University Technology Showcase

Thursday April 4th, 2019

Research Areas:
Optics, Biomedical, Microelectronics, Software and Communication, Energy and Materials, and Data Science

Welcome

Dear Colleagues,

Welcome to the 19th annual University Technology Showcase co-sponsored by the Center for Emerging and Innovative Sciences and the Center of Excellence in Data Science, two New York State funded Centers at the University of Rochester. Our event this year features presentations and a panel discussion from local entrepreneurs and posters representing a sample of the ongoing high-quality applied research at the University of Rochester and the Rochester Institute of Technology. The purpose of this annual event is to provide a forum where people from the regional business community can learn about research being conducted at these great research universities. This also provides an opportunity for members of the business and academic communities to meet and discuss topics of mutual interest. We hope that discussions will lead to continued interactions that will enable companies to tap into the wealth of technology and expertise available at our institutions of higher education to create regional job growth and economic expansion.
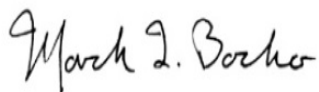
To begin our meeting this year we are very happy to host a panel discussion with founding team members from three exciting technology startup companies located in Rochester. Michel F. Molaire, from Molecular Glasses, Julie Gerstenberger from Moondog Labs, and Sharon Samjitsingh, representing Health Care Originals, will participate in a panel discussion led by Stephanie P. Heller, a corporate and venture consultant, on the challenges and strategies for launching a technology startup company in Rochester.

We are also very pleased to increase the award for the best poster, as judged by today's attendees to $1,000. Make sure you vote!

The technology showcase is one of the ways that CEIS and the CoE in Data Science work to foster industry-university collaboration and technology transfer. We also provide NYS matching funds for company-sponsored research at our local universities, provide direct support to industry through the CoE, and we sponsor workshops and seminars that bring people from industry and academia together to discuss opportunities for technology-driven economic development. Please feel free to contact us to learn more about these efforts and to discuss ways that CEIS and the CoE in Data Science can help your enterprise.

Finally, we greatly appreciate your feedback and encourage you to complete the survey in your packet or find a link to the survey on our website at http://www.ceis.rochester.edu.

Warm Regards,

Mark Bocko, PhD
Director, CEIS

Paul Ballentine, PhD
Executive Director, CEIS

Walter A.L. Johnson, PhD
Executive Director, COE in Data Science

Featured Speakers

Julie Gerstenberger, *Co-Founder and CEO, Moondog Labs*

Julie Gerstenberger is the Co-Founder and CEO of Moondog Labs, which develops unique mobile device lenses for filmmakers and photographers. Moondog Labs lenses have been used in high profile films ranging from Sundance hit Tangerine to Steven Soderbergh's recently released High Flying Bird. Julie is an electrical and optical engineer whose background includes product development and technology commercialization for a wide range of applications and markets, including some of the earliest digital imaging systems, as well as strategic planning, business development, technical management, and project management.

Stephanie Heller, *Venture and Business Coach, The Entrepreneurs Network*

Stephanie has extensive experience in leading and managing corporate development transactions, strategic initiatives, alliances and sales in US and Europe for hardware, software, services and information technology. Expertise in startup and new business growth, strategy, recognizing and driving innovation opportunities, strategic partnerships, investment strategy, marketing, and sales. She is recognized for building successful internal and external alliances with companies executing an unlimited range of investments, product/services development and marketing partnerships.

Michel Molaire, *Founder and CEO, Molecular Glasses, Inc.*

Mike Molaire has 40 years of interdisciplinary experience spanning intellectual property expertise, technology transfer, materials research, process development, project leadership, sales, business analysis and planning. In addition to 58 62 U.S. patents, he holds over 120 international patents. He has received the Kodak C.E.K. Mees Award for excellence in scientific research and reporting, as well as membership in Kodak's Distinguished Inventors Gallery and an African Scientific Institute Fellowship. A senior research associate at the Eastman Kodak Company until 2010, he recently served on the board of the Society for Imaging Science and Technology (IS&T) and the Rochester Professional Consultant Network (RPCN). A graduate of the University of Rochester, he holds a B.S. in chemistry, M.S. in polymer science and an MBA.

Featured Speakers

Sharon Samjitsingh, *Co-Founder, Health Care Originals Inc.*

Sharon has spent more than 25 years developing expertise in engineering, project and corporate management and technical entrepreneurship. Sharon obtained her Masters at the University of Rochester and prior to that she led Group Projects for a large conglomerate, having oversight on a capital project portfolio in excess of $100 million. She is one of less than 1,900 professionals worldwide to have received triple certification of PMP®, PMI-SP® and PMI-RMP®. She leads the deployment and scale-up of Sweetwater Energy's game-changing solution for biomass pre-treatment –a system that will revolutionize renewable fuels, chemicals and materials. Sweetwater Energy is deploying its first commercial-scale model in Estonia in 2019.Sharon also co-founded Health Care Originals, Inc. (HCO). HCO is an award-winning digital health startup, utilizing a combination of its proprietary technology and technology developed at the School of Nursing, University of Rochester. HCO's mission is to improve the quality of life for everyone diagnosed with a chronic respiratory disease. Sharon co-founded Health Care Originals because she has a personal understanding of the need for significant change in respiratory monitoring and is confident that Health Care Originals' technology can lead the way. Sharon is passionate about the level of freedom, depth of understanding and personalized control that digital health solutions, medical wearables and the IoT environment offer the individual, and is excited to be a part of the ecosystem bringing that promise to reality.

Recognition

2018 Recipient

John Loury, Cause + Effect Strategy and Marketing.

John Loury is a marketing strategist and Co-Founder/President of Rochester based Cause + Effect Strategy and Marketing (CESM). CESM is a marketing intelligence firm that leverages data insights to develop analytics and marketing strategies for both local and national clients. This past year CESM has seen an outstanding 83% growth in business, thanks in part to its data-driven approach to marketing strategy that is able to gain greater visibility into each client's business and unify otherwise siloed data.

A model commercial partner for the University of Rochester's Center of Excellence in Data Science (CoE), CESM is also a partner member of the Rochester Data Science Consortium. By forging productive research partnerships with data science experts in the region, CESM is able to draw upon their vast analytics expertise to develop robust marketing strategies for his clients.

A native of Rochester, John graduated from Monroe Community College, and received his BA in communication and MA in informatics from The State University of New York at Buffalo.

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Center for Advanced Ceramic Technology

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Promoting Innovation Through Law™

ROCHESTER
DATA SCIENCE CONSORTIUM

Technology Supporters

Technology Supporters

T1   Rochester Data Science Consortium

T2   AIM Photonics

T3   Light & Sound Interactive®

T4   UR Ventures

T5   Excell Partners

T6   NYS Center of Excellence – Materials Informatics at the State University of New York at Buffalo

T7   Cornell Center for Materials Research

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T12   Center for Integrated Research Computing (CIRC)

T13   Center for Advanced Ceramic Technology (CACT) at Alfred University

T14   New York State Science & Technology Law Center (NYS STLC) at Syracuse University College of Law

T15   AHEAD Energy Corporation

T16   MicroEra Power

T17   Goergen Institute for Data Science at the University of Rochester

T18   University of Rochester Center for Entrepreneurship/Technical Entrepreneurship and Management (TEAM) M.S. Program

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T1   Rochester Data Science Consortium

The Rochester Data Science Consortium was founded in 2017 by the University of Rochester and Harris Corporation, with funding from New York State and Governor Andrew M. Cuomo. Its membership now includes the some of the largest employers in the Finger Lakes Region, such as Wegmans and RIT, in addition to new and growing startup companies. Located at NextCorps in the heart of the Rochester Downtown Innovation Zone, the Rochester Data Science Consortium gives businesses and organizations a competitive edge with access to the data science expertise, partners and technologies needed for rapid development and deployment of data-driven solutions. To learn more, please visit the Rochester Data Science Consortium website at www.ROCDataScience.com.

T2   AIM Photonics

The **A**merican **I**nstitute for **M**anufacturing Integrated **Photonics** (AIM Photonics), is an industry driven public-private partnership that focuses the nation's premiere capabilities and expertise to capture critical global manufacturing leadership in a technology that is both essential to National security and positioned to provide a compelling return-on-investment to the U.S. economy. The Institute's goal is to emulate the dramatic successes experienced by the electronics industry over the past 40 years and transition key lessons, processes, and approaches to the photonic integrated circuit (PIC) industry. AIM Photonics supports Small and Medium Enterprises, providing practical access and technology on-ramps for U.S. industry, government, and academic communities. We are creating a National PIC manufacturing infrastructure, widely accessible and inherently flexible to meet the challenges of the marketplace with practical, innovative solutions.

T3   Light & Sound Interactive®

If you are looking for cutting edge technology or you have something innovative to offer, one-on-one meeting space, personal networking opportunities abound. In the heart of Rochester, start-ups and new technologies have blossomed at the Light & Sound Interactive Conference. This year the event will run June 25-27, 2019 in downtown Rochester, NY. Globally there is no other place like this region for optics, AR/VR, light and sound-based technologies. With new ideas permeating the air, you'll be sure to get inspired for your next project and network with those making waves in the industry. Over the course of two and a half days, you will dive into sessions with impressive and renowned speakers, experience cutting-edge product demos, world-class keynote style talks and meets-ups with new and like-minded enthusiasts and/or investors. In between all that, you will enjoy food, drink, and music at The Rochester International Jazz Festival.

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T4   UR Ventures

At UR Ventures, our mission is to develop UR innovations into valuable products and services to make the world ever better. Unlike the traditional academic technology transfer operation, UR Ventures has adopted a project management approach for every disclosed invention. Our goal is to locate and secure the resources necessary to get our discoveries into the hands of people who can most benefit from them or to define the gaps standing in the way of success. Every discovery that comes through our door presents a unique challenge. We look forward to meeting those challenges head on.

T5   Excell Partners

Excell is a venture fund that invests in seed and early stage high-tech startups in Upstate New York. With $12 million under management, Excell's portfolio includes investments in medical devices, advanced materials, energy, biotech, agtech, imaging and IT/Software across New York State. Excell is one of the most active seed funds in Upstate New York, with its investments resulting in more than $200 million in follow on funding and creating hundreds of high-paying jobs.

Excell, through its affiliation with the University of Rochester and partnerships with RIT, UB, Syracuse University, Cornell University, and other leading research institutions, is well positioned to tap into the unrealized potential emerging from these institutions; to identity their most promising technologies and to provide the financing, critical services, mentoring, and follow-on capital necessary to bring these companies to a commercial success. More information at: www.excell.com.

T6   NYS Center of Excellence – Materials Informatics at the State University of New York at Buffalo

Whether you are a startup or thriving company continuing to innovate, the Center of Excellence in Materials Informatics is here to help. As a solutions-driven center and community resource, we deploy the skills of University at Buffalo researchers and partnering institutions to address industry's materials challenges by developing breakthrough technologies, fostering entrepreneurship, and facilitating workforce development assistance programs. We provide materials companies with solutions to R&D challenges, the ability to discover new materials and processing methods, access to state-of-the-art equipment, and the brightest student minds looking to enter the workforce.

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T7   Cornell Center for Materials Research

The Cornell Center for Materials Research (CCMR) is funded by the National Science Foundation. Its primary mission is to perform cutting-edge materials research. The center also provides support to industry through the NYSTAR-funded Industrial Partnerships Program. The program promotes technology transfer and economic development by offering to industry low-cost, timely and flexible access to world-leading materials experts (Cornell faculty members) and to state-of-the-art instruments, enabling product development as well as expansion to wider markets.

