2025 Finger Lakes Science & Technology Showcase

April 24, 2025

at the Memorial Art Gallery

Computing in the Age of AI

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

WELCOME

Welcome to the 2025 Finger Lakes Science & 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 and artificial Intelligence (AI), at the University of Rochester. With support from New York State, our centers encourage and support industry - university collaboration and technology transfer to create economic growth in New York State. Industry and University representatives working on a wide range of technology areas will be represented this year, including data science and AI, optics, imaging, photonics, sensors, biomedical technologies, acoustics, materials, and others.

The day begins with an AR/VR Mini-Symposium featuring speakers from industry and academia presenting some of the latest developments and applications in augmented and virtual reality. Following the AR/VR session, there will be short presentations and a panel discussion on the future of computing in the age of Artificial Intelligence with panelists from L3Harris, SUNY Buffalo, and the University of Rochester. This will be followed by the presentation of our Partner Appreciation awards, lunch and a business-university networking session. To wrap up the day, there will be a poster session featuring research from area schools followed by the presentation of best posters awards (people's choice, so be sure to vote!) and a networking reception.

We hope that you enjoy spending the day in the beautiful surroundings of the Memorial Art Gallery and use this opportunity to make new connections that we hope will contribute to regional economic expansion and job growth.

Both CEIS and the CoE in Data Science and AI provide NYS matching funds for company-sponsored research at NYS universities and the CoE also funds student internships at small companies and startups across 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 & AI can help your enterprise to thrive and grow.

Warm Regards,

Mark Bocko, PhD
Director, Center for Emerging & Innovative Sciences

Mujdat Cetin, PhD
Director, COE in Data Science and AI

How are we doing?

Your feedback is important to us.

Please take a moment to scan the QR code to complete our event survey.

Agenda

8:00 AM - 1:00 PM	Registration
8:30 AM - 10:00 AM	Western New York AR/VR Mini-Symposium Presenters: Karl M. Guttag; Mark F. Bocko; Raffaella Borasi
10:00 AM - 10:15 AM	Break
10:15 AM - 10:30 AM	Welcome Remarks
10:30 AM - 12:00 PM	Panel Session & Partner Appreciation Awards Invited Panelists: Bernard Brower – Fellow, AI Chief Architect (L3Harris Technologies Space & Airborne Systems); Venu Govindaraju – Distinguished Professor and Vice President for Research and Economic Development (University of Buffalo); Christopher Kanan – Associate Professor of Computer Science (University of Rochester); Brendan Mort - Director, Center for Integrated Research Computing and Associate Professor of Chemistry (University of Rochester)
12:00 PM - 1:00 PM	Lunch
1:00 PM - 2:30 PM	Business/Faculty Networking Pitches
2:30 PM - 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)*
4:00 PM - 6:00 PM	Networking reception

Western NY Mini-Symposium on AR/VR

April 24, 2025

8:00 AM Registration desk open

8:30-10:00 AM AR/VR Mini-Symposium (Memorial Art Gallery Auditorium)
Symposium Co-Coordinators: Anis Idrizovic, Yamin Zheng, and Neil Zhang

8:30-8:50 AM Karl M. Guttag, President, KGOnTech
"Optical See Through (OST) AR Optics Tradeoffs"

8:50-9:20 AM Mark Bocko, Distinguished Professor of Electrical & Computer Engineering; Director, Center for Emerging and Innovative Sciences (CEIS)
"Designing Sonic Experiences for Immersive Media"

9:20-9:45 AM Raffaella Borasi, Frederica Warner Professor; Director, Center for Learning in the Digital Age, Warner School of Education
"What can make an AR/VR application to education more valuable?"

9:45-10:00 AM Lightning Talks – PhD NRT Trainees and Grad Students: Nicholas Otumi, Atma Anand, and Linh Tran

You are welcome to join CEIS and CoE
for their program beginning at 10:15 AM

Karl M. Guttag
President
KGOnTech
www.kguttag.com

KGOnTech
© 2011-2025 KGOnTech www.kguttag.com

Karl Guttag has 43 years of experience in the areas of display devices (LCOS and DLP) and systems including Heads Up Displays (HUD) and Near-Eye Display (augmented reality and virtual reality), Graphics and Image Processors/Co-processors, Digital Signal Processing (DSP), memory architecture, and CPU architecture and consumer video devices. Mr. Guttag holds a bachelor's degree in electrical engineering from Bradley University and a master's in electrical engineering from the University of Michigan. He worked as a fellow at Texas Instruments and served as a leader of multiple display companies: he was the CTO of Silicon Display Incorporated, Syndiant, Navdy, and the CEO of iTreatR Inc. and Ravn. Since 2011, he has written the technical blog KG On Technology (www.kguttag.com). KGOnTech is a leading source of technical information on the microdisplays (LCOS, DLP, Laser Scanning, OLED, and MicroLED), small projectors, Augmented Reality Headsets, and Heads Up Displays for Automotive use. Over 20,000 people have read articles in KGOnTech in a single month. He is named inventor on 150 issued U.S. Patents, including key patents related to display devices, graphics/ imaging processors, graphics interface circuits, microprocessors, signal processing (DSP), Synchronous DRAMs, and Video/Graphics DRAM. Billions of dollars of revenue have been attributed to products using these inventions.

