2024 Finger Lakes Science & Technology Showcase

at the Memorial Art Gallery

April 25, 2024

"Imaging in the Age of AI"

How artificial intelligence is changing computer imaging and what it could mean for the Rochester economy

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

WELCOME

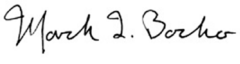
Welcome to the 2024 Finger Lakes Science & Technology Showcase. This annual event is co-sponsored by the Center for Emerging and Innovative Sciences (CEIS) and the Center of Excellence (CoE) in Data Science, at the University of Rochester. We are very pleased to host this year's Showcase at the Memorial Art Gallery for a third year. Our goal is to encourage industry - academic collaborations and technology transfer 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 data science, optics, imaging, photonics, sensors, semiconductors and electronics, 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 in augmented and virtual reality. Following the AR/VR segment, the Centers kick off the Showcase with remarks by Ben Verschueren, Executive Director of ESD's Division of Science, Technology, and Innovation (NYSTAR) and Assemblymember Harry Bronson, a champion for NYS economic development and the Assembly's Legislative Liaison to the Finger Lakes Regional Economic Development Council (FLREDC). We are excited to host a keynote presentation by Vaishali Kamat, GM of New Ventures, Ultrasound Digital Solutions from GE Healthcare on the Impact of AI on medical imaging and the democratization of health care. In addition, there will be a panel discussion to explore the intersection of AI and imaging across multiple industry sectors and the opportunities this presents to our region. These sessions will be followed by lunch then networking and "speed-dating" pitches from NYS industry and faculty from area universities. The days' events will culminate with a poster session featuring research at area universities. Posters on display will be eligible for the people's choice prizes if selected as one of the top three posters.

We hope that everyone will enjoy spending the day in the beautiful surroundings of the Memorial Art Gallery and take advantage of this opportunity to make new industry- university research connections that may contribute to regional economic expansion and job growth.

Both CEIS and the CoE in Data Science provide NYS matching funds for company-sponsored research at NYS universities. The CoE in Data Science provides full funding for industry-academia collaborations without the requirement of company sponsorship, and it 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 can help your enterprise to thrive and grow.

Warm Regards,



Mark Bocko, PhD
Director, CEIS

Mujdat Cetin, PhD
Director, COE in Data Science

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 - 10:30 AM	Western New York AR/VR Mini-Symposium Presenters: Andreas Georgiou; Wendy A. Dannels; Chao Peng; N. Katherine Hayles
10:30 AM - 10:40 AM	Break
10:40 AM - 11:00 AM	Welcome remarks (Ben Verschueren – ESD/NYSTAR, Harry Bronson - NYS Assembly)
11:00 AM - 11:30 AM	Keynote Speaker - Vaishali Kamat, New Ventures - Ultrasound Digital Solutions, GE HealthCare
11:30 AM - 12:30 PM	Town Hall with Terry Clas, Joseph Stefko, and Jan van Aardt (Terry Clas of Empire State Development will moderate a discussion with Joseph Stefko of ROC 2025 and Jan van Aardt of RIT's Chester F. Carlson Center for Imaging Science)
12:30 PM - 1:30 PM	Lunch
1:30 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 - 5:00 PM	Wine and Cheese reception

Andreas Georgiou
Optics Consultant
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Andreas Georgiou is an Independent Consultant with Reality Optics Ltd, and he is particularly interested in computational optics for wave and geometrical optical design. He worked in diffractive optics for over two decades and over a decade in Mixed Reality optics. Andreas enjoys making new ideas into operating prototypes by combining physics, mathematics, engineering, and software. He particularly likes working with head-mounted displays, three-dimensional displays, sensors, and everything unusual with lenses and gratings inside. Before his current position, Andreas worked with many product groups at Microsoft (Surface, HoloLens, Azure, and Kinect), developed micro-confocal endoscopes for surgery, designed space instruments for Mars, and created the first genuinely holographic display. He obtained his PhD in optics from Cambridge University. He is an Engineering Research Fellow at Robinson College, Cambridge, where he continues to teach. He has over 30 patents and over 20 peer-reviewed publications on head-mounted displays, data storage, holographic displays, and data transmission.

Wendy Dannels
Research Associate Professor
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Wendy A. Dannels is an Associate Research Professor and the Director of the XR Accessibility Solutions Laboratory (XR-ASL) within the National Technical Institute for the Deaf (NTID) - Deaf Health Care and Biomedical Science Hub at Rochester Institute of Technology. Her team conducts research and develops real-time, immersive, and interactive technologies including mixed, augmented, and virtual reality with a focus on accessible and inclusive experience especially for deaf individuals. Dannels is principal investigator for a three-year research project, "Evaluating the Use of Mixed Reality Smart Glasses for Real-Time Captioning Display and Interpreting Services," award from the National Institute on Disability, Independent Living, and Rehabilitation Research's (NIDILRR) center within the Administration for Community Living (ACL), Department of Health and Human Services (HHS). Also, Ms. Dannels taught and tutored engineering-related courses for more than nine years. She is a subject matter expert in product design/development and digital engineering/manufacturing, especially from prototype or service to marketplace.

Chao Peng

Associate Professor
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RIT
Rochester Institute of Technology

Chao Peng RIT Bio

Chao Peng is an Associate Professor of the School of Interactive Games and Media (SIGM) in the Golisano College of Computing and Information Sciences (GCCIS) at RIT. He is also a Resident Faculty of the RIT Center for Media, Arts, Games, Interaction & Creativity (MAGIC). Chao's areas in computing are high-performance graphics, video game development, GPU-accelerated parallel computing, big data visualization, virtual reality, and 3D interaction. He is also an artist working on various kinds of digital art, including digital paintings, 3D models, 2D & 3D animated shorts, games, and other interactive arts.

Chao received his PhD and MS in Computer Science from *Virginia Tech*; his MFA in Computer Art from the *University of Alaska Fairbanks*, and his BArch in Architectural Design (buildings) from *Hebei University of Engineering*, China.