T8   Finger Lakes Community College (FLCC) Victor Campus

FLCC Instrumentation and Control Technologies program based in Victor, works with 50+ high-tech businesses to address need for adaptable technical workforce across the Finger Lakes Greater Rochester High-tech Ecosystem. Students use LabVIEW software for courses in physics, data acquisition, automation control and robotics along with other skills such as use of microcontrollers and PLCs. Students also complete courses in CAD, Materials and Processing and Lean Six Sigma along with English and public speaking.   Students are required to complete a paid co-op; through which they learn business specific skills; often leading to full time employment with the business. Courses are scheduled after 4 pm; hence students start full-time work before graduation. The 2-year degree program has had estimated cumulative economic impact of $25 million over the past six years. This May, the seventh cohort will be graduating, bringing the total number of graduates to over 60.

T9   Monroe County/Finger Lakes PTAC

Monroe County Economic Development's purpose is promoting and providing economic development opportunities within the County of Monroe, providing additional employment and job opportunities.   Through the Monroe County Industrial Corporation (MCIDC), financial assistance is provided to small businesses demonstrating a need that cannot be met entirely from conventional financial sources. The County of Monroe Industrial Development Agency (COMIDA) provides assistance to qualified applicants/projects via tax exemptions and real property tax abatements.

Monroe County Finger Lakes Procurement Technical Assistance Center (PTAC) serves as the official procurement technical assistance center for the Finger Lakes Region. PTAC helps businesses sell their products and services to federal, state and local governments, and the military marketplace. There is no fee for MCFL PTAC services: assess readiness, analyze market opportunities, assist with registrations and proposal development, identify bid leased, and connect with government buyers and prime contractors.

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T10   RIT Intellectual Property & Technology Transfer Office

Welcome to RIT's Intellectual Property and Tech Transfer Office (IPMO) and Sponsored Research Offices (SRO). IPMO is responsible for managing RIT's Intellectual Property (IP) portfolio and bringing that IP to the marketplace through licenses to existing or start-up companies. SRO is responsible for connecting RIT's faculty to companies for sponsored research projects. We are all happy to make connections to RIT research faculty across RIT's campus – Imaging, Computing, Sustainability, Microsystems, Engineering, Science and Biomedical topic areas plus many more - see our websites at: https://www.rit.edu/ipmo; https://www.rit.edu/reasearch.

T11   NextCorps

NextCorps (formerly known as High Tech Rochester) is a not-for-profit economic development organization and is an authorized center of the NIST funded Manufacturing Extension Partnership (MEP), a manufacturing assistance program. NextCorps Growth Services provides support in areas such as strategic planning, quality system development, sales and marketing, product development and productivity improvement to all types of manufacturers in the Finger Lakes Region. NextCorps also offers business incubation for high tech startups at two different locations, the Lennox Tech Enterprise Center in Henrietta and at Sibley Square in downtown Rochester.

T12   Center for Integrated Research Computing (CIRC)

The University of Rochester established the Center for Integrated Research Computing (CIRC) to provide researchers with technology, software, training, and support necessary to utilize high-performance computing (HPC) and data science technology in research activities in all areas of academic scholarship. CIRC currently maintains systems with aggregated computational performance of about 420 teraFLOPS (including a leadership-class IBM Blue Gene/Q supercomputer), 2.2 petabytes of disk storage, and a variety of scientific software applications and tools.

CIRC hosts a number of collaborative events to help the research community learn how to use computing technology in research and development projects. Consultants, computing time, and a new visualization facility (VISTA Collaboratory) are available to help enable research projects at the University and its business partners.

T13   Center for Advanced Ceramic Technology (CACT) at Alfred University

First designated in 1987, the **Center for Advanced Ceramic Technology (CACT) at Alfred University** is one of 15 Centers for Advanced Technology (CAT) located across New York

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State, created to speed technology transfer from universities to the marketplace. The CACT specializes in applied and technical research to solve real-world problems in support of practicable, scalable solutions leading to commercialization of cutting edge technical ceramic and glass products and solutions. As the only institution in the country to offer a glass science PhD program, and one of only two institutions dedicated to ceramic engineering in the nation, the CACT links firms into a unique skill set to solve challenges addressing a wide range of technical and research areas, including but not limited to, bioceramics, electronic ceramics, metal-ceramic composites, structural ceramics, whitewares, fuel cell and energy storage materials, ceramic powders and nanoparticles, specialty glass processing, tape casting, and specialized sintering capabilities.

CACT also provides support for programming with New York State-based companies – large and small – with matching funds provided through its annual operating contract with New York State's Division of Science, Technology and Innovation (NYSTAR). Whether it's a short-term analytical testing project, or a long-term research & development program, CACT can lower development costs and help ensure faster time to market for technical ceramics and glass technologies.

T14   New York State Science & Technology Law Center (NYS STLC) at Syracuse University College of Law

The New York State Science & Technology Law Center (NYS STLC) helps researchers, entrepreneurs and companies with new technologies identify potential challenges and devise effective strategies to successfully bring that technology to market. This is accomplished by researching and providing information and education on a wide range of technology-related legal issues, including the protection and commercialization of intellectual property, technology transfer practices, patents, copyright and trademark law, and licensing agreements.

T15   AHEAD Energy Corporation

AHEAD Energy Corporation, 501(c)3, owns and occupies an open-source testing and commercialization facility in Rochester, NY. Formed in 1988 through the University of Rochester, AHEAD initially worked toward a world in which universal access to energy would enable all people to attain a high quality of life on a thriving planet. In recent years, AHEAD has re-focused locally, striving to support the Rochester clean energy community with a space for innovation and commercialization. Cost-effective, 24/7 performance and durability test facilities for engine, battery, catalyst, reformer, fuel cell stack and system testing are currently available to both industrial and academic communities.

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T16   MicroEra Power

MicroEra Power is venture-backed and is developing the world's most efficient on-site Combined Cooling, Heat, and Power systems (100 – 400 kW range) to provide businesses with ultra-reliable Back-Up Power and cost-effective On-Site Power Generation. Our system can replace an existing boiler with a hybrid power system, operating on inexpensive Natural Gas or Propane, to provide a Value-Creating Energy Management Tool with a FAST PAYBACK.

T17   Goergen Institute for Data Science at the University of Rochester

The Goergen Institute for Data Science (GIDS) at the University of Rochester is home to interdisciplinary data science research and the interdepartmental data science academic programs. Academic programs for BA, BS and MS degrees combine computer science, statistics, and a student's choice of advanced coursework in an application area of data science, including business, biology, earth and environmental science, political science, and others. GIDS is home to several [New York State Center of Excellence](#) in Data Science distinguished researchers and is a hub for interdisciplinary data science research. GIDS is also home of the Rochester Data Science Consortium to give businesses and organizations a competitive edge with access to the data science expertise, partners and technologies needed for rapid development and deployment of data-driven solutions.

T18   University of Rochester Center for Entrepreneurship/Technical Entrepreneurship and Management (TEAM) M.S. Program

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

The Center also administers a multidisciplinary engineering and business graduate program: the Master of Science in Technical Entrepreneurship and Management (TEAM). This program offers students the opportunity to immerse themselves in a technical concentration of their choice while receiving a strong foundation in entrepreneurial management. Through a fast-paced curriculum at the University's Hajim School of Engineering & Applied Sciences and the Simon Business School, students can complete the 33-credit program in as little as one academic year.

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A three-semester option, which includes a summer internship, and part-time study are also available. Degree requirements include a semester-long practicum and a written business plan and oral presentation. TEAM students also have access to comprehensive career placement programming and staff. Learn more at www.rochester.edu/team.
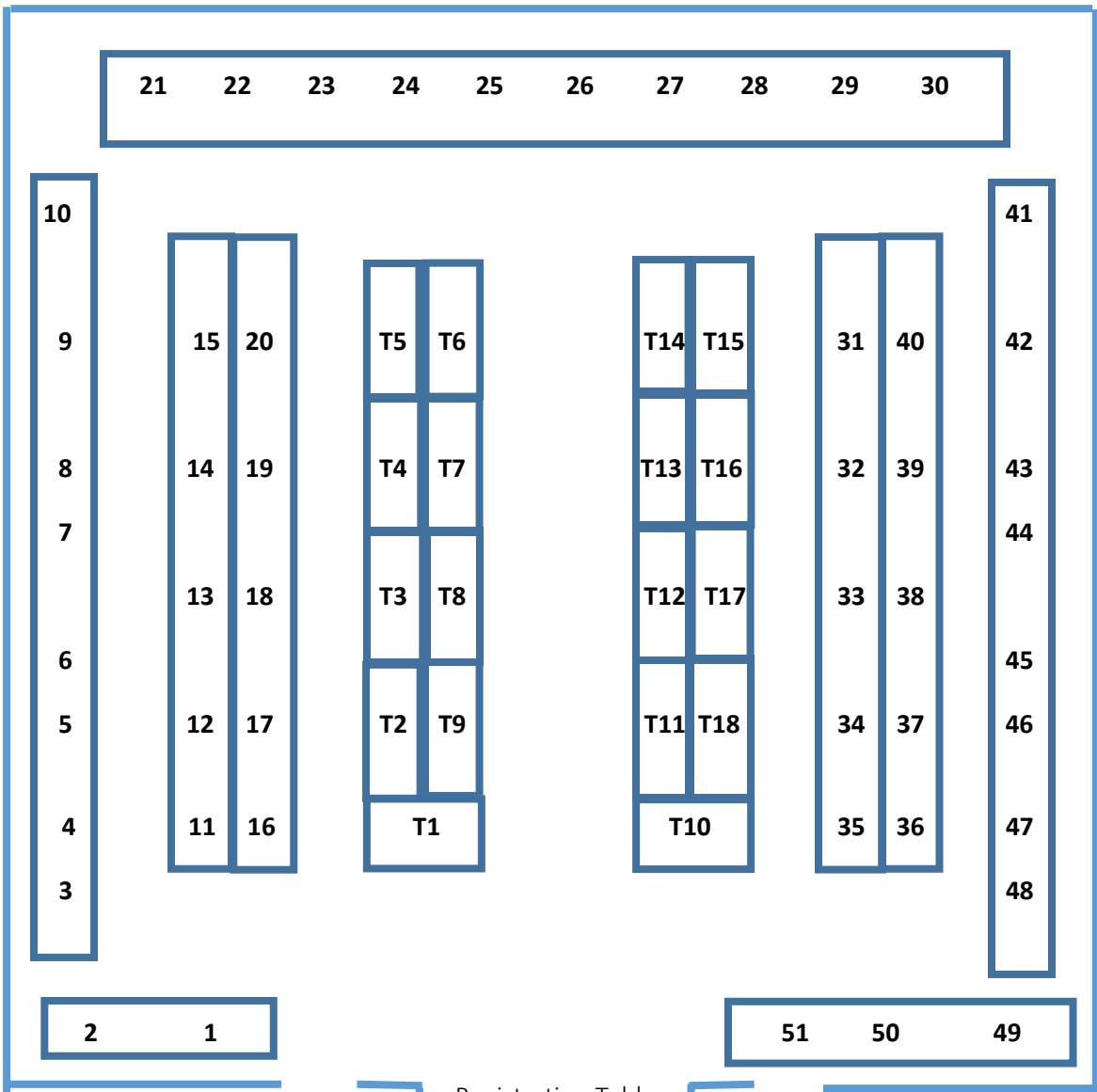
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Biomedical Engineering 30 - 36	Electrical Engineering, Computer Engineering 37 - 51