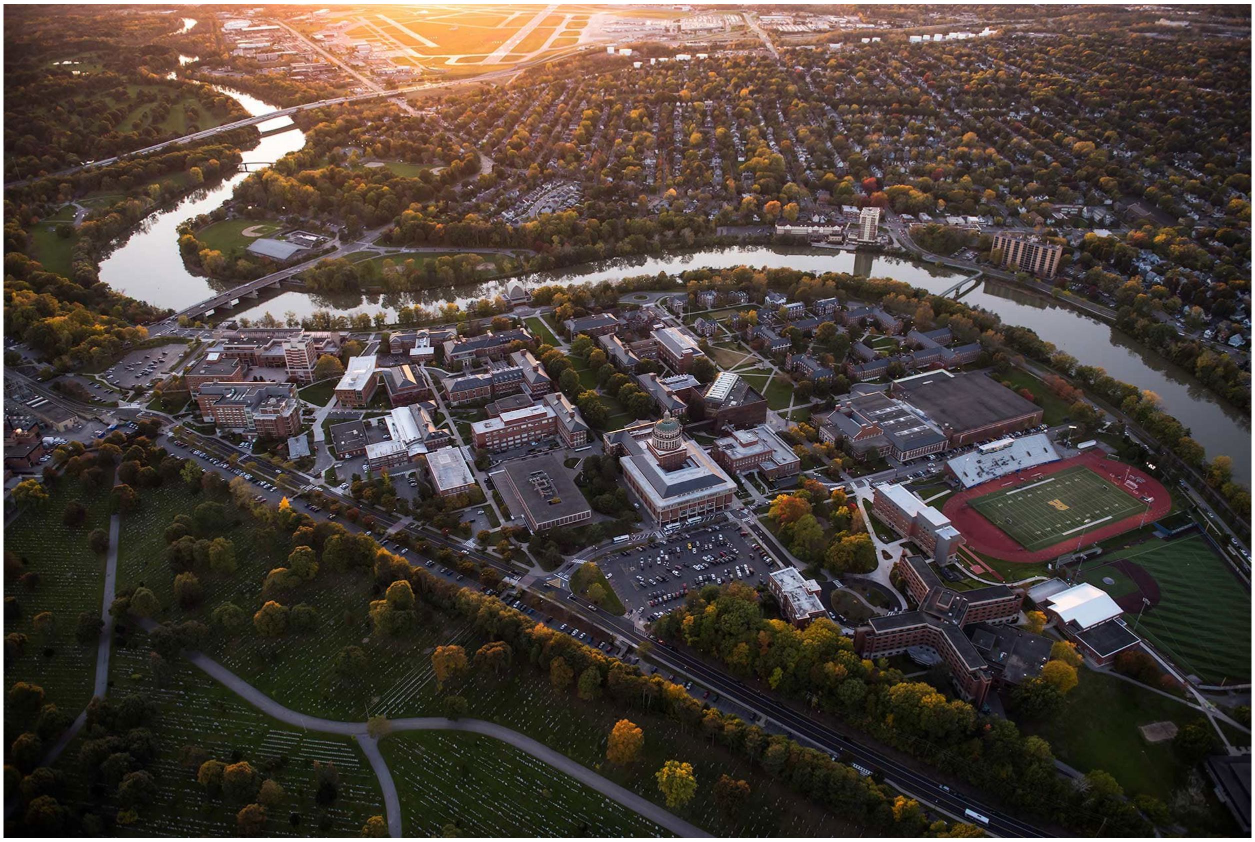
Mark Bocko
Distinguished Professor of Electrical and Computer Engineering
Director, Center for Emerging & Innovative Sciences (CEIS)
University of Rochester
mark.bocko@rochester.edu

Mark Bocko earned his PhD in Physics from the University of Rochester in 1984 with research in the field of gravitational wave detectors and the quantum limits of weak force detection in the group of David H. Douglass. After a brief post-doctoral appointment in the same laboratory, he joined the Rochester ECE department in 1985. His research has spanned multiple areas with its current focus on audio and acoustic signal processing. Previous research has been in the areas of electromechanical transducers, image sensors, non-contact ECG sensors, low-noise electronics, digital superconducting electronics, quantum coherent electronics, quantum computing, and quantum noise. He is also the Director of the Center for Emerging and Innovative Sciences (CEIS), a NYSTAR-supported Center for Advanced Technology at the University of Rochester with the mission of promoting economic development through joint university-industry research and technology development. Professor Bocko has taught courses on solid state devices, microwaves, circuits and systems, audio signal processing, and acoustics. He won five teaching awards at the University of Rochester and was named the Mercer Brugler Distinguished Teaching Professor at the University from 2008 to 2011. He was named Distinguished Professor of Electrical and Computer Engineering in 2013 and served as Chair of the ECE Department from 2004-2010 and again from 2012-2015.

Raffaella Borasi

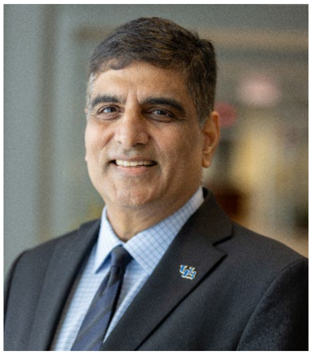
Frederica Warner Professor,
Director, Center for Learning in the Digital Age
Warner School of Education
University of Rochester
rborasi@warner.rochester.edu

Raffaella Borasi served as dean of the Warner School from 2001 to 2018. Under her leadership, the Warner School experienced significant growth, more than doubling student enrollment and research funding. A math educator by training, she has taken leadership roles in several National Science Foundation (NSF)-funded grants (for a total of over $9 million), spearheaded the launch of online courses and programs at Warner as well as the creation of programs to prepare online teachers, and has been the driving force behind the 2013 opening of Raymond F. LeChase Hall, the new state-of-the-art facility that houses the Warner School on River Campus. Most recently, she was instrumental in forging the University of Rochester's new partnership with East High School. Borasi, who joined the Warner School faculty in 1985, has roots as a mathematics educator with special interests in an inquiry approach to teaching mathematics, school mathematics reform, professional development, and teacher education. She has degrees in mathematics and education from the University of Torino (Italy) and was a Fulbright Student at the State University of New York – University Buffalo, where she received her PhD in mathematics education. She has worked on several research projects funded by the NSF to improve mathematics instruction, including most recently four Robert Noyce projects to increase the number and quality of STEM teachers. She has published more than 40 articles in national and international journals and is the author/co-author of four books: *Learning Mathematics Through Inquiry* (1992); *Reconceiving Mathematics Instruction: A Focus on Errors* (1996); *Reading Counts: Expanding the Role of Reading in Mathematics Classrooms* (2000); and *Blogging as Change: Transforming Science and Math Education Through New Media Literacies* (2011). Borasi also co-authored an NSF-commissioned monograph, *Professional Development that Supports School Mathematics Reform* (2002), which was widely circulated by the NSF to school systems across the nation as a blueprint for successful school mathematics reform through professional development. Her current research and teaching interests are in the areas of entrepreneurship in education and online teaching and learning. Borasi continues her work in school reform, entrepreneurship in education, and learning in the digital age, and now serves as the founding director of the Center for Learning in the Digital Age. She also continues to teach in the teacher preparation and doctoral programs.