N. Katherine Hayles

James B. Duke Professor of Literature
Price Lab for Digital Humanities
Duke University
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Distinguished Research Professor UCLA Department of English
UCLA Profile

Duke University — Price Lab for Digital Humanities

UCLA Department of English

N. Katherine Hayles is the Distinguished Research Professor at the University of California, Los Angeles, and the James B. Duke Professor Emerita from Duke University. Her research focuses on the relations of literature, science, and technology in the 20th and 21st centuries. Her twelve print books include *Postprint: Books and Becoming Computational* (Columbia, 2021), *Unthought: The Power of the Cognitive Nonconscious* (Univ. of Chicago Press, 2017) and *How We Think: Digital Media and Contemporary Technogenesis* (Univ. of Chicago Press 2015), in addition to over 100 peer-reviewed articles. Her books have won several prizes, including The Rene Wellek Award for the Best Book in Literary Theory for *How We Became Posthuman: Virtual Bodies in Literature, Cybernetics and Informatics*, and the Suzanne Langer Award for *Writing Machines*. Other recognitions include two NEH Fellowships, a Guggenheim, a Rockefeller Residential Fellowship at Bellagio, and two University of California Presidential Research Fellowships. She is a member of the American Academy of Arts and Sciences. She is currently at work on *Bacteria to AI: Human Futures with our Nonhuman Symbionts.*

Finger Lakes Science & Technology Showcase Speakers

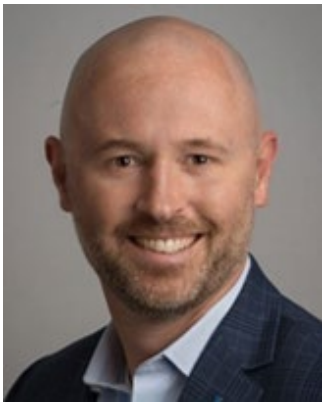
Ben Verschueren is the Executive Director of Empire State Development's Division of Science, Technology, and Innovation (NYSTAR). Ben took on the position in August 2023 after a distinguished career in industry. Ben spent most of his career in varying roles with GE, from hands-on research through managing strategic innovation portfolios at corporate and business unit levels. He established multiple innovation platforms and an incubator lab focused on funding a portfolio of projects building hands-on prototypes of exponential technologies applied to industrial ecosystems. He developed and nurtured multiple university and business partnerships and collaborations, from startups to large corporations. He also established GE Research's formal IR&D portfolio, enabling deeper government collaboration and funding opportunities. Most recently, Ben was Director of Global Labs at Fluence, where he grew a global team and network of test facilities and labs responsible for finalizing next generation, grid-scale energy storage systems. Ben graduated with bachelor's degrees in computer science and electrical engineering from Brown University, and a master's degree in computer science from Rensselaer Polytechnic Institute.

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).

Vaishali Kamat brings extensive experience in digital health and medical technology, with over 20 years in the industry. As GM, New Ventures within the Ultrasound Digital Solutions team at GE HealthCare, she focuses on bringing innovative digital and AI technologies to established and new users of diagnostic ultrasound. In addition to leading product development efforts internally within the company, Vaishali also works with external partners and collaborators to bring novel AI solutions to GE HealthCare ultrasound products. Most recently, Vaishali has been leading the integration of the Caption Health business, following its acquisition by GE HealthCare in 2023 and has helped launch the Caption Cardiac Guidance solution on the Venue Point-of-Care ultrasound portfolio. Prior to GE HealthCare, Vaishali led the Digital Health practice at Cambridge Consultants, a leading technology and product development firm, headquartered in Cambridge UK. Here she worked with a variety of MedTech and Pharmaceutical company clients to develop innovative solutions that helped pioneer new care pathways and business models.

Finger Lakes Science & Technology Showcase Speakers

Terence J. Clas is a business development executive within NY State's Division of Science, Technology and Innovation, Empire State Development. Responsibilities include supporting the NIST MEP Advanced Technology Team that provides support to industry, government, and academic institutions by offering technical resources and collaboration opportunities available through the National MEP Network, Manufacturing USA Institutes and NYS resources. Previously, Terry served as the Corporate VP, New Business Development and General Manager of the Industrial Inspection Division at VFO, LLC. His career also includes Executive VP, Marketing and Sales for VMP Nutrition. The majority of Terry's career was at Kodak with a variety of leadership roles that centered on Manufacturing Systems Technology Development in Corporate R&D. In addition, Terry was a design engineer at Texas Instruments, Electro-Optical Division. Terry holds a M.S. degree from the National Technological University (NTU) in Technology Management and a B.S. degree in Mechanical Engineering Technology from Buffalo State University.



Joseph Stefko is President & CEO of ROC2025, the alliance of economic development organizations established in 2019 to lead a $20 million coordinated capacity-building investment strategy focused on accelerating regional growth in Greater Rochester. He spent nearly 20 years with Rochester-based CGR, including seven as President & CEO, overseeing the consultancy's industry-leading work in government and education, economics and public finance, health and human services, and nonprofits and communities. From 2003-08 he served on senior staff of the emergency fiscal control board appointed by NYS to monitor the finances of the City of Buffalo and Buffalo Public Schools. During his tenure, the board's guidance contributed to more than $230M in savings and created a strong foundation for the city's revitalization. A Buffalo native, he holds B.A., M.A., and Ph.D. degrees from SUNY Buffalo.