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Registration Table

Poster Presentations

Optics, Photonics and Imaging

1. **Alleviating the Vergence-Accomodation Conflict in Virtual Reality with Extended Depth of Focus Optics**
   Jiakai Lyu [1,2,3], Cherlyn J. Ng [2,3], Chloe Degre [2,3] and Geunyoung Yoon [3,2,1]
   [1] The Institute of Optics, University of Rochester; [2] Flaum Eye Institute, University of Rochester; [3] Center for Visual Science, University of Rochester, Rochester, NY

2. **Diffractive Beam-Rider**
   Prateek Ranjan Srivastava
   Rochester Institute of Technology, Rochester, NY

3. **Femtosecond Laser Micromachining in Ophthalmic Hydrogels: Micro-Raman Spectroscopy of Materials Effects**
   Dan Yu[1], Ruiting Huang[1] and Wayne H. Knox[1,2,3]
   [1]The Institute of Optics, [2]Center for Visual Science, University of Rochester, Rochester, NY, [3]Clerio Vision, Inc., Rochester, NY

4. **Fiber to Chip Fusion Splicing for Low Loss Photonic Packaging**
   Juniyali Nauriyal[1], Meiting Song[2], Raymond Yu[2] and Jaime Cardenas[2]
   [1]Department of Electrical and Computer Engineering, University of Rochester; [2]The Institute of Optics, University of Rochester, Rochester, NY

5. **Gabor Domain Optical Coherence Elastography (GD - OCE): towards the elasticity measurement of microstructures for biomedical applications**
   Fernando Zvietcovich[1], Cristina Canavesi[2], Andrea Cogliati[2], Jannick P. Rolland[3], and Kevin J. Parker[1]
   [1]University of Rochester, Department of Electrical and Computer Engineering Rochester, New York, United States, [2]LighTopTech Corp., Rochester, NY, United States, [3]The Institute of Optics, Rochester, NY

6. **Geometric Phase Shearing Interferometer**
   L. Aleman-Castaneda[1], B. Piccirillo[2], L. Marrucci[2] and M. Alonso[1,3,4,5]
   [1]University of Rochester, Rochester, NY, [2]University of Naples Federico II; [3]Institut Fresnel; [4]Aix-Marseille Université; [5]Centrale Marseille

7. **Hemianopia Intervention Study: a Gaze-Contingent Approach to Visual Rehabilitation**
   Matthew Cavanaugh, Madhura Tamhankar, Byron Lam, Krystel Huxlin and Steven Feldon
   University of Rochester Medical Center, Rochester, NY

Poster Presentations

8. **Hybrid Gabor Domain Optical Coherence Microscopy**

   Changsik Yoon[1], Yue Qi[2], Humberto Mestre[3], Olivia Marola[4], Andrea Cogliate[5], Cristina Canavesi[5], Maiken Nedergaard[3], Richard T. Libby[4], Jannick P. Rolland[1,2,5]
   [1]The Institute of Optics, University of Rochester; [2] Department of Biomedical Engineering, University of Rochester; [3]Center for Translational Neuromedicine, Department of Neurosurgery, University of Rochester; [4]Flaum Eye Institute, Department of Ophthalmology, University of Rochester Medical Center; [5]LighTopTech Corporation, Rochester, NY

9. **Increase in Efficacy of Near-Infrared Femtosecond Micromachining in Ophthalmic Hydrogels with the Addition of Biocompatible Doping Agents**

   Sara M. G. Campaign, Wayne H. Knox
   University of Rochester, Rochester, NY

10. **Integrated Silicon Photonic Optical Phased Array Design**

    Francis Smith, Wuxiucheng Wang, Hui Wu
    Laboratory for Advanced Integrated Circuits and Systems (LAICS) University of Rochester, Rochester NY

11. **Optimization for Laser System Parameters of Femtosecond Micromachined Ophthalmic Materials**

    Ruiting Huang
    University of Rochester, Rochester, NY

12. **Picosecond UV Photodiodes**

    W. R. Donaldson, Y. Zhao
    Laboratory for Laser Energetics, University of Rochester, Rochester, NY

13. **Quantum Dot Coating of Image Detectors for Enhanced UV Sensitivity**

    Alex Knowles, Zoran Ninkov, Scott Williams and Ross Robinson
    Rochester Institute of Technology, Rochester, NY

14. **Short- and Long-term Impact of Laser-Induced Refractive Index Change (LIRIC) on Corneal Nerve Distribution in Rabbits**

    Kaitlin T. Wozniak[1A], Sam C. Butler[2], Margaret DeMagistris[1B], Christine Callan[1B], Wayne H. Knox[1A], Jonathan D. Ellis[3] and Krystel R. Huxlin[1A,B]
    [A]The Institute of Optics; [B]Flaum Eye Institute; [1]University of Rochester, Rochester, NY, [2]Clerio Vision Inc. Rochester, NY, [3]College of Optical Sciences, University of Arizona

Poster Presentations

15.The role of optical and neural factors in the peripheral retina in myopia progression

Yifei Wu[2,3], Qiuzhi Ji[1], Jiakai Lyu[1,2,3], Geunyoung Yoon[3,2,1]
[1] The Institute of Optics, University of Rochester, Rochester, NY, [2]Flaum Eye Institute, University of Rochester, Rochester, NY, [3]Center for Visual Science, University of Rochester, Rochester, NY

16.Weak Value Amplification with Integrated Photonic Device

Meiting Song[1], John Steinmetz[2], Juniyali Nauriyal[1], Marissa Granados Baez[1], Yi Zhang[1], Andrew Jordan[2], Jaime Cardenas[1]
[1]The Institute of Optics, University of Rochester; [2]Department of Physics and Astronomy and The Center for Coherence and Quantum Optics, University of Rochester, Rochester, NY

Data Science

17.A Machine-Learning Approach to Estimating a Higher Education Institution's Standing in the Global Academic Research Landscape

Meizhu Wang, Yue Zhao, Dale P. Hess, Edgar A. Bernal
Rochester Data Science Consortium, University of Rochester, Rochester, NY

18.Algorithms and Models for Efficient Human-Robot Interaction with Collaborative Robots

Jacob Arkin, Siddharth Patki, Thomas M. Howard
University of Rochester, Rochester, NY

19.Classification of Myotonic Dystrophy Time Series Based on Triplet Neural Network

L Lin[1], B. Xu[1], W. Wu[1], E. Bernal[1], T. Richardson[1], B. Martens[2], C. Thornton[2] and C. Heatwole[2]
[1]Rochester Data Science Consortium, University of Rochester; [2]University of Rochester Medical Center, Rochester, NY

20.Data Quality and Security Evaluation Toolset

Igor Khoklov
Rochester Institute of Technology, Rochester, NY

21.Exploring Parkinson's Disease Progression using Deep Generative Models Built on DaTscan Brain Imagery

T. Richardson[1], B. Xu[1], W.Wu[1], L.Lin[1], C Venuto[2], M. Javidnia[2], E. Bernal[1]
[1]Rochester Data Science Consortium, University of Rochester, Rochester, NY ,[2] Center for Health + Technology, University of Rochester Medical Center, Rochester, NY

Poster Presentations

22. Part-invariant Model for Music Generation and Harmonization

Yujia Yan, Ethan Lustig, Joseph VanderStel, Zhiyao Duan
University of Rochester, Rochester, NY

23. Towards Human-Machine Real-Time Music Improvisation

Christodoulos Benetatos, Zhiyao Duan
University of Rochester, Rochester, NY

Chemical Engineering, Mechanical Engineering, and Materials Science

24. A Pocket-Sized Chemical Plant: AR for Chemical Engineering Education

Rainier Barrett, Heta Gandhi, Zitue Yang, Tayfun Sahin, Andrew White
University of Rochester, Rochester, NY

25. Kinetics of Cationic Chemical Vapor Deposition

Dominic Giambra, Wyatt Tenhaeff
Department of Chemical Engineering, University of Rochester, Rochester, NY

26. Phthalate-plasticization of nitrile-bearing polymer electrolytes for high-voltage solid-state lithium batteries

Yineng Zhao, Wyatt E. Tenhaeff
Department of Chemical Engineering, 4303 Wegmans Hall, University of Rochester, Rochester, NY

27. Potential effects of localized material property changes on the shape and optical performance of the cornea

Elizabeth Diaz Bueno, Amy Lerner, Kathryn Colone, Paul Funkenbusch
University of Rochester, Rochester, NY

28. Stochastic Study of Vehicle-to-Grid Economics in Six Major US Cities

Heta Gandhi, Andrew D. White
Department of Chemical Engineering, University of Rochester, Rochester, NY

29. Understanding the Electrochemistry of Thin Film LiCoO2 in Aqueous Electrolytes

Marina Maria Ioanniti*, Wyatt Tenhaeff
Department of Chemical Engineering, University of Rochester, Rochester, NY

Poster Presentations

Biomedical Engineering

30. A Characterization of the Motion of a Contact Lens
Kara L. Maki, David S. Ross
Rochester Institute of Technology, Rochester, NY

31. Compressive Beamforming for Portable Ultrasound Imaging with the Promise of Super Resolution
Jovan Mitrovic[1], Lynn La Pietra[2], Zeljko Ignjatovic[1]
[1]University of Rochester, Rochester NY; [2]Carestream Health, Rochester, NY

32. Fouling of Ultrathin Silicon Membranes in Tangential Flow Filtration
Syed Danial Ahmad, Kilean Lucas, James McGrath
University of Rochester, Rochester, NY

33. Heart Rate and QT Interval Variability Index Measures Are Biomarkers for Cardiac Arrhythmias in Long QT Syndrome Type 1
Ahmed Selmi[1,2], Samuel Kashtan MS[1,2], Xiaojuan Xia PhD[2], Jean-Phillippe Couderc PhD[2], David S. Auerbach PhD[2,3,4]
[1]Biomedical Engineering ,[2]Medicine-Heart Research Follow-Up Program , [3]Medicine-Aab Cardiovascular Research Institute ; [4]Pharmacology/Physiology , University of Rochester, Rochester, NY

34. High-Frequency Quantitative Ultrasound System Development for Characterizing Collagen Fiber Alignment in Tendon
Sarah Wayson[1, 3], María Helguera[3, 4], Denise C. Hocking[2, 3], Diane Dalecki[1, 3]
[1]Department of Biomedical Engineering; [2]Department of Pharmacology and Physiology; [3]Rochester Center for Biomedical Ultrasound, University of Rochester Rochester, NY, [4]Tecnológico Mario Molina, Lagos de Moreno, Jalisco, México

35. Image-based biomarker for Cancer Recurrence Prediction Using SHG Imaging
Wencheng Wu[1], Robert Hill[2], Edward Brown[3], Beilei Xu[1], Edgar Bernal[1] and Erik Pata[3]
[1]Rochester Data Science Consortium, University of Rochester; [2]Harmonigenic Corporation; [3]Department of Biomedical Engineering, University of Rochester, Rochester, NY

36. Potential effects of localized material property changes on the shape and optical performance of the cornea
Elizabeth Diaz Bueno, Amy Lerner, Kathryn Colone, Paul Funkenbusch
University of Rochester, Rochester, NY

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Electrical Engineering, Computer Engineering

37. Aerial-CAM: Class Activation Maps of Aerial Imagery
Bhavan Vasu, Andreas Savakis
Rochester Institute of Technology, Rochester, NY

38. Beatza: Automated Hip-Hop Beat Generation
Steven Belitzky, Albert Peyton
University of Rochester, Rochester, NY

39. Binaural Perception of Stereo Noise Bursts as a Function of Burst Duration and Degree of Interchannel Coherence
Steven Crawford, Mark Bocko
University of Rochester, Rochester, NY