Finger Lakes Science & Technology Showcase Panelists

Bernard Brower has over 35 years of experience in space and airborne applications focused on imaging and data analytics. He has over 30 publications and 9 patents. As the AI Chief Architect, Bernie is leading the AI Strategic Initiative Space and Airborne Systems. This strategic initiative includes a coordinated development of AI capability that spans Intelligent space, Cyber, autonomous systems, Cognitive Electronic warfare, data analytics, and aviation safety. Developing technology roadmaps on how to leverage the most recent Advances in AI Technology like Convolutional Neural Networks (CNN), Large Language Models (LLMs), Knowledge Graphs, explainable AI (XAI) and Graphical Neural Networks (GNN). This strategic Initiative includes significant Internal Research and Development, organizational changes, AI training, and University and small business partnerships. As part of this strategy, Bernie has developed the companies Responsible AI Policy and Guidelines. Bernie is part of the team that reviews AI companies for our partnership with Shield Capital Venture Investment fund and is overseeing multiple partnerships with startup AI companies. Bernie is co-chairing the Corporate wide Technical Network on Artificial Intelligence and Autonomous Systems. This group helps defines the technology trends and disruptors that will impact the company. This group also coordinates internal Technical Exchange meetings between internal groups, external groups, universities, and startups on AI Technology.



Venu Govindaraju is Distinguished Professor and Vice President for Research and Economic Development at the University at Buffalo, State University of New York. With a prolific career spanning over three decades, Dr. Govindaraju has led research projects funded by federal agencies and high-tech companies totaling nearly $100 million, holds six patents, and authored close to 500 refereed scientific papers. He is the principal investigator of the National AI Institute for Exceptional Education at UB, a prestigious $20 million initiative funded by the National Science Foundation and the Institute of Educational Sciences. Dr. Govindaraju is a Fellow of the American Association for the Advancement of Science (AAAS), Association of Computing Machinery (ACM), International Association of Pattern Recognition (IAPR), Institute of Electrical and Electronics Engineers (IEEE), and National Academy of Inventors. In 2024, he received the University at Buffalo President’s Medal; as well, he was named Person of the Year by the Council of Heritage and Arts of India for his contributions to AI.

Christopher Kanan is an Associate Professor of Computer Science at the University of Rochester, leading the Hajim School of Engineering & Applied Sciences' AI Initiative. Chris holds secondary appointments in Brain and Cognitive Sciences, The Goergen Institute for Data Science and AI (GIDS-AI), and The Center for Visual Science. With over 20 years of experience in artificial intelligence, his research focuses on developing deep learning systems that advance the foundational capabilities necessary for artificial general intelligence (AGI). This work spans deep continual learning, multi-modal scene understanding, visual question answering, self-supervised learning, medical computer vision (pathology and radiology), semantic segmentation, object recognition, active vision, object tracking, and more. From 2018 to 2022, Chris served as an executive leader at Paige.AI, where he spearheaded AI research that led to Paige Prostate—the first FDA-cleared AI system in pathology. He played a key role in scaling Paige from a small start-up to a company with over 180 employees and led its patent initiative, earning 60+ granted patents. Previously, he was an Associate Professor in the Carlson Center for Imaging Science at the Rochester Institute of Technology (RIT). At RIT, Chris co-founded the Center for Human-aware AI (CHAI). He was also a member of RIT's McNair Scholars Advisory Board, part of RIT's Division of Diversity and Inclusion. From 2019 – 2022, he was a visiting professor at Cornell Tech in New York City, where he taught a course on Deep Learning for four years to about 100 graduate students annually. Chris received his PhD from UC San Diego (UCSD), was a postdoctoral scholar at Caltech, and worked as a scientist at NASA JPL.

Brendan Mort is the Director of the Center for Integrated Research Computing (CIRC), which provides researchers with hardware, software, training, and support necessary to utilize computational science and big data computing technology in research activities in all areas of academic scholarship. Brendan is responsible for managing a staff of computational scientists, programmers, and system administrators who oversee the identification, development, deployment, and maintenance of computational tools and methods for modeling, analyzing, and visualizing computer-driven research projects. CIRC hosts a symposium series where faculty and students showcase their research to the University community, learn about the application of computing technology to research problems, and participate in discussions that lead to collaborative opportunities. The Center's expertise, consultation services, collaboration, and community building activities are essential for facilitating the research mission of the University. Brendan received a Ph.D. in computational chemistry from the University at Buffalo, where he was a National Defense Science and Engineering Graduate Fellow. His personal expertise is focused on the use of high performance computing and big data technologies for analyzing chemical and biological systems. As a member of the faculty in the Chemistry Department, his research interests have led to collaborations in the exploration of simulations for the elucidation of structure-function relationships in biomolecular systems and the development of accurate methods for the calculation of molecular response properties.

Finger Lakes Science and Technology Showcase
2024 Partner Appreciation Award

CoE Recipient - Peter Soufleris, IngenID

Peter Soufleris is a University of Rochester alumnus and the CEO and Founder of IngenID, a Rochester-based company delivering advanced voice and biometric authentication solutions across 13+ countries and more than 40 languages. A serial entrepreneur and technologist with over 25 years of experience, Soufleris has led the development of scalable identity verification platforms that address emerging challenges such as deepfake detection and secure, frictionless authentication.

IngenID has been a model partner for the Center of Excellence in Data Science and Artificial Intelligence, with roots in a collaboration between Dr. Zhiyao Duan and Soufleris' other company, Voice Biometrics Group. That initial partnership included internships and advanced research projects with Duan's doctoral students, eventually leading to a successful joint application for a Center of Excellence research grant.

IngenID has since deepened its commitment by adding additional students through the CoE Summer Internship Program. Soufleris has been a strong ambassador for the program—participating in testimonial videos, commitment to headquartering this company in New York State, hiring students to continue beyond the internship period, and actively promoting the CoE partnerships to other companies.