Dr. Jan Van Aardt is a Professor and the Interim Director of the Chester F. Carlson Center for Imaging Science at RIT. His research interests are in imaging spectroscopy, lidar, and multi-temporal sensing, with various ecosystem and forestry projects, e.g., land quality and global change (multi-temporal), forest and savanna structural assessment using discrete and waveform lidar systems, and estimation of foliar chemistry and vegetation state (imaging spectroscopy). Jan obtained a BSc Forestry degree (biometry and silviculture specialization) from the University of Stellenbosch, SA in addition to an Hons. Forestry degree with a remote sensing and Geographical Information Systems (GIS) specialization, also from the University of Stellenbosch. Jan then completed MS and PhD Forestry degrees at Virginia Polytechnic Institute and State University, Blacksburg, Virginia - these degrees respectively focused on remote sensing applications in forestry. Prior to joining RIT, Jan worked at the Katholieke Universiteit Leuven as post-doc and the Council for Scientific and Industrial Research, South Africa, as research group leader.

Circle Optics - Zak Niazi, Founder, CEO

At Circle Optics, they provide aerospace, autonomous systems, and entertainment verticals with the most accurate imaging to support situational awareness and immersive experiences. They are experts who deliver flawless quality that embodies our principles in Know-How, Synergy, Innovation. They influence a culture of "What if?" From this, we have created the opportunity to build Circle Optics as a world leader in 360° imaging.

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EagleHawk - Patrick Walsh, Co-Founder and CEO

Businesses, governments, and non-profits use EagleHawk to reduce expenses and risk by proactively approaching large-scale facility asset management. EagleHawk will work closely with your team to compile all the necessary background and logistical information to plan the data collection flights. This mission planning process involves close coordination with your organization's safety and policy compliance departments to ensure that the proper procedures and communication plans are followed.

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FLX AI – Karla George, CEO

In 2017 New York State founded the Rochester Data Science Consortium, with funding from the Empire State Development Corporation and strategic support from the University of Rochester, the L3Harris Corporation, and Danny Wegman, to bring the benefits of data science to the Upstate New York economy. Although RDSC had a fixed term, our team decided to stay together and founded FLX AI as a commercial entity. Today we provide one of the deepest and most accessible talent pools in AI, Machine Learning, and Data Science in the Upstate region. As a multi-disciplinary team with experience working with business, government, and academic institutions, we offer scalable solutions that deploy artificial intelligence and big data to the cloud. We build platforms to gather, process, and analyze data and create models that generate insights and actionable predictions. Whether you have a specific project in mind or require guidance in how to make data work for your organization, FLX AI will partner with you to accomplish your objectives.

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LighTopTech - Cristina Canavesi, PhD, MBA, Co-Founder and President

LighTopTech Corp. is a women-owned business based in Rochester, NY. LighTopTech, an optical technology company, was founded in 2013. LighTopTech's vision is to build innovative optical instruments to bring to market disruptive technologies for non-destructive imaging in industrial fields, and noninvasive imaging and guided surgery in medical fields.
LighTopTech's mission is to create new possibilities in medical imaging and materials manufacturing towards a better collective future with our biomimetic noninvasive imaging technology.

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L3Harris - Bernard Brower, Sr. Product Development Manager

In a fast-moving and increasingly complex world, L3Harris is anticipating and rapidly responding to challenges with agile technology – creating a safer world and more secure future. At L3Harris, they anticipate and mitigate risk with end-to-end solutions that meet customers' mission-critical needs across all domains.

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GE Healthcare – Nicole Wake, Director Medical and Scientific Affairs

Enabling the human side of healthcare- At GE HealthCare, they see possibilities through innovation. They're partnering with our customers to fulfill healthcare's greatest potential through groundbreaking medical technology, intelligent devices, and care solutions. Better tools enabling better patient care. Together, they are not only building a healthier future but living their purpose to create a world where healthcare has no limits.

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Ajay Anand, PhD - Associate Professor and Deputy Director of the Goergen Institute for Data Science at the University of Rochester

Ajay Anand is currently Associate Professor and Deputy Director of the Goergen Institute for Data Science at the University of Rochester. He is also affiliated with the UR Health Lab at URMC. Prior to joining the University of Rochester, Ajay was with Philips Healthcare North America and Carestream Health as a senior research scientist and technical project leader. His recent research has focused on the development of novel machine learning-based methods combined with real-time acoustic signal processing for image-guided therapies, quantitative noninvasive imaging biomarkers, and automated vascular diagnosis in point-of-care ultrasound. His research interests include biomedical signal processing, time-series analysis, and physics-based machine learning. He is a co-inventor on more than 45 patents. Ajay received his M.S. degree in Biomedical Engineering from the University of Texas Southwestern Medical Center, Dallas, TX, and M.S. and Ph.D. degrees in Electrical Engineering from the University of Washington, Seattle.

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

Dimah Dera specializes in robust and trustworthy modern machine learning (ML) solutions for real-world applications, including healthcare, cybersecurity, remote sensing, and surveillance systems. In the rapidly evolving landscape of artificial intelligence (AI) and autonomous systems, the integration of ML techniques has paved the way for unprecedented advancements across various domains. The robustness, safety, and reliability of AI systems have emerged as pivotal requirements. The scope of her research includes developing innovative techniques to ensure the robustness, safety, and reliability of AI systems by integrating Bayesian theory and statistical signal processing foundations into modern ML frameworks. This research highlights the intricate connections

between learning Bayesian uncertainty in ML models and their robustness and safety awareness to dynamically changing environments and systems failure. This research advances theoretical and algorithmic knowledge that will transcend traditional ML and AI systems toward safe and reliable deployment of AI models in high-risk real-world applications. Dimah received the National Science Foundation (NSF) Computer and Information Science and Engineering Research Initiation Initiative (CRII) in 2023 for her research focusing on robust machine learning and time-series analysis. She won multiple awards, such as the Best Paper Award at the 2019 IEEE International Workshop on Machine Learning for Signal Processing (MLSP'19) and the IEEE Philadelphia Sections Benjamin Franklin Key Award (2021). She publishes regarding trustworthy, reliable, and expandable machine learning, signal and image processing and optimization.

