Zimmerman **NYS Science & Technology Law Center**

The Innovation Law Center (ILC) at the Syracuse University College of Law is an experiential learning program for future lawyers and businesspeople interested in the legal issues affecting the commercialization of new technology. The ILC is also a NYSTAR sponsored resource and the designated NYS Science & Technology Law Center. Law and business students complete due diligence research key to assessing the commercial prospects of new technologies. The research includes patent landscapes, and prior art searches which are helpful in tech development, patentability considerations and freedom to operate assessments. Available research also includes regulatory compliance research and secondary market research.

mzimme01@syr.edu | 315-443-8943

Ram Haddas **UR Motion Analysis Labs**

The Motion Analysis Labs assess disabilities and help patients restore and enhance function. Moreover, the labs offer researchers, clinicians, and surgeons unparalleled insight into their patients' disabilities and movement functions by connecting them to the latest biomedical research, advanced care, and technology. Laboratory analysis combined with clinical expertise yields the optimal method for determining ideal patient-specific treatment strategies and recommendations for return to function based on disability & functional outcome measurements. We are looking for people who can help us build a clinical Extended Reality (XR) environment for developing innovative rehabilitation techniques for musculoskeletal and neurological patients. Our goal is to automatically manipulate the clinical protocols and XR environment using our motion capture, force plate, wearables, EMG, and EEG systems.

Ram_Haddas@URMC.Rochester.edu

Siva Visveswaran **MCC Economic and Workforce Development Center**

MCC's Economic and Workforce Development Center focuses on career exploration initiatives to drive student interest in areas that have highest demands from employers in the Finger Lakes region. Our career exploration model addresses three major components: self-awareness, occupational awareness and decision-making. We are also looking to incorporate reflective civic engagement and multi-generational learning to increase student commitment to the region's employers, community, and service networks. We have begun to leverage AR/VR and AI technologies and would like to collaborate with organizations/research groups that have interest in (or already are) developing solutions in this area.

svisveswaran@monroecc.edu | 585-685-6364

Mark Waclawiak **Avangrid**

The Operational Performance group at Avangrid is the leading data science and analytics organization in electric utilities, focused on the development and implementation of machine learning models and A.I. to improve the reliability and resiliency of the electric grid. Our team of data scientists, engineers, and analysts are looking to collaborate with the University of Rochester to restructure, clean, and model disparate datasets to reveal new and novel insights into the operation and performance of the electrical grid, driving prioritization and strategy while developing new technologies for research and innovation.

mark.waclawiak@uinet.com | 203-499-3078 | https://www.avangrid.com/

Sam Samanta, Ph.D. **Smart Systems Technologies_FLCC Victor Campus Center**

Small medium enterprises (SMEs) need new employee with unique set of skills – they need "unicorns." We help grow the "unicorns" in collaboration with 50+ businesses across industries in the greater Rochester high-tech ecosystem, through 270 hours of co-op. HyFlex scheduling allows full-time employment while students, and incumbent workers, complete degree in two years. Our completion rate is 3X national rate. Our estimated cumulative economic impact over past decade: $100M. Recently funded by the Smart Manufacturing Institute. We are looking for industry and academic partners for development of Digital Twins & Industrial Applications for AI & AVR.

https://flcc.webex.com/meet/sam.samanta | 585-785-1105

Jim Poore **Immersitech**

Immersitech has developed a valuable portfolio of audio processing software and related patents focused on delivering next-generation, social audio experiences. Using machine learning and related AI, our products deliver advanced noise cancellation, voice clarity improvements, and immersive spatial (3D) audio capabilities for social entertainment/gaming, remote learning, and business communications applications. Our mission is to provide customers with high quality, social audio experiences that connect people in ways leading to higher user engagement, retention, and growth!

jpoore@immersitech.io | https://immersitech.io

Gonzalo Mateos **University of Rochester**

Algorithms, analysis, and application of statistical signal processing tools to the study of complex, interconnected systems. Current research focus is on graph signal processing, machine learning for network (relational) data, signal representation and inverse problems on graphs; robust, decentralized, and time-adaptive learning from high-dimensional network data; as well as AI-empowered design and operation of wireless networks. Interested in network neuroscience, collaborative IoT sensing, bias mitigation in graph-based learning, power grid analytics, and biomedical signal processing.