CEIS Recipient – Karl Hirschman, Rochester Institute of Technology

Karl Hirschman is a Professor in the Department of Electrical and Microelectronic Engineering in the Kate Gleason College of Engineering at the Rochester Institute of Technology. Dr. Hirschman is also the Associate Department Head of Microelectronic Engineering and has been the faculty director of the Semiconductor Nanofabrication Laboratory since 2001. Karl received his B.S. in Microelectronic Engineering and the M.S. in Electrical Engineering from RIT. He received the Ph.D. degree in Electrical Engineering from the University of Rochester.

Dr. Hirschman has published over 50 technical papers in refereed journals and conference proceedings. He is an active member in the IEEE, Materials Research Society and Society of Information Display. Karl has served as an officer of the Rochester IEEE Electron Device Society for the last fifteen years, and he coordinates the IEEE Annual Electron Device Society Conference in Western NY. He teaches courses at RIT in process and device technology ranging from undergraduate freshman to graduate level. His current research activities are in silicon and metal-oxide thin-film electronics.

Over the past 20 years Karl has been one of the leading principal investigators funded by CEIS. He has been awarded five grants for his work with Corning on thin film transistors and micro LED displays on glass. His repeated research contracts with Corning, which is one of CEIS's leading partners, testify to the quality of his work and the economic impact it has generated.

Finger Lakes Science & Technology Showcase Networking/Pitch Event

Ajay Anand, PhD – Professor of Data Science and Deputy Director, Goergen Institute for Data Science and Artificial Intelligence, University of Rochester

ajay.anand@rochester.edu | www.hajim.rochester.edu/dsc

Lori Bajorek – President, National Esports Association

bajorek@msn.com | www.nea.gg

Dimah Dera, PhD - Assistant Professor, Chester F. Carlson Center for Imaging Science, Rochester Institute of Technology

dimah.dera@rit.edu | www.rit.edu/science/chester-f-carlson-center-imaging-science

---

Zhiyao Duan, PhD – Associate Professor, Electrical & Computer Engineering and Computer Science, University of Rochester

zhiyao.duan@rochester.edu | www,hajim.rochester.edu/ece/sites/zduan

---

Larry Dubow – Chief Marketing Officer, Lobaki, Inc.

larry@lobaki.com | www.lobaki.com

Veena Ganeshan, PhD – Senior Instructor and Senior Laboratory Engineer, Biomedical Engineering, University of Rochester

veena.ganeshan@rochester.edu | www.hajim.rochester.edu/bme/people/technical-staff

---

Robert Hill, M.D. – CEO, Harmonigenic Corporation

robert.hill@harmonigenic.com | www.harmonigenic.com

Anis Idrizovic – PhD Student, The Institute of Optics, University of Rochester

aidrizov@ur.rochester.edu

Michael Kaminski – Owner/Founder, Hydrologic Systems, LLC

michael2kaminski@gmail.com

J. Daniel Newman, PhD – Principal Strategy Advisor, Center for Emerging & Innovative Sciences, University of Rochester

j.daniel.newman@rochester.edu

Scott Reardon – President and CTO, D3 Embedded

sreardon@d3embedded.com | www.d3embedded.com

Joseph Sirianni – Associate Director of R&D, Chester F. Carlson Center for Imaging Science and Associate Director of DIRS Laboratory, Rochester Institute of Technology

joseph.sirianni@rit.edu | www.rit.edu/directory/jdscis-joseph-sirianni

---

Peter Soufleris – Founder and CEO, IngenID

peter.soufleris@ingenid.com

Eric Wagner, PhD – Professor, Biochemistry and Biophysics, Co-Director Center for RNA Biology and NYS Center of Excellence in RNA Research & Therapeutics

eric_wagner@urmc.rochester.edu

Mark Wilson – Principal, Neworks, LLC

mark@neworks.biz | www.neworks.biz

Fei Zhang – Postdoctoral Researcher, Jan van Aardt's Lab, Chester F. Carlson Center for Imaging Science, Rochester Institute of Technology

fzhcis@rit.edu

Yunbo Zhang – Assistant Professor, Department of Industrial and Systems Engineering, Kate Gleason College of Engineering, Rochester Institute of Technology

ywzeie@rit.edu | www.rit.edu/directory/ywzeie-yunbo-zhang

Augmented Reality/Virtual Reality (1)

1. **Seeing, Signing, Speaking: XR Solutions for Inclusive and Immersive Language Learning**
   Yamin Zheng

This poster presents the author's experience with XR-based educational projects developed through the NSF-funded PhD Training Program in AR/VR at the University of Rochester. Drawing on an interdisciplinary background in education and immersive technology, the author designed an AR project that helps dual language learners understand STEM concepts using interactive 3D flashcards. The poster also features *CoSignPlay*, a team-developed VR game for ASL learning in which two users collaboratively control an avatar using hand and facial tracking to represent manual and non-manual signs. Additionally, the author discusses learning theories that inform AR/VR design for language learning. Grounded in embodied cognition and social constructivism, these projects showcase the potential of XR for inclusive, immersive language education.

Biomedical Technology (2-4)

2. **Noninvasive Bone Health Assessment via In Vivo Raman Spectroscopy and Machine Learning**
   Mohammad Hosseini

This research presents a novel approach to bone health diagnostics using in vivo Raman spectroscopy to noninvasively capture detailed molecular information from bone tissue through transcutaneous measurements. Low screening rates for osteoporosis via Dual-energy X-ray Absorptiometry (DXA) result in missed diagnoses and delayed treatment, increasing the risk of fractures and long-term complications. This study addresses this gap by developing a portable Raman-based pre-screening tool to identify patients at risk for osteoporosis. The study begins with cadaver experiments, where transcutaneous Raman signals from hands are recorded and compared to underlying bone spectra post-dissection, creating a comprehensive spectral dataset. Advanced machine learning algorithms including both Partial Least Squares (PLS) and neural networks are employed to predict and extract bone-specific signals from these transcutaneous measurements, bridging the gap between superficial readings and true bone composition. In parallel with the cadaver-based study, in vivo measurements on volunteers are conducted to evaluate the performance of the Raman system in a clinical-like setting. The ultimate goal is to develop a portable Raman device for use in clinical settings where DXA facilities are available, enabling direct comparison between Raman-based bone quality assessments and DXA-derived bone mineral density (BMD) scores. Unlike DXA, which relies on ionizing radiation and requires specialized infrastructure, the proposed Raman method is completely noninvasive and safe, potentially improving early diagnosis rates and access to osteoporosis screening worldwide.