40. Blind Identification of Invertible Graph Filters with Multiple Sparse Inputs
Chang Ye, Rasoul Shafipour, Gonzalo Mateos
Dept. of Electrical and Computer Engineering University of Rochester, Rochester, NY

41. Design and Characterization of a 10 x 10 Pixel Array THz Camera in 350nm CMOS technology
Moeen Hassanalieragh[1], Zeljko Ignjatovic[1], Katie Seery[2], Zoran Ninkov[2], J. Daniel Newman[3], Andrew Sacco[3], Kenneth Fourspring[3]
[1] University of Rochester, Rochester NY, [2] Rochester Institute of Technology Rochester NY, [3] Harris Corporation Space & Intelligence Systems Division, Rochester, NY

42. Evaluating Methods for Enabling Continuous Operation in Dynamic WiFi Direct Networks
Aaron Faulkenberry, Utku Demir, Cristiano Tapparello and Wendi Heinzelman
University of Rochester, Rochester, NY

43. Faster Art-CNN: an Extremely Fast Style Transfer Network
Bryan Blakeslee, Raymond Ptucha, Andreas Savakis
Department of Computer Engineering, Rochester Institute of Technology Rochester, NY,

44. Nanowire Light Emitting Diode with Field Effect Transistor
Matthew Hartensveld
Rochester Institute of Technology Rochester, NY,

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45. NBTI-Aware Digital Low-Dropout Regulator with Adaptive Gain Scaling Control

Soner Seçkiner, Longfei Wang, Selçuk Köse
University of Rochester, Rochester, NY

46. Online system of sound search by vocal imitation

Yichi Zhang, Yiting Zhang, Zhiyao Duan
University of Rochester, Rochester, NY

47. Performance Evaluation of Wi-Fi Direct Multi-Hop Ad-Hoc Networks

Nadir Adam, Cristiano Tapparello and Wendi Heinzelman
University of Rochester, Rochester, NY

48. Real-Time Music Improvisation

Christodoulos Benetatos
University of Rochester, Rochester, NY

49. Side-Channel Attacks: Threats and Solutions

M. Ali Vosoughi, Selçuk Köse
Department of Electrical and Computer Engineering, University of Rochester, Rochester, NY

50. Speech Super Resolution Generative Adversarial Network

Sefik Emre Eskimez, Kazuhito Koishida and Zhiyao Duan
University of Rochester, Rochester, NY

51. Towards Designing On-chip Power Delivery Against Covert Communication Attacks

Longfei Wang[1], S. Karen Khatamifard[2], Ulya R. Karpuzcu[2], and Selçuk Köse[1]
[1]University of Rochester, Rochester, NY, [2]University of Minnesota, Minneapolis, MN

Poster Presentations

Optics, Photonics and Imaging

1. Alleviating the Vergence-Accomodation Conflict in Virtual Reality with Extended Depth of Focus Optics

Jiakai Lyu [1,2,3], Cherlyn J. Ng [2,3], Chloe Degre [2,3] and Geunyoung Yoon [3,2,1]
[1] The Institute of Optics, University of Rochester; [2] Flaum Eye Institute, University of Rochester; [3] Center for Visual Science, University of Rochester, Rochester, NY

The vergence-accommodation conflict, a mismatch between vergence and accommodation in virtual/augmented reality, can cause visual discomfort and be a major problem. Extended depth of focus technique yields more allowance for accommodation induced by convergence, so it could reduce the vergence-accommodation conflict. We tested this hypothesis using spherical aberrations induced by a binocular adaptive optics vision simulator. The results demonstrated a significant increase in binocular accommodation with extended depth of focus despite acceptable degradation of visual acuity and stereoacuity. We expect that extended depth of focus minimizes visual symptoms associated with the vergence-accommodation conflict.

2. Diffractive Beam-Rider

Prateek Ranjan Srivastava
Rochester Institute of Technology, Rochester, NY

A laser-driven Light Sail is described. The Light Sail makes use of diffraction films, unlike conventional reflective films, to impart momentum for in-space propulsion. The spatially variant "bi-grating" based design of sail provides restoring force and torque when displaced from the equilibrium position and making it capable of "beam-riding". Analytical results are derived and confirmed using numerical simulations.

3. Femtosecond Laser Micromachining in Ophthalmic Hydrogels: Micro-Raman Spectroscopy of Materials Effects

Dan Yu[1], Ruiting Huang[1] and Wayne H. Knox[1,2,3]
[1]The Institute of Optics, [2]Center for Visual Science, University of Rochester, Rochester, NY
[3]Clerio Vision, Inc., Rochester, NY

With tightly focused, low-energy laser pulses, femtosecond laser micromachining can locally modify the refractive index (RI) of bulk materials via multiphoton absorption. Following the success of inducing RI changes in various ophthalmic hydrogels and corneal tissue at laser repetition rates of 80 MHz; we now find that operating at lower repetition-rates enables us to obtain much higher RI changes at lower average powers. Single layer dense line patterns of different phase change magnitudes were inscribed into hydrogels using a 405 nm, low-repetition rate laser. The microstructural changes were characterized by confocal micro-Raman spectroscopy with a special edge-detection technique.

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4. Fiber to Chip Fusion Splicing for Low Loss Photonic Packaging

Juniyali Nauriyal[1], Meiting Song[2], Raymond Yu[2] and Jaime Cardenas[2]
[1]Department of Electrical and Computer Engineering, University of Rochester; [2]The Institute of Optics, University of Rochester, Rochester, NY

Silicon photonic devices are poised to enter high volume markets such as data-communications, telecommunications, biological sensing, and optical phased arrays; however, permanently attaching a fiber to the photonic chip with high optical efficiency remains a challenge. We present a robust and low-loss packaging technique of permanent optical edge coupling between a fiber and a chip using fusion splicing which is low cost and scalable to high volume manufacturing. We fuse a SMF-28 cleaved fiber to the chip via CO2 laser and reinforce it with optical adhesive. We demonstrate minimum loss of 1.0dB per-facet with 0.6dB penalty over 160nm bandwidth from1480nm-1640nm.

5. Gabor Domain Optical Coherence Elastography (GD - OCE): towards the elasticity measurement of microstructures for biomedical applications

Fernando Zvietcovich[1], Cristina Canavesi[2], Andrea Cogliati[2], Jannick P. Rolland[3], and Kevin J. Parker[1]
[1]University of Rochester, Department of Electrical and Computer Engineering Rochester, New York, United States, [2]LighTopTech Corp., Rochester, New York, United States, [3]The Institute of Optics, Rochester, NY

In medicine, both pathological (e.g. cirrhosis) and non-pathological states (e.g. aging) can be characterized by changes in the mechanical properties of biological tissue. The use of optical techniques to measure and map the elastic properties of soft tissue, known as optical elastography, is an emergent field with applications in various clinical disciplines, including ophthalmology and dermatology. In this presentation, we propose two elastography techniques based on mechanical wave propagation for the study of cornea and brain architecture using optical coherence tomography (OCT). Subsequently, we explore the implementation of such techniques in a Gabor domain optical coherence microscopy (GD-OCM) system which provides of higher axial and lateral resolution (~ 3 μm) for the characterization of microstructures. Preliminary results in tissue mimicking phantoms demonstrate the capabilities of the first implemented GD-OCM based elastography system, also named as GD-OCE, enabling its application for future *in-vivo* clinical use.

6. Geometric Phase Shearing Interferometer

L. Aleman-Castaneda[1], B. Piccirillo[2], L. Marrucci[2] and M. Alonso[1,3,4,5]
[1]University of Rochester, Rochester, NY, [2]University of Naples Federico II; [3]Institut Fresnel; [4]Aix-Marseille Université; [5]Centrale Marseille

We present a new approach for performing common-path shearing interferometry using geometric phase introduced via spin-orbit coupling devices. Having a linearly polarized incident

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wavefront, the shearing mechanism relies on a couple of subsequent identical spatially-varying axis birefringent plates, e.g. a pair of Q-plates, that write opposite geometric phases on the two circularly polarized components, thus enabling almost any tailored directional derivative while securing a compact and robust layout.

7. Hemianopia Intervention Study: a Gaze-Contingent Approach to Visual Rehabilitation

Matthew Cavanaugh, Madhura Tamhankar, Byron Lam, Krystel Huxlin and Steven Feldon
University of Rochester Medical Center, Rochester, NY

Hemianopia is a form of blindness resulting from damage to the primary visual cortex, usually from stroke. Vision is lost in both eyes, contralateral to the side of the lesion. Currently, rehabilitation for this condition is limited to teaching subjects to compensate for their large deficit by moving their eyes or using prism lenses, since the vision loss is irreversible. However, research studies have shown that vision can be partially recovered in hemianopic fields using gaze-contingent visual discrimination training. Preliminary data show this new approach to reduce the size of the visual deficit as measured by static perimetry, the clinical gold standard measure. Unfortunately, the lack of clinical trials testing this technology means that it is not yet FDA approved. Here we describe the technology we have developed for patient (as opposed to laboratory) use and its implementation in a multi-site, double-masked, randomized clinical trial scheduled to conclude in November 2019. This trial is currently ongoing at three eye Institutes and includes two training arms in order to determine if gaze-contingent visual training technology is a suitable treatment for hemianopia.

8. Hybrid Gabor Domain Optical Coherence Microscopy

Changsik Yoon[1], Yue Qi[2], Humberto Mestre[3], Olivia Marola[4], Andrea Cogliate[5], Cristina Canavesi[5], Maiken Nedergaard[3], Richard T. Libby[4], Jannick P. Rolland[1,2,5]
[1]The Institute of Optics, University of Rochester; [2] Department of Biomedical Engineering, University of Rochester; [3]Center for Translational Neuromedicine, Department of Neurosurgery, University of Rochester; [4]Flaum Eye Institute, Department of Ophthalmology, University of Rochester Medical Center; [5]LighTopTech Corporation, Rochester, NY

We report on the development of hybrid Gabor domain optical coherence microscopy (h-GDOCM) that is a combination of Gabor domain optical coherence microscopy (GDOCM) with laser scanning confocal fluorescence microscopy (LSCFM) for dual synchronous microstructural and fluorescence imaging. The dynamic focusing capability of light by a singular GDOCM is shared with LSCFM and provides the optimal environment for imaging glass-covered tissues. In 2019 CEIS University Technology Showcase, we display the architecture of h-GDOCM then report its applications of imaging the DsRed-expressing pericytes of the transgenic mouse brain and Cy3-labeled ganglion cells of the mouse retina.

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9. Increase in Efficacy of Near-Infrared Femtosecond Micromachining in Ophthalmic Hydrogels with the Addition of Biocompatible Doping Agents

Sara M. G. Campaign, Wayne H. Knox
University of Rochester, Rochester, NY

Femtosecond micromachining in ophthalmic materials (contact lenses, intraocular lenses, and corneal tissue) induces highly localized areas of refractive index change via multi-photon absorption without damage to the material. Using femtosecond pulses centered at near-infrared wavelengths offers advantages for clinical applications of this process in corneal tissue for vision correction, but the multi-photon absorption order is higher at these wavelengths, leading to lower refractive index changes. Three biocompatible exogenous doping agents with large two-photon absorption cross-sections in the near infrared were incorporated into Contamac Contaflex GM Advance 58 ophthalmic hydrogels (Acofilcon A) to reduce the multi-photon absorption order of the femtosecond micromachining process and study the effect on the refractive index change induced. These hydrogels were soaked in low concentrations of sodium fluorescein, riboflavin, and rose bengal prior to femtosecond micromachining at both 720 nm and 800 nm. Using any of the three doping agents in the concentrations studied produced an increase in the amount of refractive index or optical phase change induced in the material at both writing wavelengths and reduced the amount of power needed to induce a desired amount of phase change. As all three of these dopants are biocompatible and have been used in ophthalmology, this work suggests potential for future improvement of near-infrared femtosecond micromachining in both ophthalmic hydrogels and corneal tissue.