gmateosb@ece.rochester.edu | 585-275-5930 | www.hajim.rochester.edu/ece/sites/gmateos/

Jean-Philippe Couderc **VPG Medical, Inc.**

VPG Medical, Inc. is a digital health service company developing innovative healthcare solutions by leveraging disruptive monitoring technologies. The HealthKam® technology is based on research conducted at both the University of Rochester (NY) and the Rochester Institute of Technology since 2012. It enables effortless cardiac monitoring utilizing smart devices and laptops to deliver improved diagnoses and therapeutic strategies, thereby enhancing the quality of life and health outcomes.

jp.couderc@vpgmedical.com | 585-754-3397 | www.vpgmedical.com

John Balbian **Zalliant**

Zalliant is a tech company with a focus on developing IoT devices in the arena of agriculture. We have set out to improve the ability to analyze large data sets regarding animal health and wellness. We have multiple devices and patents in animal agriculture. Our current work surrounds time series data derived from a thermistor, an accelerometer, and a gyrometer. The data is collected, analyzed and summarized for farms and ranches. Our future development is focused on expanding our accelerometer and gryometer data analysis to improve animal welfare. Our goal is to be able to reduce the amount of data needed to make accurate predictions.

john@zalliant.com | 518-366-1477

Dan Steiner **Phlotonics, Inc.**

Phlotonics, Inc. is a photonics technology company that focuses on revolutionizing healthcare diagnostics. Our technology combines custom designed photonic sensors with a versatile microfluidics platform to bring the clinical laboratory to the bedside. Our sensors are designed with modular biological target detection in mind and have already been used to measure antibody response to COVID-19 and its variants, immune response to *Staphylococcus aureus* infection, and serum biomarkers implicated in cardiovascular disease. Phlotonics, Inc. is looking to expand its network for investment partners, business development and device deployment.

DJS@phlotonics.com | 585-340-7179

Caitlin Dreisbach, PhD, RN **University of Rochester**

Caitlin Dreisbach, PhD, RN, is an Assistant Professor at the University of Rochester School of Nursing and the Goergen Institute for Data Science. Her research focus is on the use of quantitative methods to make better clinical assessments during pregnancy. As a former labor and delivery nurse, Dr. Dreisbach is interested in reimagining the current state of technology use during pregnancy to increase the evidence base for clinical guidelines. Dr. Dreisbach is looking for collaborations in, 1) analysis of sensor data (including wearables), 2) integration of deep learning tools in the healthcare setting, and 3) networking in the startup space.

Caitlin_dreisbach@urmc.rochester.edu

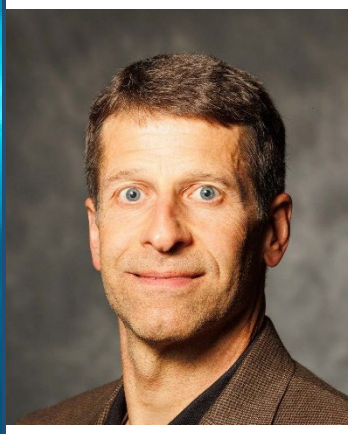
University Technology Showcase Speakers

Harry Bronson was first elected to the New York State Assembly in November 2010. The 138th District includes parts of the City of Rochester and the suburban and rural towns of Henrietta and Chili. Before being elected to the state Assembly, he served in the Monroe County Legislature and held leadership positions during his entire tenure, including Minority Leader. As the Chair of the Assembly Standing Committee on Economic Development, Job Creation, Commerce and Industry, Harry oversees economic development and business regulation throughout New York State. Additionally, he is the Assembly's Legislative Liaison to the Finger Lakes Regional Economic Development Council (FLREDC).