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Marvin Doyley, PhD - Chair of Department of Electrical and Computer Engineering, Wilson Professor of Electronic Imaging, Professor of Biomedical Engineering, and of Imaging Sciences at the University of Rochester

Marvin M. Doyley received his PhD degree in biophysics from the Institute of Cancer Research (Sutton), University of London Imperial College. Following post-doctoral training at Erasmus University in the Netherlands and Dartmouth College in Hanover, NH, he joined the faculty of the Department of Electrical and Computer Engineering at the University of Rochester in 2008. Dr. Doyley is the Wilson Professor of Electronic Imaging and is currently Chair and Professor of the Department of Electrical and Computer Engineering, with joint appointments in the Departments of Biomedical Engineering and Imaging Sciences. His research team at the University of Rochester concentrates on non-invasive vascular elastography, high-frequency nonlinear ultrasound imaging, and structural and functional imaging of pancreatic and colorectal cancer. Dr. Doyley is a fellow of the IEEE (Institute of Electrical and Electronics Engineers), AIUM (American Institute of Ultrasound in Medicine), AIMBE (American Institute for Medical and Biological Engineering), and the Asia-Pacific Artificial Intelligence Association (AAIA). He currently serves on the editorial boards of *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control*, *SPIE Journal of Medical Imaging*, *Physics in Medicine and Biology*, and *Nature Scientific Reports*.

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Wayne Knox, PhD - Professor of Optics and Physics, of Visual Sciences, and of Materials Science, and Distinguished Scientist, Laboratory for Laser Energetics at the University of Rochester

Wayne H. Knox obtained BS (1979) and PhD degrees (1983) at The Institute of Optics, University of Rochester in Rochester, NY. He worked at Bell Labs Advanced Photonics Research in Holmdel NJ 1984-2001. In April 2001 he returned to The Institute of Optics as Director (2001-2011) and Professor of Optics where he currently conducts a research program in ultrafast nonlinear optics and applications in vision correction. He is also Professor of Physics, Materials Science and Vision Science, and Chief Science Officer at Clerio Vision, a company that he co-founded in 2014. He is a Fellow of the Optical Society of America and a Fellow and Life member of the American Physical Society, and Fellow of the National Academy of Inventors. At the University of Rochester, he teaches Optical Engineering Senior Design and Senior Thesis classes.

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James McGrath, PhD - William R. Kenan, Jr. Professor of Biomedical Engineering at the University of Rochester

Professor McGrath graduated from Arizona State in 1991 with a BS degree in mechanical engineering. He earned a master's degree in mechanical engineering from MIT in 1994 and a PhD in biological engineering from Harvard/MIT's Division of Health Sciences and Technology in 1998. He then trained as a Distinguished Post-doctoral Fellow in the Department of Biomedical Engineering at the Johns Hopkins University. Since 2001, Professor McGrath has been on the Biomedical Engineering faculty at the University of Rochester and served the department for over 10 years as the first director of the BME graduate program.

While historically, Professor McGrath's research focused on the phenomena of cell migration, since 2007 he has been leading the Nanomembrane Research Group - a highly interdisciplinary, multi-institutional team that is developing and applying ultrathin silicon 'nanomembrane' technologies. Professor McGrath is also a co-founder and past president of SiMPore Inc. a company founded to commercially manufacture the nanomembranes. In 2023 he was appointed the William R. Kenan, Jr., Professorship. He was also a recipient of the Edmund A. Hajim Outstanding Faculty Award in 2019, and in 2015 he was elected as a Fellow of the American Institute for Medical and Biological Engineering (AIMBE).

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www.urmc.rochester.edu/news/story/nih-awards-7-5m-for-ur-center-to-help-shape-future-of-drug-development

Chenliang Xu - Associate Professor, Department of Computer Science at the University of Rochester

Chenliang Xu is an Associate Professor in the Department of Computer Science at the University of Rochester. He received his Ph.D. in Computer Science from the University of Michigan in 2016, an M.S. in Computer Science from the University at Buffalo in 2012, and a B.S. in Information and Computing Science from Nanjing University of Aeronautics and Astronautics, China, in 2010. His research originates in computer vision and tackles interdisciplinary topics, including video understanding, audio-visual learning, vision and language, and methods for trustworthy AI. Xu is a recipient of the James P. Wilmot Distinguished Professorship (2021), the University of Rochester Research Award (2021), the Best Paper Award at the 17th ACM SIGGRAPH VRCAI Conference (2019), the Best Paper Award at the 14th Sound and Music Computing Conference (2017), and the University of Rochester AR/VR Pilot Award (2017). He has authored over 100 peer-reviewed papers in computer vision, machine learning, multimedia, and AI venues. He served as an associate editor for IEEE Transactions on Multimedia and an area chair/reviewer for various international conferences.

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Augmented Reality/Virtual Reality (1-5)

1. **When Artificial Intelligence Meets Augmented Reality in Robotics: Robot Learning from Human Demonstrations**
   Yunbo Zhang

Currently, a new industrial revolution, also known as Industry 4.0, is transforming manufacturing industries towards higher production efficiency, greater levels of automation, more intelligence in processes, increased product complexity, and enhanced customization flexibility. Human-robot collaboration (HRC) is considered pivotal for this transition, wherein robots work alongside their human partners to automate repetitive, physically demanding tasks and to replace humans in hazardous or extreme working environments. On the other hand, integrating humans with robots enhances the flexibility and adaptability of manufacturing tasks, given that the high-level cognitive and decision-making abilities of human workers still surpass those of robots. However, the current level of collaboration between humans and robots is far below what is expected for human-like collaboration. From a human perspective, current methods for collaborating with robots are unintuitive, time-consuming, and lack intelligence. It is challenging for robots to understand human workers' high-level intentions and respond appropriately. Moreover, human expertise, cognitive abilities, and decision-making capabilities have not been effectively transferred to and utilized by robots. To tackle these issues, Dr. Zhang has delved into a multidisciplinary research area that intersects multiple domains, including Human-Computer Interaction (HCI), AI, Robotics, and Computer Vision. In this poster, Dr. Zhang will present his research progress in three aspects: 1) Extended Reality (XR) interfaces and associated new paradigms to enable human communication and demonstration; 2) AI-enabled robot grasp planning learned from human demonstrations; and 3) Visual language model-based multimodal robot learning from human instructions and demonstrations for long-horizon tasks.