10. Integrated Silicon Photonic Optical Phased Array Design

Francis Smith, Wuxiucheng Wang, Hui Wu
Laboratory for Advanced Integrated Circuits and Systems (LAICS) University of Rochester, Rochester NY

We present a scalable optical phased array (OPA) design methodology based on synthesizing the array from a single element, decoupling simulation accuracy and time tradeoffs, and enabling robust modeling of arbitrary array geometries and sizes. To efficiently control the phased array, we study the process and physical design parameters of a silicon photonic thermo-optic phase shifter with etched air trenches to improve energy efficiency. Multi-physics simulation and measurement results from a test chip generate design guidelines. Finally, the design methodology is used to guide the development of an OPA prototype. Initial measurement results are presented.

11. Optimization for Laser System Parameters of Femtosecond Micromachined Ophthalmic Materials

Ruiting Huang[1], Wayne H. Knox[1,2]
[1]The Institute of Optics, University of Rochester, Rochester, NY, [2]Clerio Vision, Inc., Rochester, NY

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We studied the effects of various laser system parameters on femtosecond micromachining ophthalmic materials by examining the phase change induced in hydrogel-based contact lenses and rabbit cornea tissues. We successfully inscribe grating lines and phase bars inside both materials using repetition rates in the range from 1 MHz to 60 MHz, wavelengths at 1035 nm, 517 nm and 405 nm, average power from tens of milliwatts to several watts, scan speed from 10 mm/s to 250 mm/s, and two NAs at 0.45 and 0.25. Results show the same phase change can be obtained at a much lower power and a faster scan speed by taking advantage of a lower repetition rate, a shorter wavelength and a lower NA. The optical damage thresholds at different repetition rates are also investigated. Due to excessive heat accumulation effect, the optical damage threshold in terms of single pulse energy is smaller at higher repetition rate (~60 MHz) while the optical damage thresholds are almost the same for low repetition rates (< 15 MHz). Additionally, a photochemical model has been developed to help explain the laser system parameter dependency of the amount of induced phase change.

12. Picosecond UV Photodiodes

W. R. Donaldson, Y. Zhao
Laboratory for Laser Energetics, University of Rochester, Rochester, NY

Aluminum gallium nitride (AlGaN) photodetectors were successfully fabricated with micrometer scale metal–semiconductor–metal structures (MSM's). A number of devices were fabricated spanning a parameter space that included different electrode geometries, dopant types, and wafer-fabrication techniques. The devices were tested with an ultrafast, deep-UV (266-nm) laser and a single-shot, high-bandwidth oscilloscope. Pulse-broadening effects caused by the measurement system were systematically evaluated and reduced to resolve the intrinsic response time of the detector. The best-performance devices showed a response time of below 20 ps and dark currents below 10 pA. The devices showed excellent response linearity with the bias voltage and the laser energy. Applications of this technology include, plasma diagnostics, free-space communication links, and flame detection. This material is based upon work supported by the Department of Energy National Nuclear Security Administration under Award Number DE-NA0003856, the University of Rochester, and the New York State Energy Research and Development Authority.

13. Quantum Dot Coating of Image Detectors for Enhanced UV Sensitivity

Alex Knowles, Zoran Ninkov, Scott Williams and Ross Robinson
Rochester Institute of Technology, Rochester, NY

Improving the sensitivity of silicon-based CMOS and CCD in the deep-UV is an area of ongoing interest. Lumogen has been used for this purpose for many years but has several known issues including limitations to its use in both vacuum and radiation harsh environments. Quantum Dots (QD) offers a more robust alternative to Lumogen. The fluorescence wavelength of QDs is tunable and can be fabricated to match the peak sensor quantum efficiency. Ink Jet printing is being used for the deposition of QDs on a variety of substrates and on commercially available

sensor arrays. While the films deposited onto various substrates have a surface morphology characterized by aggregate formations, the insight obtained will lead to much more uniform layers in the near future.

14. Short- and Long-term Impact of Laser-Induced Refractive Index Change (LIRIC) on Corneal Nerve Distribution in Rabbits

Kaitlin T. Wozniak[1A], Sam C. Butler[2], Margaret DeMagistris[1B], Christine Callan[1B], Wayne H. Knox[1A], Jonathan D. Ellis[3] and Krystel R. Huxlin[1A,B]
[A]The Institute of Optics; [B]Flaum Eye Institute; [1]University of Rochester, Rochester, NY ; [2]Clerio Vision Inc., Rochester, NY; [3]College of Optical Sciences, University of Arizona

Disruption of corneal innervation is a significant side-effect of laser refractive surgeries such as LASIK. Our team has developed Intra-tissue Refractive Index Shaping (IRIS) into a non-ablative, laser refractive correction procedure named Laser-Induced Refractive Index Change (LIRIC), which was recently performed in humans for the first time. Here, we asked whether LIRIC damages or otherwise impacts the distribution of corneal nerves in a rabbit model. LIRIC was performedin10 eyes from 8 Dutch Belted rabbits using a405nm Ti:Sapphire laser under topical and surgical anesthesia. Corneas were applanated and a high NA objective was used to create a 4.5mm diameter Fresnel lens with a +2.5D spherical correction in the mid-stroma. To separate laser from applanation effects, 6 Sham eyes received no laser treatment, but were applanated for the same duration. To compare short-and long-term effects of LIRIC in a living rabbit model, rabbits were sacrificed either 4hours or 3 months following the LIRIC procedure. Two rabbit eyes were analyzed a sun treated controls. Frozen corneal sections were immunoreacted with βIII tubulin (TUJ1) antibodies, followed by secondary antibodies tagged with Alexa-555, and counter-stained with DAPI. Corneal sections were traced and analyzed with Neurolucida to measure nerve lengths and densities. No difference was seen in stromal nerved density between LIRIC, Sham, or control eyes. LIRIC and Sham eyes exhibited depressed TUJ1 staining in the epithelium and sub-basal layers immediately after treatment, suggesting that the effect was caused by applanation rather than LIRIC. Because this effect had disappeared 3 months later, we concluded that LIRIC does not negatively impact corneal nerve distribution and may avoid long-term, post-operative side-effects such as pain, discomfort, and dry eye.

15. The role of optical and neural factors in the peripheral retina in myopia progression

Yifei Wu[2,3], Qiuzhi Ji[1], Jiakai Lyu[1,2,3], Geunyoung Yoon[3,2,1]
[1] The Institute of Optics, University of Rochester, Rochester, NY, [2]Flaum Eye Institute, University of Rochester, Rochester, NY, [3]Center for Visual Science, University of Rochester, Rochester, NY

Although modifying peripheral retinal image qualities with bifocal/multifocal contact lenses changes the rate of myopia progression in both animal models and human subjects, its mechanism remains unclear. The study aims to investigate potential factors affecting excessive

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axial elongation of the eye i.e. myopia. A wide-field scanning wavefront sensor was developed to quantify the peripheral ocular optics up to ±30° retinal eccentricity. An adaptive optics vision simulator was used to measure peripheral through-focus visual performance. The results suggested that through-focus blur orientation signal as well as neural anisotropy in the peripheral retina can be factors related to myopia progression.

16. Weak Value Amplification with Integrated Photonic Device

Meiting Song[1], John Steinmetz[2], Juniyali Nauriyal[1], Marissa Granados Baez[1], Yi Zhang[1], Andrew Jordan[2], Jaime Cardenas[1]
[1]The Institute of Optics, University of Rochester; [2]Department of Physics and Astronomy and The Center for Coherence and Quantum Optics, University of Rochester, Rochester, NY

Weak value amplification with integrated photonics devices adds compatibility and stability to ultrasensitive measurements. We designed and fabricated an on-chip Mach-Zander interferometer for inverse weak value amplification of phase shift measurements. Our testing results of the device has shown the ability to detect phase shifts by monitoring the output light signal.

Data Science

17. A Machine-Learning Approach to Estimating a Higher Education Institution's Standing in the Global Academic Research Landscape

Meizhu Wang, Yue Zhao, Dale P. Hess, Edgar A. Bernal
Rochester Data Science Consortium, University of Rochester, Rochester, NY

Most of the current university ranking methodologies leverage reputational data extracted from surveys performed across populations of interest, usually including educators; however, it has been argued that the outcomes of such studies are skewed towards favoring a few selected institutions due to intrinsic human bias. Further, university rankings provide a static snapshot into the layout of the academic landscape, which we believe can better be understood if thought of as a dynamic entity. In this work, we introduce a data-based approach to constructing time-dependent snapshots of the global academic research landscape. To that end, we leverage the Dimensions dataset, a collaborative data platform that catalogs publications, grants, patents, and clinical trials, as well as connections among them. We query Dimensions to build global-and institution-level temporal research trends. We then compute cross-correlations with varying lags across the extracted temporal trends to determine whether an institution is ahead, on par or behind a given reference trend. Lastly, we leverage long-short-term memory networks (LSTM) to predict the future path of research trends, which enables us to anticipate the evolution of a given institution's standing in a particular research field.

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18. Algorithms and Models for Efficient Human-Robot Interaction with Collaborative Robots

Jacob Arkin, Siddharth Patki, Thomas M. Howard
University of Rochester, Rochester, NY

Collaborative robots are cyber-physical systems that operate as part of human-robot teams to perform one or more shared tasks in domains such as manufacturing, agriculture, medicine, and exploration. Advances in perception, planning, and control have enabled collaborative robots to begin the transition from specialized systems designed for specific tasks in simple environments to general platforms that perform many functions in a diversity of settings. To effectively contribute as part of a human-robot team, collaborative robots must be able to communicate information about what they see, what they have done, and what actions they plan to perform. Algorithms for natural language understanding and generation for human-robot interaction must be capable of inferring the meaning of language and sensor observations in real-time with limited computational resources. In this work we present a series of approximate algorithms and models for efficient natural language understanding for human-robot interaction that increases runtime performance without a loss in accuracy. We present experimental results on collaborative robots including robotic torsos, assistive robotic manipulators, field robots, and mobile manipulators.

19. Classification of Myotonic Dystrophy Time Series Based on Triplet Neural Network

L Lin[1], B. Xu[1], W. Wu[1], E. Bernal[1], T. Richardson[1], B. Martens[2], C. Thornton[2] and C. Heatwole[2]
[1]Rochester Data Science Consortium, University of Rochester; [2]University of Rochester Medical Center, Rochester, NY

Myotonic muscular dystrophy is a genetic disorder. Symptoms include gradually worsening muscle loss and weakness. QMA is a small device that records the time sequence of the force on a spring during a hand squeeze, where the peak force and relaxation time are commonly used as biomarkers to quantify hand-grip myotonia. In this work, we developed a triplet-network for time-series to quantify the symptom and evaluate the effectiveness of new treatments. Our method demonstrated a high classification accuracy of the dystrophy and moreover, the learned embedding space can be used to quantify the treatment effect and warm-up effect.