Matt Hurlbutt is President and Chief Executive Officer at Greater Rochester Enterprise (GRE). Matt has responsibility for supporting business attraction and expansion in the Greater Rochester, New York region. Matt guides business development strategies, organizational resources and outreach efforts to position Rochester as a destination of choice for business investment. Matt works directly with corporate executives and national site selectors as they consider locations for investment and job creation. Before assuming this leadership role Matt served as GRE's executive vice president and chief operating officer for nine years. Matt was directly involved in bringing Alpina Foods, Catalant Technologies, FedEx Freight, Foundation Financial Group, Intrinsiq Materials, LiveTiles, Love Beets USA, Muller Quaker Dairy, NEST iON, OFD Foods, Omni-ID, and Quintel Solutions to the region. He also worked with American Packaging Corporation, Brand Networks, Concentrix, IEC Electronics, Intergrow, LiDestri Food & Drink, Maximus, Optimax, and Rochester Precision Optics as the companies expanded in the region.

Chris Zeltmann is Regional Director of U.S. Senator Charles E. Schumer's Rochester Finger Lakes Office. Chris directs and manages the Senator's office activity within the nine-county Rochester Finger Lakes region and provides federal support and attention to constituents, municipalities, community and economic organizations in the region. Acting as an essential link between the region and Senator Schumer's New York City and Washington DC offices, the Rochester office performs constituent services, organizes official events, maintains relationships with local officials, and addresses vital regional issues.

Laura Fox O'Sullivan is the Director of Empire State Development's Finger Lakes Regional Office and the Executive Director of The Finger Lakes Regional Economic Development Council. Prior to joining Empire State Development, Laura served as the President of the region's first food business incubator, The Commissary, and as Vice President of the Rochester Downtown Development Corporation. As an urban planner and native Rochestarian, Laura has keen interest in working to facilitate this region's economic development.



Karl Hirschman is the Micron Professor of Microelectronic Engineering in the Electrical & Microelectronic Engineering Department at the Rochester Institute of Technology. He received his Ph.D. degree in Electrical Engineering in 2000 from the University of Rochester, and has published over 80 technical papers in refereed journals and conference proceedings. He has been teaching courses in semiconductor devices and processes at RIT for over 25 years, and is now serving as the director of microelectronic engineering programs.

Eric Bohannon joined AMD in February of 2022 as a PMTS Silicon Design Engineer. As a member of the Circuit Technologies team, he works on Integrated Voltage Regulator (IVR) technology. Prior to joining AMD, Eric worked at Sony Corporation where he focused on pixel design for quantum film image sensors and high dynamic range (HDR) analog front ends for machine vision applications. From 2010 to 2018, he worked at Synaptics Incorporated where he focused on architecting high dynamic range analog front ends to sense capacitive touch, capacitive fingerprint, and optical fingerprint. Eric played a key role in pioneering the integration of touch and display technology at Synaptics. He holds over 25 U.S. patents and received his B.S./M.S. and PhD degrees from the Rochester Institute of Technology (RIT) in 2007 and 2011, respectively.

TECHNOLOGY SUPPORTERS

Ain Center for Entrepreneurship / Technical Entrepreneurship and Management (TEAM) M.S. Program

Center for Integrated Research Computing (CIRC)

Finger Lakes Community College Smart Systems Technologies

FLX AI, Inc.

Goergen Institute for Data Science

Monroe County Finger Lakes APEX Accelerator

NextCorps

New York State Science & Technology Law Center (NYS STLC) at Syracuse University College of Law

Photonics, Inc.

URVentures

AUGMENTED REALITY/VIRTUAL REALITY (1 - 5)

1 Metagrating in-coupler meets the geometry-based efficiency limit for AR waveguides

Jeremy Goodsell, Pei Xiong, Daniel K. Nikolov, Nick Vamivakas, Jannick P. Rolland
University of Rochester, Rochester, NY

Waveguide combiners for augmented reality (AR) provide a pathway to expanding the eyebox provided a given field of view at the expense of light efficiency. In this work, we show that the geometry of a waveguide sets a fundamental limit on how efficient the combiner can be. Using this limit as a benchmark, we design two in-couplers, one using a metasurface-based grating (metagrating) and another using a conventional surface relief grating (SRG). We compare these two gratings because SRGs are commonly used as couplers in waveguide combiners and are useful as a secondary benchmark. Thus, we compare the in-coupling efficiency for each in-coupler against each other and the fundamental limit. Results show that the metagrating's 28% efficiency surpasses the SRG's 20% efficiency and nearly matches the geometry-based fundamental limit of 29%. The superior angular response control of metasurfaces compared to SRGs helps explain this finding. This work provides a new understanding of the efficiency limit of waveguide-based combiners and paves a novel path toward implementing metasurfaces in efficient waveguide AR displays.