2. **Perceptual Transparency Scaling in Optical See-Through Augmented Reality**
   Sofie Herbeck, Michael Murdoch, Christopher Thorstenson

Optical see-through augmented reality (OST-AR) is an increasingly popular display technology which superimposes rendered objects onto an observer’s view of the real world via a translucent pane. The see-through nature of OST-AR displays carries challenges, especially with objects of lower chroma or value (lightness/darkness). These may be less visible or create visual dissonance with mismatched lighting between the real scene and rendered object(s). Still, some transparency in the rendered object is not necessarily negative—we haven't yet characterized preferences for transparency levels when interacting with people in AR modalities. Psychophysical experiments asked observers to adjust transparency in AR to perceptually match an emissive display's image opacity, then to judge each transparency level's visual acceptability. These let us probe the effect of skin color on observers’

transparency perception and acceptability judgments. Assessing transparency perception and visual acceptability will convey useful guidance to OST-AR developers, pointing toward the highest-impact areas of future OST-AR innovation.

3. MagicTime: Time-lapse Video Generation Models as Metamorphic Simulators

Jinfa Huang

Recent advances in Text-to-Video generation (T2V) have achieved remarkable success in synthesizing high-quality general videos from textual descriptions. A largely overlooked problem in T2V is that existing models have not adequately encoded physical knowledge of the real world, thus generated videos tend to have limited motion and poor variations. In this paper, we propose MagicTime, a metamorphic time-lapse video generation model, which learns real-world physics knowledge from time-lapse videos and implements metamorphic generation. First, we design a MagicAdapter scheme to decouple spatial and temporal training, encode more physical knowledge from metamorphic videos, and transform pre-trained T2V models to generate metamorphic videos. Second, we introduce a Dynamic Frames Extraction strategy to adapt to metamorphic time-lapse videos, which have a wider variation range and cover dramatic object metamorphic processes, thus embodying more physical knowledge than general videos. Finally, we introduce a Magic Text-Encoder to improve the understanding of metamorphic video prompts. Furthermore, we create a time-lapse video-text dataset called ChronoMagic, specifically curated to unlock the metamorphic video generation ability. Extensive experiments demonstrate the superiority and effectiveness of MagicTime for generating high-quality and dynamic metamorphic videos, suggesting time-lapse video generation is a promising path toward building metamorphic simulators of the physical world.

4. Enhancing STEM Learning with VR and AI Integration: A Study on Engagement and Comprehension in Astronomy Education

Adma Gama-Krummel, Ziming Li, Elizabeth Wilson, and April Luehmann

This study aims to investigate how integrating Virtual Reality (VR) with artificial intelligence (AI) can enhance learning in STEM subjects, primarily focusing on astronomy. The research question seeks to determine how this technological integration impacts participant engagement and comprehension and identifies its perceived benefits and challenges. Previous studies have established VR's effectiveness in improving scientific understanding and retention by creating immersive, interactive environments (Çakıroğlu et al., 2021; Lindgren et al., 2016). Moreover, studies by Luo et al. (2021) and Knox (2019) highlight the potential of VR and AI in fostering greater cognitive skills and personalized learning experiences. This study employs a mixed-methods approach, where data was collected through surveys at the Rochester Museum & Science Center Eclipse Festival. The collected data both quantitative and qualitative was analyzed to assess the effectiveness of VR and AI in improving engagement and learning outcomes in STEM education. This research aims to contributes to understanding how emerging technologies can be harnessed to enhance educational practices and learner outcomes in complex subjects like astronomy.

5. **VR Robotics Simulator: High School Students' Performance, Motivation, and Cognitive Engagement**
   Qinqin Xiao, Raffaela Borasi

This dissertation examines the impact of a Virtual Reality (VR) Robotics Simulator game on high school students' learning outcomes, motivation, and cognitive engagement in robot arm technology. Utilizing a mixed-methods experimental design, the study contrasts the experiences of students engaging with the VR game against those using a conventional 3D model. The research is anchored in theories of constructivism, embodied learning, motivation, and cognitive engagement. Findings indicate significant improvements in students' knowledge, interest in robot technology, and learning performance when using the VR simulator. Quantitatively, the VR group showed marked enhancements in pre- and post-test assessments of knowledge and interest levels. Qualitatively, immersive VR experiences were found to deepen understanding of complex concepts, enhance motivation through interactive and engaging content, and foster a higher degree of cognitive engagement through active participation and problem-solving. Overall, the VR Robotics Simulator game is demonstrated to be an effective tool for enhancing educational outcomes, motivating students, and engaging them cognitively, offering valuable insights into the benefits of incorporating VR technologies in educational settings.

Biomedical Technology (6-11)

6. **Robotics for Biosensor Assembly**
   Daniel J. Steiner, Braley E. Lachner, Michael R. Bryan, Benjamin L. Miller

Effective deployment of biosensor diagnostics requires precise and efficient assembly methods. Laboratory research tools allow individuals to assemble tens to hundreds of devices using manual assembly techniques. However, to move towards broader commercial feasibility, it is necessary to produce thousands to millions of devices with minimal variation in assembly. It is thus necessary to identify pathways toward automated, repeatable, and precise device production. Towards this goal, we have demonstrated the use of a of an Epson SCARA (Selective Compliance Assembly Robot Arm) robot for the manipulation and assembly of photonic biosensors. The Epson robot was initialized and programmed to use a vision recognition approach to identify 1x4 mm photonic sensor chips and place them directly onto an adhesive layer located on a high surface energy passive microfluid card. This study moves us closer towards full assembly automation, and ultimately scalable production of biosensors for the medical diagnostic marketplace.