20. Data Quality and Security Evaluation Toolset

Igor Khoklov
Rochester Institute of Technology, Rochester, NY

We present our data quality and security evaluation set of tools for mobile sensor devices. To improve a decision-making process, these tools augment data with its quality indicators, which are based on such infrastructure characteristics as trustworthiness,

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privacy, security, and conventional data quality metrics. This poster focuses on a security evaluation and presents Android applications that are already available at the Google Play Store. These applications calculate the overall security score, give advice on how to improve smartphone security and detect apps that were installed from the untrusted sources. Employment of these tools in financial institutions, educational enterprises, and medical facilities will improve their system's overall security and performance.

21. Exploring Parkinson's Disease Progression using Deep Generative Models Built on DaTscan Brain Imagery

T. Richardson[1], B. Xu[1], W.Wu[1], L.Lin[1], C Venuto[2], M. Javidnia[2], E. Bernal[1]
[1]Rochester Data Science Consortium, University of Rochester, Rochester, NY ,[2] Center for Health + Technology, University of Rochester Medical Center, Rochester, NY

For Parkinson's Disease(PD), which affects one percent of the population over sixty, no objective biomarkers for diagnosis or progression have been validated to date. The current approach to measuring PD disease progression is the Unified Parkinson Disease Rating Scale (UPDRS).The UPDRS scoring mechanism is a subjective quantitative scale, and previous research has shown that the variance of an individual's score assigned by different doctors is unreasonably high. This measurement variance adversely affects the quality of the data collected from expensive and lengthy clinical trials on PD and impedes the community of researchers focused on solving problems centered on PD. We propose constructing a new method for scoring disease progression and diagnosis using state of the art data-driven deep generate models in the hopes of alleviating the aforementioned problems. The approach exploits previously underutilized image data, such as DaTscan imagery, provided by the Parkinson's Progression Markers Initiative (PPMI) dataset. Not only would this methodological approach provide a way to minimize or eliminate variance injected by subjective human measurements, but would also potentially provide a novel avenue for constructing new medical tools and expand our understanding of PD progression.

22. Part-invariant Model for Music Generation and Harmonization

Yujia Yan, Ethan Lustig, Joseph VanderStel, Zhiyao Duan
University of Rochester, Rochester, NY

The task of generating music has been established as an open problem for centuries. Have you ever played Google's recent doodle for Bach's 334th birthday?
Our model published at ISMIR 2018 does more than that. We formulate the problem as coupled monophonic lines, which is more musically plausible than treating a music piece as an image. By doing this, it will always try to make individual lines in good shape. As a result, our model, trained exclusively on Bach's four-part chorales, is capable of generating/harmonizing music other than four parts. It also gives interesting results on melodies very different from Bach's four-part chorales.

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23. Towards Human-Machine Real-Time Music Improvisation

Christodoulos Benetatos, Zhiyao Duan
University of Rochester, Rochester, NY

In this project we explore the idea of human performers interacting real-time with neural network, to produce music. The last few years, we have seen a lot of research in generating music sequences using neural networks. However most of them, either generate music in offline fashion (i.e bidirectional RNN's), or in online, but in solo configuration, without incorporating humans in the generation chain. In similar systems to ours, like AI Duets, or the "Continuator", a human performer and a computer are interacting, however not at the same time, but in a call and response configuration.
We create a dataset of 2-voice musical pieces, and we train two different architectures to predict the next note for a voice, given the past of both voices, in an online fashion.
The results are encouraging, and the computation time of both architectures is sufficient for implementing a real time application.

Chemical Engineering, Mechanical Engineering, and Materials Science

24. A Pocket-Sized Chemical Plant: AR for Chemical Engineering Education

Rainier Barrett, Heta Gandhi, Zitue Yang, Tayfun Sahin, Andrew White
University of Rochester, Rochester, NY

Due to the size, cost, and possible hazards associated with running a life-size chemical plant, it is not possible to have a hands-on chemical engineering laboratory activity for large reactor staging. We address this problem with augmented reality (AR) technology. With an AR phone app, chemical engineering students can design their own chemical plants with the tap of a finger. Our phone-based AR app uses 3D-printed reactor models to simulate a user-designed chemical plant in real time. This interactive and collaborative learning environment makes for easy and fun tactile learning, and can supplement a traditional laboratory curriculum with an otherwise-impossible activity.

25. Kinetics of Cationic Chemical Vapor Deposition

Dominic Giambra, Wyatt Tenhaeff
Department of Chemical Engineering, University of Rochester, Rochester, NY

Chemical vapor deposition (CVD) is a modern technique used to synthesize polymer thin films, with strong control over film composition and thickness. A new initiation scheme using cationic initiators (catCVD), $TiCl_4$ and H_2O has recently been developed. The kinetics of this initiation scheme is investigated. Derived polymerization rate laws for the catCVD synthesis of polystyrene and polyalpha-methylstyrene are presented, as well as effective activation energies for each reaction.

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26. Phthalate-plasticization of nitrile-bearing polymer electrolytes for high-voltage solid-state lithium batteries

Yineng Zhao, Wyatt E. Tenhaeff
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Solid-state lithium batteries are desirable alternatives to lithium ion batteries given their high theoretical energy densities associated with Li metal anodes and the potentially superior safety from the elimination of flammable liquid electrolytes. Compelling ceramic lithium conductors having ionic conductivities surpassing those of conventional liquid electrolytes have been developed, but they suffer from high fabrication and processing costs. Moreover, achieving intimate solid-solid contact at the electrolyte-electrode interface is challenging. In contrast, polymer electrolytes are alternative materials that offer processing ease and the ability to fully infiltrate and wet composite electrodes. Poly(ethylene oxide) (PEO) mixed with lithium salt is the archetypal polymer electrolyte and solid-state cells using $LiFePO_4$ cathode and lithium metal anode have been successfully commercialized. However, a significant limitation of PEO is its low oxidative stability, which restricts its application to lower voltage cathode (e.g. LiFePO4). Thus, polymer electrolytes with higher oxidative stabilities are desperately needed. In previous work, our group investigated hydrogenated nitrile butadiene rubber (HNBR) as a candidate for high- voltage application because of its superior oxidative stability of 5.4V vs. Li/Li^+. This polymer readily dissolves lithium bis(trifluoromethane)sulfonimide (LiTFSI) salt and has a high lithium transference number (0.56 compared to 0.37 for PEO). However, HNBR-LiTFSI suffers from low ionic conductivity (2.2×10^{-5} S·cm^{-1} at 70°C and 3. 2×10^{-7} S·cm^{-1} at 25°C) , which severely limits transport in full solid-state cells.

27. Potential effects of localized material property changes on the shape and optical performance of the cornea

Elizabeth Diaz Bueno, Amy Lerner, Kathryn Colone, Paul Funkenbusch
University of Rochester, Rochester, NY

The LIRIC (Laser Induced Refractive Index Change) process is being developed as a non-invasive method for improving vision by modifying the cornea. In addition to changing the refractive index to produce gradient index optical corrections, LIRIC may be able to locally modify the mechanical properties of the cornea and, thus, cornea shape. This provides a potential second modality for producing optical corrections. In this research finite element modeling of the cornea is being used to study the effect of changes in cornea mechanical properties on shape and optical performance. Modeling shows how the geometry and position of the LIRIC pattern can affect shape and optical performance. Moreover, different optical corrections (e.g. spherical aberration, refractive power) are found to be sensitive to different aspects of the LIRIC writing pattern (e.g. diameter, number of layers), providing a potential pathway to control/tune these effects.

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28. Stochastic Study of Vehicle-to-Grid Economics in Six Major US Cities

Heta Gandhi, Andrew D. White
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The continued growth of renewable energy sources leads to grid-level intermittent supply and demand mismatch. There are a number of research and engineering solutions that address this problem including grid-level energy storage and demand response via a smart grid infrastructure. Vehicle-to-grid (V2G) is a promising approach because it uses the existing resource of electric vehicle batteries as the energy storage medium. Electric vehicles charge at night while power is cheap, commute to work, and discharge when demand is high yielding the electric vehicle owner a profit. This simple sounding process has a number of complicating economic issues and in this paper we discuss them. For example, charge/discharge efficiency, battery degradation, and location-based marginal pricing of electricity. In our model, a stochastic economic analysis of V2G which takes into account randomness in driving patterns and work patterns of EV users is presented. We use battery degradation models to study the impact of vehicle battery degradation on this process. Our preliminary conclusion is V2G is slightly profitable to an electric vehicle owner with current technology and electricity pricing.

29. Understanding the Electrochemistry of Thin Film LiCoO2 in Aqueous Electrolytes

Marina Maria Ioanniti, Wyatt Tenhaeff*
Department of Chemical Engineering, University of Rochester, Rochester, NY

$LiCoO_2$ (LCO) has been widely used as a cathode material in lithium ion batteries due to its high specific capacity, high discharge potential and long cycle-life. Fabrication of this material as thin film cathode is currently receiving much attention due to its application in all-solid-state thin film batteries and as a model material in the investigation of the intrinsic electrochemical properties of LCO without interference from the polymer binder and carbonaceous conductive additives in composite electrodes. Another potential application of LCO thin film is protective coating on solid state lithium conductors to prevent their exposure and consequent reactivity with aqueous electrolytes in hybrid cell constructions. Aqueous lithium ion electrolytes are intriguing because they lower cell costs, increase electrolyte ionic conductivity (power performance), and provide greater safety relative to conventional aprotic electrolytes.

To understand the chemical and electrochemical behavior of LCO in aqueous electrolytes, thin films with nominal thicknesses of 1μm were fabricated and characterized. In order to determine the best fabrication protocol, films were deposited on a number of substrates using RF magnetron sputtering and then annealed in oxygen and argon atmospheres at various temperatures to crystallize the films. Scanning electron microscopy, atomic force microscopy and surface roughness measurements were employed to characterize the film texturing and surface morphology as a function of substrate uniformity and roughness. The chemical stability and electrochemical performance of the films were characterized by cyclic voltammetry and galvanostatic cycling. The thin films were immersed in a three-electrode beaker cell, where the

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LCO thin film was the working electrode and Ag/AgCl and Pt mesh were the reference and counter electrode, respectively. The results revealed that a smooth substrate will yield LCO films of higher quality and that extreme annealing conditions lead to the formation of secondary phases. Annealing in argon typically gives higher initial specific capacity and remarkably less polarization. However, the films annealed in oxygen exhibit improved stability and capacity retention. During cycling, the argon samples lose their columnar structure, which is attributed to loss of Li ions due to partially irreversible re-intercalation.

Biomedical Engineering

30. A Characterization of the Motion of a Contact Lens
Kara L. Maki, David S. Ross
Rochester Institute of Technology, Rochester, NY

An important mechanical feature of a contact lens is its ability to re-center on the front of the eye when displaced by the lid. In equilibrium, the contact lens pushes and pulls on the ocular surface generating a suction pressure in the tear film between the surface of the eye and the back side of the lens. The lid can displace the lens from its equilibrium position. We have proposed a mechanism for the re-centering of the contact lens based on generated suction pressure gradients in the tear film. We will explain the mathematical model we developed to verify our hypothesis.

31. Compressive Beamforming for Portable Ultrasound Imaging with the Promise of Super Resolution
Jovan Mitrovic[1], Lynn La Pietra[2], Zeljko Ignjatovic[1]
[1]University of Rochester, Rochester, NY; [2]Carestream Health, Rochester, NY

Most of the advancements in medical ultrasound is concentrated on increasing the quality and resolution of resulting images, without much concern for hardware footprint. The proposed method is concerned with hardware complexity reduction without sacrificing image quality or resolution. This is done by compressing the acquired signal in analog domain, while the image reconstruction employs the concept of random modulation pre-integration as well as convex optimization. A clinical study involving 20 human subjects has been completed to compare the imaging and diagnostic quality of our proposed compressive beamforming method and traditional clinical ultrasound. Even though the hardware complexity of the proposed method is reduced by a factor of 16, the clinical results indicate that there is no statistically significant difference between the full-aperture B-mode images and images obtained by the proposed method ($t=1.82$, $p=0.058$).