2 AR/VR-based STEM and Vocational Training Education

Qinqin Xiao
University of Rochester, Rochester, NY

The rapid advancement of emerging technologies such as Artificial Intelligence, Robotics, and Automation has revolutionized the modern society. However, integrating these technologies into K-12 STEM education and workforce development programs has posed significant challenges. This research focuses on utilizing cognitive learning theories and methods of learning science to support effective learning of emerging technologies. The two central research questions addressed in this study are the identification and reduction of barriers to learning emerging technologies and the incorporation of learning science theories with technical enablers to facilitate effective learning. The study explores the intersection of learning science with areas such as Human-Computer Interaction, AI, data science, and Robotics. The research efforts have resulted in new systems and methods that help K-12 learners understand machine learning and data science concepts through visualization and interaction design, Augmented/Virtual Reality, and optics. The study also includes the development of an AR-based Human-Robot-Interaction (HRI) interface and a Virtual Reality

(VR)-based machinist training system that uses cognitive load management to train novice workers in error management. The proposed interface has been tested through user studies, which confirmed its efficiency and effectiveness. Overall, the research aim is to reduce the gap between the demand and supply of engineers and workers skilled in emerging technologies, ultimately contributing to the development of a technologically advanced society.

3 AR/VR-based STEM and Vocational Training Education

Qinqin Xiao
University of Rochester, Rochester, NY

The rapid development of emerging technologies such as Artificial Intelligence (AI), Robotics, and automation has brought numerous benefits to human society. However, these advancements have also created challenges for K-12 STEM education and adult workforce development in the United States. The complexity of these technologies has made it difficult to effectively integrate them into current curriculums, leading to a potential gap in the supply and demand of engineers and workers in the future. To address this issue, this research focuses on applying learn science and cognition theories to support the learning of emerging technologies in both K-12 STEM education and workforce development. Two central research questions are posed: how can we understand the barriers in learning emerging technologies, and how can we incorporate theories and methods of learning science with technical enablers to support more effective learning?

4 HRTF Field: Unifying Measured HRTF Magnitude Representation with Neural Fields

You Zhang, Yuxiang Wang, Zhiyao Duan
University of Rochester, Rochester, NY

Head-related transfer functions (HRTFs) are a set of functions describing the spatial filtering effect of the outer ear (i.e., torso, head, and pinnae) onto sound sources at different azimuth and elevation angles. They are widely used in spatial audio rendering. While the azimuth and elevation angles are intrinsically continuous, measured HRTFs in existing datasets employ different spatial sampling schemes, making it difficult to model HRTFs across datasets. In this work, we propose to use neural fields, a differentiable representation of functions through neural networks, to model HRTFs with arbitrary spatial sampling schemes. Such representation is unified across datasets with different spatial sampling schemes. HRTFs for arbitrary azimuth and elevation angles can be derived from this representation. We further introduce a generative model named HRTF field to learn the latent space of the HRTF neural fields across subjects. We demonstrate promising performance on HRTF interpolation and generation tasks and point out potential future work.

5 Predicting Global Head-Related Transfer Functions From Scanned Head Geometry Using Deep Learning and Compact Representations

Yuxiang Wang, You Zhang, Zhiyao Duan, Mark Bocko
University of Rochester, Rochester, NY

We present a Head-Related Transfer Function (HRTF) personalization method employing convolutional neural networks (CNN) to predict a subject's HRTFs for all directions from their scanned head geometry. To ease the training of the CNN models, we propose novel pre-processing methods for both the head scans and HRTF data to achieve compact representations. For the head scan, we use truncated spherical cap harmonic (SCH) coefficients to represent the pinna area, which is essential in the acoustic scattering process. For the HRTF data, we use truncated spherical harmonic (SH) coefficients to represent the HRTF magnitudes and onsets. One CNN model is trained to predict the SH coefficients of the HRTF magnitudes from the SCH coefficients of the scanned ear geometry and other anthropometric measurements of the head. Combining the magnitude and onset predictions, our method is able to predict the complete and global HRTF data. A leave-one-out validation with the log-spectral distortion (LSD) metric is used for objective evaluation. The results show a decent LSD level at both spatial & temporal dimensions compared to the ground-truth HRTFs and a lower LSD than the boundary element method (BEM) simulation of HRTFs that the database provides.