3. **The μSiM-MVB – A Microfluidic System for Sepsis Drug Development and Immune Cell Studies**
   Danial Ahmad, James McGrath

Sepsis pathophysiology involves complex interactions between vascular endothelium and circulating immune cells. Importantly, while the role of dysregulated polymorphonuclear leukocyte (PMN) transmigration in septic mediated tissue damage is well documented, strategies to mitigate aberrant transmigration across endothelium have yet to yield viable therapeutics. Much of this can be attributed to the usage of animal models in preclinical trials that lack translational relevance. Recently, however, microphysiological systems (MPS) have emerged as novel in vitro mimetics that facilitate the development of human models of disease. With this advancement, we can now directly probe leukocyte-endothelial interactions that are difficult to assess with other models. Here, we overview the μSiM-MVB, (microphysiological system enabled by a silicon membrane – microvascular barrier) which is a drug development tool for studying immune cell transmigration. Importantly, we demonstrate our machine-learning based, high throughput analytical pipeline and an upcoming commercialization strategy with pharmaceutical partners.

4. **Development of an Outer Retinal Blood Barrier-on-a-Chip for Screening Drug Bioavailability, Toxicity, and Barrier Disruption Potential**
   Kevin Ling, Gram Hepner, Jordan Jones, Meng Hsu-Chun, Mehran Mansouri, Sami Farajollahi, Vinay Abhyankar, Ruchira Singh, Danielle S.W. Benoit, and James McGrath

Dysfunction of the outer retinal blood barrier (ORBB) is implicated in retinal degeneration. The ORBB is primarily comprised of the retinal pigment epithelium (RPE) and the choroidal microvasculature. The ORBB maintains retinal homeostasis by regulating nutrient transport. Clinically approved drugs such as hydroxychloroquine are linked with retinal degeneration. Animal models are limited, and current in vitro ORBB models fail to reproduce retinal degeneration or drug toxicity. We developed an ORBB-on-a-chip, which leverages ultrathin nanoporous silicon nitride membranes and the microfluidic μSiM (microphysiological system enabled by a silicon membrane). Our results show that cells cultured in the μSiM-ORBB form functional barrier tissues with similarities to native ORBB. The integration of physiological flow enables us to assess the bioavailability and barrier toxicity of drugs that cross the ORBB from the bloodstream into the retinal space. Our work establishes the μSiM-ORBB as a new tool for predicting retinal availability and toxicity of drugs.

Data Science and AI (5-15)

5. **Pursuing ground state of on-chip optomechanical resonators at room-temperature enabled by machine learning**
   Christer Everly, Pablo Postigo

Optomechanics has brought the goal of room-temperature quantum experimentation and technology into reality via ultra-high mechanical-Q resonators, laser cooled to their motional quantum ground states.[Our work makes steps toward bringing quantum states to on-chip platforms via photonic crystal shielded nanobeam photonic crystal resonators. Particularly difficult in this endeavor is the high optical-Q requirement to reach resolved-sideband cooling necessary for cooling to ground state without cryostats. Historically, this has necessitated the use of an external optical cavity. We develop a new shared-mode optimization based off a data driven approach utilizing deep neural networks and genetic algorithms. Using this technique, we can unlock new geometric solutions that do not appear in present analytic solutions.

6. Diffusion Models for Ultrasound Image Denoising

Melika Filvantorkaman, Marvin Doyley

Ultrasound imaging is a widely used diagnostic tool, but its effectiveness is often limited by high levels of noise and the ill-posed nature of inverse problems in image reconstruction. In this work, we present a deep learning framework based on diffusion models to enhance ultrasound image quality. Diffusion models, known for their powerful generative capabilities, are applied to denoise ultrasound images by modeling and reversing the noise generation process. Our approach integrates knowledge of the physical imaging system to better address the forward and inverse problems inherent in ultrasound. Experimental results on simulated and real ultrasound data demonstrate that our method outperforms conventional denoising techniques, preserving anatomical structures with improved clarity. This AI-driven solution offers a promising step toward more accurate and interpretable ultrasound imaging for clinical use.

7. Investigation of Racial Bias in Vision-Language Assistants in Workplace Settings

Linh Tran, Christopher Kanan

It is becoming increasingly common for Vision-Language Assistants (VLAs) built from pretrained Large Language Models (LLMs) to be used in everyday life. However, since machine learning models are trained from human data, VLAs can carry racial bias shown in the real world. In this research, we study racial bias in some popular open-sourced VLAs with respect to personality traits, skills, and occupations related to workplace. Our results shows that VLAs contains racial stereotypes or associate certain attributes to specific racial groups when associating attributes given an individual's images. Even though these stereotypes are not strictly positive or negative, they can still influence hiring decisions unknowingly.

8. LLMs as Sociologists: Leveraging AI/ML Contextual Knowledge for Social Oppression

John Nguyen, Linh Tran, Hanjia Lyu, Sree Chatterjee, Timothy Dye

LLMs, like ChatGPT, have made headlines over recent years for their immense capability in understanding human texts and making meaningful responses to such inputs. The models themselves are aggregators of knowledge over the internet and potentially possess some world model of its own. More recently, Gemini is offering an AI research assistant that aids researchers in creating and testing new hypotheses. Yet, AI has not been trusted as a source of truth themselves due to lack of transparency. The present study attempts to examine the validity of general-purpose LLMs to act as sociologists and help determine the trustworthiness of such responses. The potential of such systems could bridge the present gap of knowledge due to language barriers, geographic barriers, and resource availability.