32. Fouling of Ultrathin Silicon Membranes in Tangential Flow Filtration
Syed Danial Ahmad, Kilean Lucas, James McGrath
University of Rochester, Rochester, NY

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Dead-end filtration of protein-rich fluids through ultrathin nanomembranes (<100nm thick freestanding) leads to rapid surface fouling due to their high permeability and lack of internal structure. By contrast, tangential flow operations with ultrathin membranes and complex biofluids (such as hemodialysis) have been found to proceed for days without a loss of membrane permeability, even with limited ultra filtration. Inspired by these observations, here we systematically assess the fouling capacity of these membranes -in both physical testing and simulation-intangential flow filtration (TFF).Specifically, we first optimize the critical flux capabilities of our nanomembranes by varying protein solution concentrations and flow rates. After removing protein aggregates by centrifugation, we show that solutions of bovine serum albumin (BSA) as concentrated as 10 mg/ml achieve a critical flux of 1157 l/m2 h in a microfluidic device featuring 18.8% porosity nanoporous silicon nitride (NPN) membranes at a flow rate of 30μl/min. We then modeled membrane occupancy in COMSOL by creating a geometric system capable of small particle capture. We use this model to define optimal capture conditions, and then validate it by demonstrating the capture of > 75% of 60nm and 100nm gold particles suspended in1mg/ml BSA via TFF. Ultimately, we posit that this system of particle capture is viable for further analysis and exposition.

33.Heart Rate and QT Interval Variability Index Measures Are Biomarkers for Cardiac Arrhythmias in Long QT Syndrome Type 1

Ahmed Selmi[1,2], Samuel Kashtan MS[1,2], Xiaojuan Xia PhD[2], Jean-Phillippe Couderc PhD[2] , David S. Auerbach PhD[2,3,4]
[1]Biomedical Engineering ,[2]Medicine-Heart Research Follow-Up Program , [3]Medicine-Aab Cardiovascular Research Institute ; [4]Pharmacology/Physiology , University of Rochester, Rochester, NY

Background: Patients with Long QT Syndrome (LQTS) are at an increased risk of arrhythmias, particularly during exercise (LQTS1) or startle/arousal (LQTS2.) Yet, it remains unknown whether patients with LQTS harbor differences in autonomic nervous system (ANS) function. Also, it remains unknown whether ANS function differs in patients with vs. without a history of arrhythmias. Methods: The study included 24-hour Holter Monitoring electrocardiogram (ECG) recordings from patients genotype positive for LQTS1 (n=83), LQTS2 (n=42), and LQTS genotype negative (LQTS- , n=16.) Patients were stratified by history of arrhythmias and seizures. Time and frequency domain heart rate variability (HRV) analyses provided detailed measures of ANS function during various physiological states. Additionally, QT variability index, which is associated with cardiac disease, was compared in these groups. All results were confirmed via multi-variate analyses adjusting for QTc duration, beta blocker use, heart rate, and stratified for sex. Results: At a time of minimum heart rate, total (SDNN, RMSSD, pNN50, & LF+HF), vagal (HF) and sympathetic (LF) ANS tone was lower in LQTS1 and LQTS2 patients, compared to LQTS- patients. The QTc and QTVI was higher in LQTS1 and LQTS2 patients. At a time of sympathetic dominance (max LF/HF), total (SDNN, RMSSD, pNN50) and vagal (higher HF) ANS tone was higher in LQTS2 vs. LQTS1 patients, and LF was lower in LQTS2 patients. QTVI was elevated during times of vagal dominance (min LF/HF.) In LQTS1 patients, a history of arrhythmias was

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associated with reduced total ANS tone (SDNN & RMSSD) and elevated QTVI, during periods of vagal dominance. HRV and QTVI measures were not associated with arrhythmias in LQTS2. Conclusion: Heart rate and QT variability index measures differentiate LQTS vs. LQTSpatients, and LQTS1 patients with vs. without a history of arrhythmias. ANS and ventricular repolarization measures provide biomarkers for LQTS and arrhythmias.

34. High-Frequency Quantitative Ultrasound System Development for Characterizing Collagen Fiber Alignment in Tendon

Sarah Wayson[1, 3], María Helguera[3, 4], Denise C. Hocking[2, 3], Diane Dalecki[1, 3]
[1]Department of Biomedical Engineering; [2]Department of Pharmacology and Physiology; [3]Rochester Center for Biomedical Ultrasound, University of Rochester, Rochester, NY, [4]Tecnológico Mario Molina, Lagos de Moreno, Jalisco, México

The overall goal of this project is to develop a high- frequency quantitative ultrasound system to characterize collagen fiber alignment in normal, diabetic, and scarred tendon following surgical repair. I hypothesize that measuring the integrated backscatter coefficient as a function of insonification angle can be used to non- invasively detect changes in collagen fiber organization. The long-term goal of this work is to apply this quantitative ultrasound technique

to non-invasively predict mechanical properties of normal, diabetic, and surgically repaired tendon. These metrics can serve as the foundation for a dedicated point-of-care clinical imaging system guiding physical therapy protocols for orthopaedic rehabilitation of diabetic and surgically-repaired tendon.

35. Image-based biomarker for Cancer Recurrence Prediction Using SHG Imaging

Wencheng Wu[1], Robert Hill[2], Edward Brown[3], Beilei Xu[1], Edgar Bernal[1] and Erik Pata[3]
[1]Rochester Data Science Consortium, University of Rochester, Rochester, NY, [2]Harmonigenic Corporation, Rochester, NY, [3]Department of Biomedical Engineering, University of Rochester, Rochester, NY

Cancer treatment for solid tumors has evolved from surgical treatment alone to surgical treatment followed by adjuvant chemotherapy or just endocrine therapy for early stage cancers with low risk of recurrence, to neoadjuvant chemotherapy where chemotherapy is given before surgery for cancers where there is a high risk of distant metastatic recurrence or to shrink another wise inoperable tumor. A better understanding of recurrence risk at diagnosis as well as prediction of treatment response to choose the most cost-effective treatments is needed to produce the best outcomes for individual patients. With these aspects in mind, the objective of this project is thus to carry out a feasibility study aimed at improving existing or discovering new biomarkers indicative of the prediction of cancer recurrence at the time of diagnosis. More specifically, we are exploring whether it is feasible to extract/learn image features from SHG imaging that are discriminative in the context of the diagnosis, and as such are good biomarker candidates.

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36.Potential effects of localized material property changes on the shape and optical performance of the cornea

Elizabeth Diaz Bueno, Amy Lerner, Kathryn Colone, Paul Funkenbusch
University of Rochester, Rochester, NY

The LIRIC (Laser Induced Refractive Index Change) process is being developed as a non-invasive method for improving vision by modifying the cornea. In addition to changing the refractive index to produce gradient index optical corrections, LIRIC may be able to locally modify the mechanical properties of the cornea and, thus, cornea shape. This provides a potential second modality for producing optical corrections. In this research finite element modeling of the cornea is being used to study the effect of changes in cornea mechanical properties on shape and optical performance. Modeling shows how the geometry and position of the LIRIC pattern can affect shape and optical performance. Moreover, different optical corrections (e.g. spherical aberration, refractive power) are found to be sensitive to different aspects of the LIRIC writing pattern (e.g. diameter, number of layers), providing a potential pathway to control/tune these effects.

Electrical Engineering, Computer Engineering

37.Aerial-CAM: Class Activation Maps of Aerial Imagery

Bhavan Vasu and Andreas Savakis
Rochester Institute of Technology, Rochester, NY

This research aims at visualizing how deep networks interpret aerial scenes by examining their internal representations. We utilize Class Activation Mapping (CAM) techniques to obtain a view of a deep network's perception of aerial images and identify salient local regions. We apply our methods on two remote sensing datasets and show that local structures and textures emerge in the most active regions of aerial images. We then analyze these interpretations when the network is trained on one dataset and tested on another to demonstrate the robustness of feature learning across aerial datasets. We finally visualize these interpretations when transfer learning is performed from an aerial dataset (AID) to a generic object dataset (MS-COCO) to illustrate how transfer learning benefits the network's internal representations.

38.Beatza: Automated Hip-Hop Beat Generation

Steven Belitzky and Albert Peyton
University of Rocheste,r Rochester, NY

We set out to design an algorithm that given a short audio recording, would automatically create a grooving hip hop beat. This topic is of interest to us because it incorporates aspects of signal processing to create music. This project is akin to that of the smart drummer feature in logic and garage band, which generates purely percussive drum loop solely based off the tempo of a given track, as well as some user inputs such as complexity and dynamics. Our program

goes deeper than this, as it generates not only percussive loops, but also generates an 808 bass pattern tuned to the key of the sample. Using beat tracking and key identification algorithms, we created an application to create a hip-hop beat given a short audio recording.

39.Binaural Perception of Stereo Noise Bursts as a Function of Burst Duration and Degree of Interchannel Coherence

Steven Crawford, Mark Bocko
University of Rochester, Rochester, NY

Amplitude panning for virtual sound source rendering in stereo and multi- channel audio reproduction is well established. Binaural fusion can be represented by vector addition of the acoustic wave propagation vectors from individual speakers; however, this applies only to stereo signals with perfect interchannel coherence and does not provide a description of the perceived sound image when the coherence is less than complete. Listening tests show that the stereo image formed by continuous incoherent noise fills the space between the loudspeakers; however, for a very short noise burst, the image collapses to a single point in space with its location determined by the lag of the maximum in the interchannel cross-correlation function. Concatenation of an ensemble of short noise bursts with a distribution of cross-correlation function maxima creates a long noise burst that displays a broad peak in its interchannel cross correlation function; the location and width of which correspond to the apparent location and spread of the virtual image. We present a model that combines the effective averaging time of the human binaural fusion mechanism and the interchannel coherence of the stereo signal to predict the spatial properties of virtual sound sources.

40.Blind Identification of Invertible Graph Filters with Multiple Sparse Inputs

Chang Ye, Rasoul Shafipour, Gonzalo Mateos
Dept. of Electrical and Computer Engineering University of Rochester, Rochester, NY

This paper[1] deals with the problem of blind identification of a graph filter and its sparse input signal, thus broadening the scope of classical blind deconvo- lution of temporal and spatial signals to irregular graph domains. While the observations are bilinear functions of the unknowns, a mild requirement on in- vertibility of the filter enables an efficient convex formulation, without relying on matrix lifting that can hinder applicability to large graphs. On top of scal- ing, it is argued that (non-cyclic) permutation ambiguities may arise with some particular graphs. Deterministic sufficient conditions under which the proposed convex relaxation can exactly recover the unknowns are stated, along with those guaranteeing identifiability under the Bernoulli-Gaussian model for the inputs. Numerical tests with synthetic and real-world networks illustrate the merits of the proposed algorithm, as well as the benefits of leveraging multiple signals to aid the (blind) localization of sources of diffusion. Work in this paper was supported by the NSF award CCF-1750428.

[1] Chang Ye, Rasoul Shafipour, and Gonzalo Mateos. Blind identification of invertible graph filters with multiple sparse inputs. In *2018 26th European Signal Processing Conference (EUSIPCO)*, pages 121–125. IEEE, 2018.