7. **Modeling the temperature distribution inside hydrogels during LIRIC writing using a moving hot spot approximation**
   Javier Berjon de la Parra, Wayne Knox

During the process of multiphoton femtosecond micromachining of ophthalmic materials, the energy deposited by the laser leads to a local change of the temperature of the material surrounding the excited volume. A moving hot spot model was used to estimate the temperature distribution surrounding the laser focal volume during the LIRIC writing process.

8. **Curating A Database for PlasAnn: A Highly Accurate and Rapid Plasmid Annotation**
   Abhishek Sharma, Habibul Islam, Jordan Blair, Allison J. Lopatkin

Plasmid annotation is a critical yet challenging process in biomedical research. To address this, we present PlasAnn, a novel tool for highly accurate and rapid plasmid annotation. At the core of PlasAnn is a curated database of high-quality plasmid sequences sourced from NCBI. This poster outlines the pipeline for the PlasAnn tool and the comprehensive process of developing the underlying database. The database curation involved thorough data gathering, processing, and rigorous computational validation to ensure the highest quality. Some database insights are also highlighted. By leveraging this specialized database, PlasAnn demonstrates superior performance in plasmid feature identification, providing researchers with a powerful solution to accelerate their work and gain deeper insights into plasmid biology. The poster underscores the significance of accurate plasmid annotation and the pivotal role PlasAnn can play in advancing biomedical research.

9. **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

The current approach at OrthoCare field service is to exercise "corrective maintenance", where service engineers identify failures based on deviations in sensor response tolerances required for acceptable test performance. However, such maintenance protocol results in high operating expenses in millions of dollars, increased service time, and customer dissatisfaction due to system outage management. In addition to these problems, this approach fails to capitalize on the rich sensor data provided by the system to OCDX servers, which we hypothesize can be leveraged to predict failures allowing for better planning and implementation of service visits.

10. **The µSiM-MVB - A Microfluidic System for Sepsis Drug Development**
    Isabelle Linares, Anthony Pietropaoli, Richard Waugh, 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 key results from prior studies that frame the µSiM-MVB (microphysiological system enabled by a silicon membrane - microvascular barrier) as a drug development tool. Importantly, we demonstrate a machine-learning based, high throughput analytical pipeline and recapitulation of the attenuated PMN chemotaxis seen in sepsis.

11. Engineering Resins for Two-Photon Polymerization

Madelyn P. Jeske, David R. Harding, Mitchell Anthamatten, Yongfeng Lu

Additive manufacturing for the fabrication of microdevices, metamaterials, and cell scaffolds requires high resolution, precise material placement. Two-photon polymerization (TPP) uses a femtosecond 780 nm laser to 3D print polymers at the sub-micron scale; however, majority of resins used are commercial with proprietary components and resulting chemical networks are not well explored. Additionally, commercial resins leave polymers brittle, difficult to analyze, and limits applications. In this work, "click" chemistry was used with TPP for high fidelity printing due to the mechanisms' chemical selectivity for consistent, stronger polymers. For the first time, a photobase generator was used in place of conventional free-radical initiation producing stiffer polymers with thermal shape-memory ability. Results guide the development of TPP resins for printing polymers with improved printing properties to benefit manufacturing of inertial confinement fusion targets and biotechnological devices.

Data Science (12-18)

12. Big-Data Approaches to Wafer-Scale Analysis of Silicon Biosensor Yield and Prediction of Function

Aashrith Maisa, Michael R. Bryan, Jordan Butt, Benjamin L. Miller

Digital health and healthcare analytics stand as rapidly burgeoning fields within the realm of data science, poised to revolutionize the landscape of personalized medicine. The democratization of healthcare analytics hinges on the advent of innovative point-of-care (POC) diagnostic tools seamlessly integrated with electronic health record (EHR) systems. These advancements streamline data aggregation, enabling analysis through machine learning methodologies, thus fostering enhancements in patient outcomes. Central to ensuring widespread availability and affordability of diagnostic tools is the imperative to scale up manufacturing processes, transitioning from small-scale production to mass production, spanning from hundreds to hundreds-of-thousands, and beyond. However, achieving fabrication at such magnitudes necessitates the implementation of robust quality control measures and yield optimization techniques. In this context, we delve into the intricate relationship between inline wafer-scale refractive index data and localized sensor performance. By investigating this correlation, we aim to refine manufacturing processes and enhance sensor efficacy, thereby advancing the accessibility and effectiveness of diagnostic tools.

13. Discover and Mitigate Multiple Biased Subgroups in Image Classifiers

Zeliang Zhang, Mingqian Feng, Zhiheng Li, Chenliang Xu

Machine learning models can perform well on in-distribution data but often fail on biased subgroups that are underrepresented in the training data, hindering the robustness of models for reliable applications. Such subgroups are typically unknown due to the absence of subgroup labels. Discovering biased subgroups is the key to understanding models' failure modes and further improving models' robustness. Most previous works of subgroup discovery make an implicit assumption that models only underperform on a single biased subgroup, which does not hold on in-the-wild data where multiple biased subgroups exist. In this work, we propose Decomposition, Interpretation, and Mitigation (DIM), a novel method

to address a more challenging but also more practical problem of discovering multiple biased subgroups in image classifiers.

14. Creating an Authoring Tool for K-12 Teachers to Design ML-Supported Scientific Inquiry Learning

Xiaofei Zhou, Hanjia Lyu, Michael Daley, Zhen Bai

Despite significant advances in machine learning (ML) applications within science, there is a notable gap in its integration into K-12 education to enhance data literacy and scientific inquiry (SI) skills. To address this gap, we enable K-12 teachers with limited technical expertise to apply ML for pattern discovery and explore how ML can empower educators in teaching SI. We design a web-based tool, ML4SI, for teachers to create ML-supported SI learning activities. This tool can also facilitate collecting data about the interaction between ML techniques and SI learning. A pilot study with three K-12 teachers provides insights to prepare the next generation for the era of big data through ML-supported SI learning.