9. Mix-QSAM: Mixed-Precision Quantization of the Segment Anything Model

Navin Ranjan, Andreas Savakis

The Segment Anything Model (SAM) is a popular vision foundation model; however, its high computational and memory demands make deployment on resource-constrained devices challenging. While Post-Training Quantization (PTQ) is a practical approach for reducing computational overhead, existing PTQ methods rely on fixed bit-width quantization, leading to suboptimal accuracy and efficiency. To address this limitation, we propose Mix-QSAM, a mixed-precision PTQ framework for SAM. First, we introduce a layer-wise importance score, derived using Kullback-Leibler (KL) divergence, to quantify each layer's contribution to the model's output. Second, we introduce cross-layer synergy, a novel metric based on causal mutual information, to capture dependencies between adjacent layers. This ensures that highly interdependent layers maintain similar bit-widths, preventing abrupt precision mismatches that degrade feature propagation and numerical stability. Using these metrics, we formulate an Integer Quadratic Programming (IQP) problem to determine optimal bit-width allocation under model size and bit-operation constraints, assigning higher precision to critical layers while minimizing bit width in less influential layers. Experimental results demonstrate that Mix-QSAM consistently outperforms existing PTQ methods on instance segmentation and object detection tasks, achieving up to 20% higher average precision under 6-bit and 4-bit mixed-precision settings, while maintaining computational efficiency.

10. Targeted Forgetting of Image Subgroups in CLIP Models

Zeliang Zhang, Mingqian Feng, Chenliang Xu

Foundation models (FMs) such as CLIP have demonstrated impressive zero-shot performance across various tasks by leveraging large-scale, unsupervised pre-training. However, they often inherit harmful or unwanted knowledge from noisy internet-sourced datasets, compromising their reliability in real-world applications. Existing model unlearning methods either rely on access to pre-trained datasets or focus on coarse-grained unlearning (e.g., entire classes), leaving a critical gap for fine-grained unlearning. In this paper, we address the challenging scenario of selectively forgetting specific portions of knowledge within a class, without access to pre-trained data, while preserving the model's overall performance. We propose a novel three-stage approach that progressively unlearns targeted knowledge while mitigating over-forgetting. It consists of (1) a forgetting stage to fine-tune the CLIP on samples to be forgotten, (2) a reminding stage to restore performance on retained samples, and (3) a restoring stage to recover zero-shot capabilities using model souping. Additionally, we introduce knowledge distillation to handle the distribution disparity between forgetting/retaining samples and unseen pre-trained data. Extensive experiments on CIFAR-10, ImageNet-1K, and style datasets demonstrate that our approach effectively unlearns specific subgroups while maintaining strong zero-shot performance on semantically similar subgroups and other categories, significantly outperforming baseline unlearning methods, which lose effectiveness under the CLIP unlearning setting.

11. Do More Details Always Introduce More Hallucinations in LVLM-based Image Captioning?

Mingqian Feng, Zeliang Zhang, Chenliang Xu

Generating descriptions using large vision-language models (LVLMs) often involves hallucinations, in which the output text misrepresents the visual information in the input image. While previous studies attribute the occurrence of hallucinations to the inclusion of more details, our study finds technical flaws in existing metrics, leading to unreliable evaluations of models and conclusions about hallucinations. This has sparked a debate on the question: Do more details always introduce more hallucinations in LVLM-based image captioning? In this paper, we address this debate by proposing a novel decoding strategy, Differentiated Beam Decoding (DBD), along with a reliable new set of evaluation metrics: CLIP-Precision, CLIP-Recall, and CLIP-F1. DBD decodes the wealth of information hidden in visual input into distinct language representations called unit facts in parallel. This decoding is achieved via a well-designed differential score that guides the parallel search and candidate screening. The selected unit facts are then aggregated to generate the final caption. Our proposed metrics evaluate the comprehensiveness and accuracy of image captions by comparing the embedding groups of ground-truth image regions and generated text partitions. Extensive experiments on the Visual Genome dataset validate the effectiveness of our approach, demonstrating that it produces detailed descriptions while maintaining low hallucination levels.

12. AI-Driven Passive Alignment System for Fiber-to-Chip Integration Using Image Processing and Deep Learning

Supun Liyanaarachchi, Jaime Cardenas

We introduce a fully automated, passive alignment system for fiber-to-chip integration designed to eliminate the need for human intervention. At the core of our approach is the use of advanced computer vision, where digital image processing and Fourier transform spectrum analysis are employed to extract critical alignment features from optical images. These features serve as inputs to a deep learning model, which then precisely controls a motorized three-axis stage to perform real-time alignment. By combining artificial intelligence with automation, our methodology offers faster and more reliable fiber-to-chip alignment compared to current industry standards. As a result, this system has the potential to revolutionize photonic device packaging by drastically reducing alignment time and increasing throughput.

13. Convolutional GNN on Directed Acyclic Graphs

Samuel Rey, Hamed Ajorlou, Gonzalo Mateos

We introduce a fully automated, passive alignment system for fiber-to-chip integration designed to eliminate the need for human intervention. At the core of our approach is the use of advanced computer vision, where digital image processing and Fourier transform spectrum analysis are employed to extract critical alignment features from optical images. These features serve as inputs to a deep learning model, which then precisely controls a motorized three-axis stage to perform real-time alignment. By combining artificial intelligence with automation, our methodology offers faster and more reliable fiber-to-chip alignment compared to current industry standards. As a result, this system has the potential to revolutionize photonic device packaging by drastically reducing alignment time and increasing throughput

14. Comparative Analysis of Silicon Wafer Sensor Data at 1580 nm and 1550 nm: Spatial Variability and Pattern Discovery

Oliva Shrestha, Michael Bryan, Benjamin Miller

Photonic sensors provide a sensitive and versatile approach to detecting biological molecules, but their performance can vary due to subtle variations in the manufacturing processes. This study explores the behavior of silicon wafer-based photonic sensors fabricated at 300 mm wafer scale across 64 reticles at two key wavelengths: 1580 nm and 1550 nm. Initial analysis involved cleaning and visualizing resonance red shift for a wafer with 64 reticles using heat maps across six channels and two rings. Other visualizations were used to map sensor data spatially. Further statistical analysis included examining the mean, range, and outlier for wavelengths(nm) for each channel and ring. This was followed by OLS regression and Principal Component Analysis (PCA). Initial findings indicated that 1580 nm data showed more consistency in shift, with Channels 2, 3, and 5 contributing most to errors. PCA revealed that range and standard deviation were the key contributors to variance. K-means clustering was done with the elbow method and silhouette analysis, which identified distinct reticle clusters with spatial trends relating to wafer layout. After completing this initial analysis, we compared two data collection methods, termed A and D, using six datasets. In comparison to A, Method D consistently produced lower variance data and more reliable measurements. These findings were confirmed in a new dataset collected using Method D at 1580 nm. This data showed a significantly low cluster variance and reduced noise. However, missing data, particularly in Ring 2 across all six channels, highlighted systematic issues while taking data. Filtering extreme values (shift (nm) ≤ 0 or ≥ 1) significantly improved data clarity and noise. These findings show Method D's superiority in collecting consistent and interpretable data. Nevertheless, the missing data remains a challenge. Ongoing work is focused on refining the data collection process and developing algorithms to automatically detect and group signals into their correct rings to improve overall data completeness and reliability.