BIOMEDICAL TECHNOLOGY (6 – 7)

6 Aiding intraoperative recognition of peripheral nerves with Multispectral polarization imaging

Haolin Liao, Wayne H. Knox, David J. Mitten, Gregory Heyworth
University of Rochester, Rochester, NY

The peripheral nerves are important parts of the human nerve system, and it is crucial to keep the integrity and functioning of the peripheral nerve system during and after operations. Here we introduce an effective intraoperative nerve identifying device that can be an aid to the pre-surgery imaging and the clinical experience of the surgeon in avoiding accidental nerve injury. Using colored LEDs as the light sources, the system consists of a pair of orthogonally placed linear polarizers and a driving motor that can rotate the polarizers at a constant speed of 160 rpm. Due to the polarization angle sensitive reflective intensity under the rotating crossed-linear polarization (XPI) system, the periodically varying reflective intensities of tissues can be extracted from the video frames. By performing lock-in processing, the AC component of the periodical signal of different types of tissues in the chicken thigh is acquired and the sciatic nerve is distinct for automatic identification. In both

chicken thigh models and cadaver arms, the nerve tissues are successfully highlighted in the lock-in processed output image. In conclusion, the rotating XPI system with advanced processing methods can serve as an automatic nerve identification aid.

7 Predictive Maintenance for Fault Detection and Diagnosis of VITROSTM Immunoassay analyzers with Big Data Analytics

Siladitya Khan, Matthew Tice, Ajay Anand, and Stephen A McAleavey
University of Rochester, Rochester, NY

We propose to develop a "predictive maintenance" (PdM) framework with a suite of machine learning algorithms that will leverage available historical data to forecast, detect, and stage machine state of OCDx analyzers in health and failure. The complete framework of data ingestion from "e-connected" analyzers (that routinely stream back to OCDx data servers), to final failure mode prediction will be performed over OCDX provisioned cloud infrastructure, leveraging state-of-art tools for Big Data analytics. Specifically, we propose to develop and deploy an automated classification algorithm for existing fault-codes, a time-series forecasting model for predicting future occurrences of severe error codes and models for assessing remaining useful life (RUL). Finally, a state-of-art deep autoencoder network for anomaly detection will be developed from maintenance data of serviced whole blood analyzers in the field with unlabeled fault code triggers.

DATA SCIENCE (8 – 10)

8 Nextgen Wind and Water Turbines

Ronald J Hunt

The intersection of Enlightened Engineering and Enlightened Entrepreneurship. Green Tornado Wind and Water Turbines:
Solves Global Warming while saving 💰for Utilities
Solves Global Warming while saving 💰for Industry
Solves Global Warming while saving 💰for Consumers
Solves Global Warming while saving 🦅, 🐋, 🐬's

9 Adversarial Discriminative Domain Adaptation and Transformers for EEG-based Cross-Subject Emotion Recognition

Shadi Sartipi, 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). In this work, we propose a combination of using transformers (TF) and adversarial discriminative domain adaptation (ADDA) to perform the emotion recognition task in a cross-subject manner. Our proposed approach performs scale-dot product attention on the feature-channel aspect of EEG data to improve the spatial features. Then, the temporal transforming is applied to get the global discriminative representations from the time component. Moreover, ADDA aims to minimize the discrepancy of EEG data from various subjects.

10 A Whac-A-Mole Dilemma: Shortcuts Come in Multiples Where Mitigating One Amplifies Others

Zhiheng Li, Ivan Evtimov, Albert Gordo, Caner Hazirbas, Tal Hassner, Cristian Canton Ferrer, Chenliang Xu, Mark Ibrahim
University of Rochester, Rochester, NY