15. Glitch: A Light-weight Invariant Checker For G-code

Yumeng He, Chandrakana Nandi, Sreepathi Pai

A 3D printed object often requires many rounds of trial and error. If the only practical way for users to experiment with 3D printing is to conduct repeated prints, the fabrication process becomes inefficient and wasteful. We present a light-weight technique for debugging 3D prints using offline checks. By reconstructing the G-code as a three-dimensional object, we can compare the reconstructed models before and after rotation to reveal unexpected differences. We have found that these differences expose various kinds of design faults in the models as well as slicer bugs. Compared to existing mesh diagnosis and repair tools, our technique catches a wider range of problems since it relies on fundamental invariant checking instead of specific mesh properties. We developed a prototype tool implementing our technique and found that it helps narrow down the root cause of failure in ten real-world models from actual bugs reported for a popular slicer.

16. Passive Automated Fiber-Chip alignment system based on Image Processing and Deep Learning

Jesus Sanchez, Jaime Cardenas, and Supun Liyanaarachchi

This research shows the development of an algorithm for passive Fiber-Chip alignment without human interaction. A methodology was developed to apply Digital Image Processing and the Fourier Transform spectrum to identify alignment patterns using AI. The Deep Learning model controls a motorize three axis stage to perform the alignment process. By implementing computer vision and AI technologies with the optical fiber-to-chip alignment process, we intend to significantly reduce alignment times compared to current industry standards.

17. Online Network Source Localization from Streaming Graph Signals

Chang Ye, Gonzalo Mateos

Localizing sources of network diffusion is a challenging problem with applications in several fields, including sensor-based environmental monitoring, social networks, neural signal processing, or epidemiology. Here, an online network source localization algorithm is developed to process streaming graph signal observations. While the observations are bilinear functions of the unknown sources and diffusion filter coefficients, a mild requirement on invertibility of the filter facilitates a convex, time-separable formulation that we minimize using an online alternating-direction method of multipliers. We derive performance guarantees by conducting a dynamic regret analysis. Unlike batch algorithms for this problem, the novel lightweight iterations incur computational cost and memory footprint that do not grow with the number of temporal samples acquired. Preliminary simulations confirm that the proposed online scheme performs efficient network source localization.

18. Generating Synthetic 2D XRD Patterns for Advanced Deep Learning Analyses

A. Shahnazari, Z. Zhang, S. Dissanayake, C. Xu, and N. Abdolrahim

Two-Dimensional X-Ray Diffraction (2D XRD) is an advanced technique used for the analysis of materials. Unlike traditional X-ray diffraction methods that provide one-dimensional data, 2D XRD captures diffraction patterns in two dimensions. This allows for more comprehensive information on the structure, phase, orientation, and strain of materials. 2D XRD patterns can be classified into two main types: ring patterns (for polycrystals) and spot patterns (for single crystals). In this project, we have focused on generating synthetic 2D XRD spot patterns (single crystal).

High Performance Computing (19)

19. Measuring Data Access Latency in Large CPU Caches

Shaotong Sun, Yifan Zhu, Chen Ding

This project describes a new, multi-locality benchmark program for testing memory access latency and using it to study recent AMD machines equipped with 3D vertical cache (V-Cache) that can be over 1 GiB in total size on a single node. The latency study shows that these large caches differ from traditional LLCs in two aspects: the V-Cache is partitioned rather than shared, and the cache replacement policy is more similar to random than it is to LRU.

Optics, Photonics, Imaging (20-26)

20. Multispectral polarimetric imaging of peripheral nerves

Haolin Liao, Dave J Mitten, Wayne H Knox

In this work we introduce a method for real-time intraoperative peripheral nerve identification. Using LEDs as the light sources, the system contains a driving motor that rotates a pair of orthogonally placed linear polarizers. By performing video lock-in processing to frames taken under the rotating crossed-linear polarization imaging (XPI) system, the AC components of the

periodic backscattering signal of chicken tissues are acquired and compared, and the sciatic nerve is distinct for automatic identification. In both chicken thigh and cadaver arm models, the nerve tissues are successfully highlighted in the lock-in processed output image, while with the frame calculation processing, a real-time mask can be overlaid back to the original frames, highlighting only the nerve. In conclusion, the rotating XPI system with advanced processing methods can serve as an intraoperative nerve identification aid.

21. Modifying the Refractive Index of Hydrogels in the Single Shot Limit

Z. A. Manning, W. R. Donaldson, W. H. Knox

Using high energy femtosecond pulses in a line focus geometry, we demonstrate the writing of refractive index changes in common ophthalmic hydrogel materials at speeds previously unattainable. Compared to the point focus traditionally used for laser micromachining, our process requires higher laser powers, but allows more modification to be performed with each pulse. We present results pushing this to the limit, writing an entire line of index change in a single shot - enabling large, high quality transmission gratings to be written in seconds.

22. On Aligning Segment Anything Model to Remote Sensing Data

Rajat Sahay and Andreas Savakis

The Segment Anything Model (SAM) has demonstrated exceptional capabilities for object segmentation in various settings. In this work, we focus on the remote sensing domain and examine whether SAM's performance can be improved for overhead imagery and geospatial data. Our evaluation indicates that directly applying the pre-trained SAM model to aerial imagery does not yield satisfactory performance due to the domain gap between natural and aerial images. To bridge this gap, we utilize three parameter-efficient fine-tuning strategies and evaluate SAM's performance across a set of diverse benchmarks. Our results show that while a vanilla SAM model lacks the intrinsic ability to generate accurate masks for smaller objects often found in overhead imagery, fine-tuning greatly improves performance and produces results comparable to current state-of-the-art techniques.