15. Establishing a Framework Using Visual-Language Models to Acquire Machining Skills

Yunbo Zhang

This project focuses on capturing and transferring CNC machining skills from experienced machinists to the next generation through an AI-empowered XR training system. A multi-modal data collection pipeline has been established, incorporating an AR headset with eye tracking, a stereo camera, and a third person view camera to capture machinists' gaze behavior, verbal instructions, and task execution videos. A vision-language model (VLM)-based knowledge extraction method is developed to interpret and organize the multimodal data. Building on this, a prototype AR training system is created, allowing real-time interaction with trainees by providing verbal and textual guidance based on gaze and object recognition. The final system will be transferred to our industry partner, AA Tech, to support efficient and scalable training for new machinists, enhancing knowledge continuity and workforce readiness.

High Performance Computing (16)

16. InstaTrain: Adaptive Training via Ultra-Fast Natural Annealing within Dynamical Systems
Chuan Liu

Time-series modeling is broadly adopted to capture underlying patterns present in historical data, allowing prediction of future values. However, one crucial aspect of such modeling is often overlooked: in highly dynamic environments, data distributions can shift drastically within a second or less. Under these circumstances, traditional predictive models, and even online learning methods, struggle to adapt to the ultra-fast and complex distribution shifts present in highly dynamic scenarios. To address this, we propose InstaTrain, a novel learning approach that enables ultra-fast model updates for real-world prediction tasks, thereby keeping pace with rapidly evolving data distributions. In this work, (1) we transform the slow and expensive training process into an ultra-fast natural annealing process within a dynamical system. (2) Leveraging a recently proposed electronic dynamical system, we augment the system with parameter update modules, extending its capabilities to encompass both rapid training and inference. Experimental results on highly dynamic datasets demonstrate that our method achieves orders-of-magnitude improvements in training speed and energy efficiency while delivering superior accuracy compared to baselines running on GPUs.

Optics, Photonics, Imaging (17-26)

17. Multi-Wavelength Coherent Beam Shaping with Gradient Index Materials: A Path Toward Machine Learning Integration
Haibo Gao, Greg Schmidt

We present a multi-wavelength coherent beam shaper designed using gradient index (GRIN) materials with both conventional and machine learning-based methods. By utilizing multi-material GRIN structures, the design enables efficient phase and amplitude control across several wavelengths. Compared to traditional techniques, machine learning approaches reveal novel index profiles and beam shapes that improve power efficiency, yet fabrication feasibility remains an ongoing area of investigation. This work highlights a data-driven path toward advanced, wavelength-flexible beam shaping components.

18. Assessing Corneal Viscoelasticity Using Multi-Frequency Reverberant Elastography
Hamidreza Asemani, Jannick P. Rolland, Kevin J. Parker

Accurate characterization of corneal viscoelastic properties requires estimating shear wave speed (SWS) across multiple frequencies due to dispersion-induced variations in wave speed. This study introduces a multi-frequency reverberant OCE (MFR-OCE) approach to enhance corneal biomechanical assessment. We validate MFRSW-OCE through gelatin phantoms, and ex vivo porcine cornea elastography experiments. Our findings indicate agreement between MFRSW-OCE and single-frequency OCE, with differences under 3%. The extracted dispersion coefficients align with the viscoelastic power law model, with gelatin phantoms exhibiting low viscoelasticity (exponent = 0.13) and the cornea showing intermediate viscoelastic behavior (exponent = 0.33). Our group has previously applied OCE to assess brain tissue mechanics, and this multi-frequency reverberant approach holds promise for further advancing brain viscoelastic characterization. These findings highlight the potential of MFR-OCE for improving corneal and neurological tissue assessment in both research and clinical applications.

19. Polarimetric imaging of peripheral nerves: an intraoperative aid

Haolin Liao, David J. Mitten, Wayne H. Knox

We present a real-time method for intraoperative peripheral nerve identification using a rotating crossed polarization imaging (RXPI) system. By applying lock-in processing to sequential image frames, our approach enhances nerve visibility and achieves an area under the ROC curve (AUC) of 93%. We further discuss recent results from live human subject trials and explore the integration of machine learning-based segmentation for automated analysis. These findings suggest that the RXPI system, combined with lock-in processing, holds strong potential as a practical tool for assisting nerve identification during surgery.

20. Laser Induced Refractive Index Change in Silk Fibroin Hydrogels

Quazi Rushnan Islam, Rocio Gutierrez-Contreras, Susana Marcos, and Wayne H. Knox

We demonstrate induced refractive index changes in silk-fibroin hydrogels via femtosecond laser micromachining techniques. The biocompatibility and optically transparent properties of silk-fibroin make it an ideal platform for developing intraocular implants, corneal inlays and contact lenses incorporating custom refractive correctors.

21. Sag- and Slope-Orthogonal Cartesian Bases for Freeform Surfaces

Yannis Nuzzolo, John Mahoney, Miguel A. Alonso, Greg W. Forbes

Mid-spatial frequency errors naturally arise during the fabrication of freeform surfaces. These structures can be characterized using orthogonal polynomial bases. Commonly used families, such as Legendre, Chebyshev, and Zernike polynomials, often struggle to provide an optimal fit. This poster presents a comparative analysis of various polynomial bases in a rectangular domain, considering sag- and slope-orthogonality with different weighting schemes. Recurrence relations for each basis are explored, as they enable efficient and precise computation of higher-order polynomials. Additionally, we investigate Rapidly Decaying Fourier-like (RDF) functions and demonstrate their application in fitting and denoising for image processing.