Machine learning models have been found to learn shortcuts---unintended decision rules that are unable to generalize---undermining models' reliability. Previous works address this problem under the tenuous assumption that only a single shortcut exists in the training data. Real-world images are rife with multiple visual cues from background to texture. Key to advancing the reliability of vision systems is understanding whether existing methods can overcome multiple shortcuts or struggle in a Whac-A-Mole game, i.e., where mitigating one shortcut amplifies reliance on others. To address this shortcoming, we propose two benchmarks: 1) UrbanCars, a dataset with precisely controlled spurious cues, and 2) ImageNet-W, an evaluation set based on ImageNet for watermark, a shortcut we discovered affects nearly every modern vision model. Along with texture and background, ImageNet-W allows us to study multiple shortcuts emerging from training on natural images. We find computer vision models, including large foundation models---regardless of training set, architecture, and supervision---struggle when multiple shortcuts are present. Even methods explicitly designed to combat shortcuts struggle in a Whac-A-Mole dilemma. To tackle this challenge, we propose Last Layer Ensemble, a simple-yet-effective method to mitigate multiple shortcuts without Whac-A-Mole behavior. Our results surface multi-shortcut mitigation as an overlooked challenge critical to advancing the reliability of vision systems motion recognition based on electroencephalography (EEG) signals has been receiving significant attention in the domains of affective computing and brain-computer interfaces (BCI). In this work, we propose a combination of using transformers (TF) and adversarial discriminative domain adaptation (ADDA) to perform the emotion recognition task in a cross-subject manner. Our proposed approach performs scale-dot product attention on the feature-channel aspect of EEG data to improve the spatial features. Then, the temporal transforming is applied to get the global discriminative representations from the time

component. Moreover, ADDA aims to minimize the discrepancy of EEG data from various subjects.

OPTICS, PHOTONICS, IMAGING (11 – 18)

11 Disposable Photonics: Engineering Light for Triage at the Point-of-Care

Daniel J. Steiner, Michael R. Bryan, Benjamin L. Miller
University of Rochester, Rochester, NY

Photonic devices are ubiquitous in the telecommunications industry, augmented and virtual reality, and data processing. These devices have reduced Size, Weight, and Power (SWAP) requirements, are unaffected by electromagnetic noise and are produced commercially in high volumes using standard semiconductor foundry processes. The previously listed characteristics, in addition to the sensitivity of the fundamental photonic mode to environmental influence, makes photonic integrated circuits an attractive technology for biomedical diagnostics devices. Phlotonics, Inc. is commercializing a technical approach developed by a consortium of academic, industrial, and DoD laboratory researchers to overcome critical engineering challenges associated with deploying photonic sensors at the Point-of-Care (POC). These challenges include sensor design and footprint, fabrication, activation and functionalization at scale, alignment and input/output reader development, and spectral signal interrogation and analysis. Each of these subsystems is critical for the successful deployment of photonic technology as a diagnostic tool to improve patient outcomes and reduce strain on healthcare systems.

12 IGZO TFT Backplane Integration for µLED Flat-Panel Display

Eli Powell
Rochester Institute of Technology, Rochester, NY; Tyndall National Institute, Cork Ireland & Corning, Inc., Corning, NY

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.

13 Mechanical Design at the Laboratory for Laser Energetics

Ethan D Burnham-Fay
University of Rochester, Rochester, NY

The unique systems employed at the LLE require specialized mechanical design solutions. Recent design challenges and solutions are discussed, including cryogenic target design and deployment, calorimeter operation, and the FLUX laser system.

14 On Vision Transformers and Convolutional Networks for Domain Adaptation

Georgi Thomas, Rajat Sahay, Mihir Manjrekar, Andreas Savakis
Rochester Institute of Technology, Rochester, NY

Unsupervised domain adaptation (UDA) has emerged as a promising technique to address the challenge of limited labeled data in computer vision. UDA uses unlabeled data from a target domain to adapt a model trained on a source domain with labeled data. In this work, we use the Source HypOthesis Transfer (SHOT) framework for UDA. SHOT leverages the information learned in the source domain to align the image features in the target domain. The de facto feature extraction method in domain adaptation and deep learning vision tasks has been Convolutional Neural Networks (CNN). In recent years, a new architecture known as Vision Transformers has grown in popularity. We benchmark vision transformers and convolutional architectures on domain generalization and adaptation tasks. We find that vision transformers, and attention-based architectures in general, perform better compared to traditional convolutional architectures.