23. Shear Wave Speed Estimation with Integrated Difference Autocorrelation

Hamidreza Asemani, Jannick P. Rolland, Kevin J. Parker

In SWE, the aim is to measure the velocity of shear waves, however unwanted compression waves and bulk tissue motion pose challenges in evaluating tissue stiffness. Conventional approaches often struggle to discriminate between shear and compression waves, leading to inaccurate shear wave speed (SWS) estimation. In this study, we propose a novel approach known as the difference autocorrelation estimator to accurately estimate reverberant SWS in the presence of compression waves and noise. Unlike conventional techniques, the difference autocorrelation estimator computes the subtraction of velocity between neighboring particles, effectively minimizing the impact of long wavelength compression waves and other wide-area movements such as those caused by respiration. Our results demonstrate that IDA accurately estimates SWS, even in the presence of strong compression waves. Additionally, IDA exhibits consistency across different modalities and excitation scenarios, highlighting its robustness and potential clinical utility.

24. Molecular Engineering of Shape-Memory and Optical Materials

Mitchell Anthamatten, Ben Carlson, Xinquan Cheng, Madelyn Jeske, Wenshi Zhang

Chemical crosslinking, molecular glass formation, and thermal sintering are employed to crosslink polymeric structures or to fix molecular or particle assemblies into static superstructures. An overview will be provided of: (i) shape-memory networks that can store large amounts of strain elastic energy; (ii) glassy liquid crystals that exhibit selective reflection and transmission of circular polarized light; (iii) thiol-Micheal resins for high resolution, two-photon printing; and (iv) blade-coating and sintering of anisotropic nanoparticles for optical waveplates.

25. Neural Network and Genetic Algorithm Assisted Optimization of Femtosecond Laser Processed Superhydrophobic Surface for Pharmaceutical Applications

Tianshu Xu, Ran Wei, 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. Machine Learning for the Design of Far Ultraviolet Optical Filters

Nikitha Reddy, Pablo A. Postigo

Optical filters are among the most important consumer products in optics. They have wide applications in photography, astronomy, and technical and scientific areas such as biology and medical detection. Multilayer coatings in the far UV (FUV) are required for various fields of application, such as space instrumentation for astrophysics, solar physics, and atmosphere physics, as well as free electron lasers, plasma diagnostics, synchrotron radiation, spectroscopy, etc. Several fluorides are among the materials that keep their transparency down to the short FUV, making them almost the only choice for multilayer coatings tuned in the ~100-180 nm wavelength range. Using the optical constants of MgF2 and LaF3 we have designed a NN that can design an optical filter with a narrowband reflective feature in the FUV. The multilayer may have up to 6 layers and reproduces experimental measurements. The results can be extrapolated to other spectral ranges of interest.

Sensors, Acoustics, Materials (27-29)

27. Complete Electrocatalytic Defluorination of PFOS in Aqueous Electrolyte

Ziyi Meng, Madeleine K. Wilsey, Connor P. Cox, Astrid M. Müller

Perfluorooctane sulfonate (PFOS) was completely defluorinated in aqueous electrocatalysis with nonprecious laser-made [NiFe]-layered double hydroxide nanocatalysts immobilized on hydrophilic carbon fiber paper anodes. Pulsed electrolysis of 0.50 or 0.05 mM PFOS in aqueous 8.0 M LiOH solution assisted by ultraviolet light irradiation enhanced electrical

energy and capital expense efficiency compared to existing techniques. Electrocatalytic defluorination occurred within the anode microenvironment, as evidenced by pulsed electrolysis vs continuous chronoamperometry data and electrolyte agitation experiments. We observed adsorbed PFOS and surface-bound OOH in X-ray photoelectron spectra of post-electrocatalysis anodes, corroborating that electrocatalytically regenerated reactive oxygen species defluorinated PFOS within the anode microenvironment. High concentrations of lithium ions and high basicity were essential for efficient defluorination, which also worked for perfluorooctanoic acid, albeit more efficiently for PFOS, presumably due to advanced oxidation processes by sulfate radicals near the anode that assisted defluorination.

28. Development of a Low-Cost, Low-Power Integrated Machine Health Monitoring Sensor

Michael C. Heilemann, Mark F. Bocko

This project, in conjunction with ADVIS Inc. is focused on developing a device to cost-effectively bring machine health monitoring (MHM) to a broad spectrum of Department of Defense (DoD) assets (vehicles, pumps, rotating machinery), where the implementation of conventional monitoring systems is cost prohibitive. To meet size (1 cubic inch) and power consumption (battery life of 3 years) requirements, the device utilizes low-power embedded machine learning (ML) models with data from acoustic and vibration sensing systems. Spectral features extracted from a recorded signal can be used to train an embedded ML model to perform tasks such as the detection of anomalies and faults in mechanical systems. As security is a primary consideration for the DoD, the device cannot communicate with any of the vehicle's electronics or transmit data to the cloud. Instead, faults are detected with distributed sensing elements and machine learning models deployed on near-to-the-sensor hardware. A prototype anomaly detection model was developed and trained that uses less than 50 kilobytes of memory and consumes less than 140 ÂµW of power during inference, allowing the model to detect anomalies on low-powered embedded devices.

29. Accelerating Decarbonization with Natural Language Processing

Shane Michtavy, Mayk Caldas, Marc D. Porosoff, Andrew D. White

Machine learning (ML) techniques aimed at accelerating catalytic material discovery face key challenges: accurate physical representation of design spaces, high data acquisition costs, and a lack of actionable results for efficient optimization and discovery. To address these issues, we have developed an approach that utilizes natural language to represent materials and experiments. This process leverages advancements in natural language processing to optimize catalysis and generate actionable outcomes. We integrate a modified Bayesian optimization loop to enhance performance in low-data scenarios, while using in-context learning which inherently avoids the common cost and carbon footprints associated with traditional ML methods. Our method has proven effective in exploring large design spaces to optimize objective functions such as CO2 upcycling yields, using both external and proprietary data. This approach could be useful for meeting ambitious carbon dioxide sequestration targets of 10 billion tons per year, by promoting rapid material and process optimization essential for global temperature control.

30. Terahertz Time Domain Spectroscopy for Treatment Monitoring in Pancreatic Ductal Adenocarcinoma

Debamitra Chakraborty

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