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41. Design and Characterization of a 10 x 10 Pixel Array THz Camera in 350nm CMOS technology

Moeen Hassanalieragh[1], Zeljko Ignjatovic[1], Katie Seery[2], Zoran Ninkov[2], J. Daniel Newman[3], Andrew Sacco[3], Kenneth Fourspring[3]
[1] University of Rochester, Rochester NY, [2] Rochester Institute of Technology Rochester NY, [3] Harris Corporation Space & Intelligence Systems Division Rochester, NY,

In this work, a 10x10 pixel array camera for room-temperature THz imaging application in 350 nm CMOS technology is presented. The camera consists of a 10x10 focal-plane array (FPA) of THz detectors, on-chip switched-capacitor amplifiers with adjustable gain, digital-to-analog converter (DAC) and on-chip SRAM memory for per-pixel calibration. High performance THz detectors are realized by integrating on-chip antennas and sub-threshold Si MOSFETs. The detectors are biased with a current source for increased responsivity, and the calibration scheme allows for adjusting the operating point of the pixels in the presence of process variation. To alleviate the test, calibration and imaging procedure, a controller board is designed to interface with the camera chip. The controller board communicates with a host PC where the calibration and imaging Matlab codes run. Our experimental results indicate an imaging SNR of approximately 40 dB with low amplifier gain settings. The achieved high imaging SNR demonstrates the potential of using CMOS technology to build compact THz cameras. In addition, Responsivity and NEP of 19kV/W and 535 pW/sqrt(Hz), respectively, have been experimentally demonstrated.

42. Evaluating Methods for Enabling Continuous Operation in Dynamic Wi-Fi Direct Networks

Aaron Faulkenberry, Utku Demir, Cristiano Tapparello and Wendi Heinzelman
University of Rochester, Rochester, NY

Designing protocols for optimizing and controlling Mobile Ad Hoc Networks (MANETs) has been an active subject of research for many years; however, the autonomous configuration and maintenance of MANETs remains an open problem. WiFi Direct, a Wi-Fi Alliance standard facilitating peer-to-peer communication without the need for traditional WiFi access points, has been adopted on a variety of platforms including, phones, tablets, printers, smart TVs, and many other Linux based operating systems. Despite its widespread availability, current WiFi Direct implementations rely on a human-in-the-loop in order to restore connectivity in the event of a network failure. In a highly dynamic environment, time spent manually configuring and maintaining a MANET reduces its utility. This work evaluates several of our previously proposed non-interactive protocols that facilitate the autonomous creation and maintenance of WiFi Direct groups with the goal of quickly restoring communication in the event of network failures. We compare two methods for reforming a network in the event of group disconnection, which can be caused by node mobility or the energy constraints of mobile nodes, with an approach of maintaining two simultaneous WiFi Direct groups, allowing for the diversion of traffic in the event of an outage in one of the groups. Each method is implemented

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and evaluated on a testbed of Raspberry Pi 3B single board computers as well as on a testbed of virtual machines making use of the same external wireless cards. Finally, we present scenarios that highlight the strengths and weakness of each method.

43. Faster Art-CNN: an Extremely Fast Style Transfer Network

Bryan Blakeslee, Raymond Ptucha, Andreas Savakis
Department of Computer Engineering, Rochester Institute of Technology, Rochester, NY

Convolutional neural networks have recently found applications in the artistic realm, where style and content images can be combined to yield a new image. This paper presents a novel architecture for the performance of extremely high speed style transfer in the feed-forward mode, with a minimal qualitative decrease in image quality. This is accomplished by training a deconvolutional neural network to apply a specific style to the provided content image. To make the problem computationally tractable, the content images in this work are restricted to the dataset of Labeled Faces in the Wild. Our faster style transfer results favorably compare to the traditional backpropagation technique and another existing feed-forward technique. The real time performance of our Faster Art-CNN would be suitable for augmented reality, video conferencing and other computationally demanding applications.

44. Nanowire Light Emitting Diode with Field Effect Transistor

Matthew Hartensveld
Rochester Institute of Technology, Rochester, NY

Current display technology is reaching its practical limitations as the Thin-Film-Transistors (TFTs) that make up displays are struggling to be reduced further in size. Instead, nanowire Light Emitting Diodes (LEDs) are being pursued due to higher efficiencies (70% vs. 5-7%), high reliability, and the ability to be manufactured at the nanoscale. In this technology each nanowire can produce red, green, or blue light to compose a pixel. A number of companies are all pursing this technology due to the material advantages and cost savings. The issue is that there has been no easy way to integrate LEDs with transistors in order to control the displays. The current approaches sacrifice LED area, along with reducing device performance, limiting potential applications. The approach here makes use of a previously unused layer of the LED, common to how LEDs are grown, in order to integrate a Field Effect Transistor (FET). The layer is unintentionally doped GaN which is grown before the main LED structure. Here, this allows for vertical integration of a FET without sacrificing device area. During processing, metal is deposited at the base of the wire and annealed. This creates an n-type region, where the FET then has a complete n-i-n structure common to modern transistors. Integration of the FET and LED does not negatively impact device performance and can boost light output through the use of insulating layers. These layers are used to build up the final device. Large scale arrays of nanowire LED scan easily be fabricated allowing the rapid adoption of use in display technology.

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45. NBTI-Aware Digital Low-Dropout Regulator with Adaptive Gain Scaling Control

Soner Seçkiner, Longfei Wang, Selçuk Köse
University of Rochester, Rochester, NY

Digital low-dropout voltage regulators (DLDOs) have drawn increasing attention for the easy implementation of nanoscale devices. Although they have various benefits over the analog LDOs, the disadvantage may arise in the form of negative bias temperature instability (NBTI) induced performance degradation. The conventional DLDOs can suffer from this disadvantage which has been studied previously. In this paper, a simple and effective adaptive gain scaling (AGS) with steady-state capture is proposed. Moreover, a novel uni-directional barrel shifter for enhanced reliability for DLDO is proposed. The benefits of the proposed methods are explored and highlighted through extensive simulations. The method has negligible power and area overhead. It is demonstrated that NBTI-aware design with AGS can reduce the transient response time by 59.5% as compared to aging unaware conventional DLDO and mitigate the aging effect up to 33%.

46. Online system of sound search by vocal imitation

Yichi Zhang, Yiting Zhang, Zhiyao Duan
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This online system is the first to demonstrate a novel way to search sounds in a sound library: Instead of using text/keywords, users are asked to use vocal imitations as queries. The search engine will return a list of sounds that are acoustically most similar to the imitation query. The frontend GUI is designed using Javascript, HTML, and CSS and the backend server uses node.js framework and keras/tensorflow deep learning library. Specifically, the deep learning based search algorithm is our previously proposed Siamese Style Convolutional Neural Networks (SS-CNN) called TL-IMINET to learn feature representations and similarity measures between the vocal imitations and original sounds in a unified end-to-end training framework. A text based sound search web application is also designed as a baseline to compare with our proposed vocal imitation based system.

47. Performance Evaluation of Wi-Fi Direct Multi-Hop Ad-Hoc Networks

Nadir Adam, Cristiano Tapparello and Wendi Heinzelman
University of Rochester, Rochester, NY

With the increasing number of mobile de-vices with access to the Internet, and the availability of various wireless networks, it is essential to obtain the best connection, whether this is a direct path through infrastructure networks or an indirect path using multi-hop ad-hoc networks. In this paper, we have developed an Android application to create and measure the throughput and delay of 1-hop, 2-hop and 3-hop ad-hoc networks based on Wi-Fi Direct, and compare their performance to direct WiFi and cellular connections. Moreover, we have

analyzed the energy consumption of the multi-hop ad-hoc networks using energy consumption models for transmit-ting and receiving data using cellular, Wi-Fi and Wi-Fi Direct. Experimental results show that extending access to the Internet to devices that might not otherwise have a direct connection through multi-hop ad-hoc connections is feasible at the expense of a reduction in throughput. Furthermore, we have shown that extending access to the Internet through 1-hop, 2-hop and 3-hop ad-hoc networks achieves higher throughput and is more energy-efficient when transferring larger data sizes compared to when transferring smaller data sizes. Finally, we have shown that Wi-Fi Direct multi-hop ad-hoc networks with Wi-Fi connection from the gateway node are more energy efficient to upload and download data compared to direct cellular connection up to 7 and 3 hops, respectively.

48. Real-Time Music Improvisation

Christodoulos Benetatos
University of Rochester, Rochester, NY

In this project we explore the idea of human performers interacting real-time with neural network, to produce music. The last few years, we have seen a lot of research in generating music sequences using neural networks. However most of them, either generate music in offline fashion (i.e bidirectional RNN's), or in online, but in solo configuration, without incorporating humans in the generation chain. In similar systems to ours, like AI Duets, or the "Continuator", a human performer and a computer are interacting, however not at the same time, but in a call and response configuration. We create a dataset of 2-voice musical pieces, and we train two different architectures to predict the next note for a voice, given the past of both voices, in an online fashion. The results are encouraging, and the computation time of both architectures is sufficient for implementing a real time application.

49. Side-Channel Attacks: Threats and Solutions

M. Ali Vosoughi, Selçuk Köse
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Cryptographic circuits (CCs) have dedicated electromagnetic emanations, power consumption traces, processing time signatures, or faulty outputs that are highly correlated with sensitive information such as a cryptographic key. The emanations may provide useful information for an attacker to obtain the cryptographic key inside the CC and are called side-channel information. In a side-channel attack, the side-channel leakage is utilized to significantly speed up the process to retrieve the secret key that is stored in a CC. This research further contributes to techniques to perform a side-channel attack by combining multiple attacks. Moreover, novel techniques are introduced to combine multiple countermeasures to secure a CC against side-channel threats. On-chip voltage regulators, which are essential parts of an on-chip CC, are designed in a security-aware fashion to enhance the security of a CC against side-channel attacks.

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50. Speech Super Resolution Generative Adversarial Network

Sefik Emre Eskimez, Kazuhito Koishida and Zhiyao Duan
University of Rochester, Rochester, NY

The goal of speech super-resolution (SSR) or speech bandwidth expansion is to generate the missing high-frequency components for a given low-resolution speech signal. It has the potential to improve the quality of telecommunications. We propose a new method for SSR that leverages the generative adversarial networks (GANs) and a regularization method for stabilizing the GAN training. The generator network is a convolutional autoencoder with 1D convolution kernels, operating along time-axis and generating the high-frequency log-power spectra from the low-frequency log-power spectra input. We employ two recent deep neural network (DNN) based approaches to compare them with our proposed method, including both objective speech quality metrics and subjective perceptual tests. We show that our proposed method outperforms the baseline methods in terms of both objective and subjective evaluations.

51. Towards Designing On-chip Power Delivery Against Covert Communication Attacks

Longfei Wang[1], S. Karen Khatamifard[2], Ulya R. Karpuzcu[2], and Selçuk Köse[1]
[1]University of Rochester, Rochester, NY, [2]University of Minnesota, Minneapolis, MN

Modern integrated systems feature shared on-chip power delivery resource, which has been demonstrated in this work to incur security vulnerabilities. Due to the feedback control of on-chip voltage regulators, load current change at the voltage regulator output leads to changes of output voltage ripple, input voltage ripple, and control signal. Such characteristics may be leveraged by an attacker to encode sensitive information by means of a switching load current to transmit from the source voltage regulator to the sink node through the shared global power grid. Covert communication attacks through such security vulnerabilities have been demonstrated through Cadence simulations, featuring the necessity of integrating security into the early stage of circuit design.

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