15 Advanced Autocorrelation Estimators for Shear Wave Elastography

Hamidreza Asemani, Jannick P. Rolland, Kevin J. Parker
University of Rochester, Rochester, NY

Shear wave elastography has become increasingly popular in medical imaging due to its ability to visualize shear wave speed with high resolution. However, accurately measuring shear wave speed in elastography scans can be challenging. In this study, we explore the use of advanced autocorrelation estimators for shear wave speed estimation. We examine the

effectiveness of these estimators using k-wave simulation, and then evaluate their performance in ultrasound elastography and OCE scans. Our findings suggest that using advanced autocorrelation estimators provides a promising approach for accurate and efficient shear wave speed estimation in medical imaging applications.

16 Modeling the temperature distribution inside hydrogels during LIRIC using a moving hot spot approximation

Javier Berjon de la Parra
University of Rochester, Rochester, NY

Laser-induced refractive index change (LIRIC) is a technique used to modify ophthalmic materials through multiphoton processes. A successful photochemical model exists that describes this femtosecond micromachining process at low and mid intensities. However, at higher laser intensities approaching the damage threshold of the ophthalmic material, the model cannot accurately describe the process. It seems that thermal accumulation becomes a driving factor for damage at this point, and therefore a model for the temperature distribution during micromachining is needed. In this poster, we present our work on a temperature model of the micromachining spot derived from the standard heat equation, along with experimental setups that in future research should help corroborate our calculations. Our model estimates that the ophthalmic materials undergo fast temperature changes that easily exceed 100°C, supporting the notion that thermal effects are a leading cause of damage to the material.

17 Disposable Photonics Platform for Antibody Detection in Humans

Jordan Butt, Michael R Bryan, Benjamin L Miller
University of Rochester, Rochester, NY

The COVID-19 pandemic has demonstrated a need for low-cost, efficient, and effective diagnostics that detect biomarkers in individuals to determine immunity. As new variants of COVID emerge, it is important to be able to assess how preexisting immunity provides protection going forward. Photonics-based diagnostics represent one potential low-cost solution that can take advantage of a versatile process in fabrication and design of silicon-based photonic sensors, enabling an accurate and low-cost sensor for clinical use. Beyond the optical and analytical performance of the sensor itself, the development of an optical detection tool in response to a pressing research or diagnostic need requires consideration of a host of additional factors. A multiplex photonic sensor system has been developed for measuring immunity to different variants of COVID-19 simultaneously. This method focuses on enabling a low-cost and high-speed sensor that uses a small (1 x 4 mm) ring resonator photonic chip embedded in a plastic card able to provide passive transport of human samples. This “disposable photonics” platform is able to detect binding between anti-COVID

antibodies in a human sample and spike proteins of various COVID variants in minutes, making it attractive for high-throughput testing applications as a disposable point-of-care diagnostic tool.

18 Subarray Design and Thermal Crosstalk Optimization for Power-Efficient Optical Phased Array

Wuxiucheng Wang, Lejie Lu, Lydia King, Yongchao Liu, Ming Gong, Shuangyang Li, and Hui Wu
University of Rochester, Rochester, NY

We propose to address thermal crosstalk in integrated optical phased arrays by circuit design and array control. A silicon photonic chip prototype demonstrates that subarray design and thermal crosstalk optimization reduces power consumption by 38%.

SENSORS, ACOUSTICS, MATERIALS (19)

19 Interacting with Smart Audio Devices Using Induced Structural Vibrations

Tre DiPassio, Michael C. Heilemann, Mark F. Bocko
University of Rochester, Rochester, NY

Smart audio devices have risen to prominence in the last decade as advances in on-device and cloud computing have enhanced their reliability and scope. While developments in display technology have enabled a trend of compactness among recent electronics, a form factor trade-off persists in these devices where high-quality audio reproduction is a functional priority. This work investigates a method for simultaneously recording and reproducing sound using induced vibrations on flat panels, such that a duplex audio interface can be embedded on the screen of a device itself by affixing structural sensors and actuators. The intelligibility of speech recorded by structural sensors affixed to panel surfaces is measured using the speech transmission index. A word error rate metric is introduced to assess the reliability with which an automatic speech recognition system can transcribe the recordings made in this manner. Methods for crosstalk cancellation are developed for situations when the proposed interface is simultaneously recording and reproducing sound.