22. Calibration for Single-Molecule Localization Microscopy

Sherry Yi-Ting Feng, Luis A. Alemán Castañeda, Thomas G. Brown, Miguel A. Alonso

Single-molecule localization microscopy (SMLM) is a powerful technique for reconstructing biological structures at the nanoscale. However, achieving high localization accuracy depends on precise system calibration. Conventional calibration often uses fluorescent beads, which differ significantly in size and optical behavior from single fluorophores. These differences distort the point spread function (PSF), limiting precision. In this study, we propose two new calibration approaches. First, we use a metal tip to mimic the emission of single fluorophores. By exploiting the lightning rod effect, the tip generates a highly localized electromagnetic field that closely resembles that of an axial emitter. Preliminary results suggest this method may reduce calibration errors. Second, we explore the use of fluorescent beads combined with polarizers. This theoretical approach aims to tune the emission properties of beads to better match those of real fluorophores, addressing mismatches caused by size and optical differences. Together, these strategies show potential for improving calibration accuracy in SMLM and enhancing nanoscale imaging.

23. Mapping the Wild in 3D: LiDAR Insights into Forest Ecology

Fei Zhang, Rob Chancia, Josie Clapp, Richard MacKenzie, Jan van Aardt

Forests are full of complex structures that shape biodiversity and ecosystem health. Using terrestrial LiDAR, we capture detailed 3D scans of two distinct environments: the temperate woodlands of Harvard Forest and the tangled mangrove forest of Palau. These 3D point clouds reveal patterns in vegetation that support research in ecology, conservation, and environmental monitoring.

24. Inverse Design of Bullseye Cavities Using Tandem Neural Networks

Martin Sanchez, Christer Everly, Lukas Weituschat, Pablo Postigo

Circular Bragg Grating (aka "Bullseye") cavities are widely used in single photon sources due to their moderate Purcell enhancement and excellent emission directionality. Although fundamentally simple, the design of Bullseye cavities demands computationally expensive and time-consuming iterations for optimization, and is limited in performance due to designer intuition, particularly when the number of adjustable parameters is large. Therefore, the inverse design of a Bullseye cavity is ideal, where geometry is determined as a function of target cavity performance instead of calculating cavity performance based on geometry. Here, we demonstrate that a Tandem Neural Network (TNN) architecture for the inverse design of Bullseye cavities can optimize Purcell enhancement and collimation efficiency at target resonant wavelengths within a training dataset. We describe how to implement this approach for a dielectric-based Bullseye cavity with a resonant wavelength of 690nm, achieving a comparatively high Purcell enhancement of 32.6, and an extraction efficiency of 63%. We also report the fabrication of some TNN-designed Bullseye cavities, where their measured optical quality factor (Q) matches the expected theoretical optical quality factor. Furthermore, we demonstrate the technique's generalizability to other materials and Bullseye geometries. We also illustrate how to incorporate fabrication constraints to tailor the design to minimum feature sizes and/or layer thickness. This technique not only significantly reduces design and simulation time while uncovering new favorable geometries for Bullseye cavities but could also be extended to other multiparameter photonic cavity systems.

25. Neural network and genetic algorithm assisted optimization of femtosecond laser processed superhydrophobic surface for pharmaceutical applications

Tianshu Xu, Ran Wei, Chloe Zhang, Subash, Singh, and Chunlei Guo

In this project, we developed a machine learning framework that directly connects the femtosecond laser processing parameters to the resulting surface wettability on stainless steel without any intermediate steps. The framework allows a rapid prediction of the optimal laser processing parameters for the ideal superhydrophobicity. The machine learning predicted laser processing parameters produce excellent superhydrophobic surfaces for pharmaceutical applications.

26. Neural Networks for Detection of Micro Ring Resonances
Lukas Weituschat

Sensors, Acoustics, Materials (27-28)

27. Development of a Low-Cost, Low-Power, Machine Health Monitoring Sensor
Aaron Bundy and Benjamin Thompson, Michael Heilemann

The focus of this project is on designing sensor systems capable of enabling machine health monitoring (MHM) for a broad spectrum of Department of Defense (DoD) assets including vehicles, pumps and rotating machinery at a low cost. The system utilizes low-power, embedded machine learning to identify and classify vibration data by analyzing spectral features of a recorded vibration signal. The network may be configured for anomaly detection or fault classification depending on the availability of labeled fault data. In the first year of the STTR Phase II effort, a custom hardware board was developed to interface between the ADVIS Inc. sensor and the embedded processor. The features on the custom board include the sensor preamp, an audio CODEC, and micro-SD card storage. The dimensions of the board match the dimensions of the embedded processor to minimize the profile of the hardware so that the unit meets the minimum size requirements of <1 cubic inch.

28. Voice Conversion via Optimal Transport
Maitreya Kocharekar and Anton Selitskiy

We propose a voice conversion model that transforms input speech into the voice of a target speaker using a WavLM-based encoder and Neural Optimal Transport to align speaker representations. To improve audio quality, we additionally train a diffusion-based vocoder conditioned on wav2vec features for high-fidelity waveform reconstruction.

Submissions from The Harley School

Eliminating BioFilms
Margaret Kass, Brynn McHenry, Sybille Michel

Neuralander - The Picture Taking Robot for NASA Landings
Charlie Clark, Sol Sohn, Henry Winchester

TECHNOLOGY SUPPORTERS

CENTER OF EXCELLENCE IN RNA RESEARCH AND THERAPEUTICS (CERRT)

CENTER FOR INTEGRATED RESEARCH COMPUTING (CIRC)

CHESTER F. CARLSON CENTER FOR IMAGING SCIENCE – JAN VAN AARDT'S LAB

GOERGEN INSTITUTE FOR DATA SCIENCE AND AI (GIDS-AI)

LOBAKI, INC.

MONROE COUNTY ECONOMIC DEVELOPMENT

MONROE COUNTY FINGER LAKES APEX ACCELERATOR

NATIONAL ESPORTS ASSOCIATION

PHLOTONICS, INC.

THE INSTITUTE OF OPTICS AT UNIVERSITY OF ROCHESTER

URVENTURES