University Technology

Showcase

Thursday April 12th, 2018

Research Focus Areas:

Optics, Photonics, Biomedical Technology, Microelectronics, Software and Communication, Energy and Materials, and Data Science
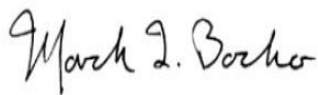
Welcome

Dear Colleagues,

Welcome to the 18th annual University Technology Showcase sponsored by the Center for Emerging and Innovative Sciences and the Center of Excellence in Data Science, both New York State funded Centers at the University of Rochester. Our event this year features presentations and posters that are a sample of the high quality applied research being conducted 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 kick off the meeting this year we are pleased to welcome our speakers, Dr. Art Papier and Dr. Walter Johnson from the University of Rochester and Mr. William Strassburgh from Wegmans Corporation. We are also very pleased to continue an award of $500 to the best poster, as judged by today's attendees.

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 fill in one of the forms handed out at the registration table or to go on line at http://www.ceis.rochester.edu.
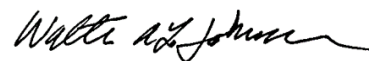
Warm Regards,

Mark Bocko, PhD   Paul Ballentine, PhD   Walter A.L. Johnson, PhD
Director, CEIS   Executive Director, CEIS   Executive Director,
                                                              CoE in Data Science

Featured Speakers

Bill Strassburg, *Board of Directors, Wegmans*

Bill Strassburg joined Wegmans in 1977. Bill has worked in marketing research, pricing, special promotions, marketing, real estate, operations, special projects, and strategic planning for Finger Lakes Regional Economic Development Council and FLX Food. He was the president of Chase-Pitkin Home and Garden, a division of Wegmans. Bill has a Bachelor of Science degree in Finance and Marketing from SUNY Albany and a Master of Business Administration in Finance and Marketing from University of Rochester. He currently serves as a board member of the Greater Rochester Chamber of Commerce and sits on the board for Greater Rochester Enterprise, FLREDC, LSI (UR), NYSAES and Pluta Cancer Center (UR).

Walt Johnson, *Executive Director, Goergen Institute of Data Science, Center of Excellence for Data Science, and the Rochester Data Science Consortium*

Dr. Johnson was Vice President of the Palo Alto Research Center (Xerox PARC), managing their Intelligent Systems Laboratory in Palo Alto until 2014 at which time he moved to Rochester to integrate Xerox's Webster Research Center into PARC. Previously, Walt served as Senior Vice President of Operations at SkyGrid, Inc., a real-time financial news analytics startup, as well as the Vice President of Strategy and Business Development at Uppercase, Inc., a tablet PC startup acquired by Microsoft. He is a former scientist in PARC's groundbreaking Human-Computer Interaction group, where he specialized in intelligent interfaces for mobile and ubiquitous computing applications. His work on an embedded document application environment for multifunction devices led to the creation of a special enterprise-level division of Xerox, for which he received the Xerox President's Award and the PARC Excellence in Science and Technology award. Walt holds 15 United States patents. Dr. Johnson obtained his Ph.D. in Cognitive Psychology from the University of Pittsburgh, and B.A. and MA. degrees at the University of Arizona.

Featured Speakers

Art Papier, *Founder and CEO, VisualDx*

Art. Papier MD is a founder of VisualDx and CEO.   A dermatologist, and medical informaticist, Art has a particular interest in designing clinical systems that leverage the human ability for pattern recognition, thereby increasing clinical accuracy and reducing diagnostic error at the point of care. In line with this goal, he has led the development of VisualDx, the first diagnostic clinical decision support system to be widely used. Art is also passionate about the engagement of people in their medical decisions, in consumer health, and developing tools to educate and empower patients in their homes and on their mobile devices.

A graduate of Wesleyan University, Art received his MD from the University of Vermont College of Medicine, and completed his graduate medical training at the University of Rochester Medical Center. He is also an Associate Professor of Dermatology and Medical Informatics at the University of Rochester School of Medicine and Dentistry.

Recognition

Center for Emerging and Innovative Sciences
Partner Appreciation Award

2017 Recipient

J. Mikael Totterman, Clerio Vision Inc.

Mikael Totterman is a serial entrepreneur and the CEO of Rochester based Clerio Vision, Inc., a UR Medical Center spin-out. Clerio Vision is developing a revolutionary product for the global refractive surgery market. Mike has extensive start-up and VC experience across the medical and pharmaceutical industries. Previously, he co-founded and/or led several Rochester based medical-related start-ups with connections to UR. Those include VirtualScopics, Qmetrics Technologies and iCardiac.

A native of Brighton, Mike holds an MBA with a Technology Concentration from Dartmouth College, the Tuck School of Business, and received his bachelor's degree in Industrial Engineering from Stanford University.

Co - Sponsors

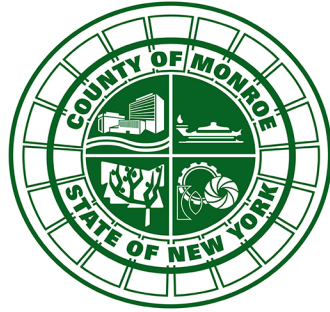**GOERGEN INSTITUTE FOR DATA SCIENCE**
AT THE UNIVERSITY OF ROCHESTER

CEIS Center for Emerging & Innovative Sciences

NYSTAR ®
Empire State Development
Division of Science, Technology & Innovation

URVentures

BATTERY
PROTOTYPING CENTER

R·I·T | INTELLECTUAL PROPERTY &
TECHNOLOGY TRANSFER OFFICE

COUNTY OF MONROE
STATE OF NEW YORK

CHERYL DINOLFO
COUNTY EXECUTIVE

nextcorps

AIN CENTER FOR
ENTREPRENEURSHIP
"Generating and Transforming Ideas into Enterprises That Create Value"

AIM
photonics
AMERICAN INSTITUTE for MANUFACTURING INTEGRATED PHOTONICS

CACT
Center for
Advanced
Ceramic
Technology

VERACITY
VRCADE

NYS SCIENCE+TECHNOLOGY
LAW CENTER
AT SYRACUSE UNIVERSITY COLLEGE OF LAW

Promoting Innovation Through Law℠

AHEAD ENERGY
Climate Friendly Energy Solutions

CIRC

FINGER LAKES COMMUNITY COLLEGE
INSTRUMENTATION & CONTROL TECHNOLOGIES
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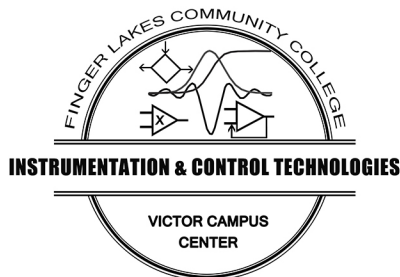
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T1   **Center of Excellence in Data Science**

T2   **AIM Photonics**

T3   **UR Ventures**

T4   **Excell Partners**

T5   **FLCC's Victor Campus**

T6   **Center for Advanced Ceramic Technology (CACT) at Alfred University**

T7   **RIT Offices of Technology Transfer and Research Relations**

T8   **NextCorps**

T9   **University of Rochester Center for Entrepreneurship/Technical Entrepreneurship and Management (TEAM) M.S. Program**

T10   **New York State Science & Technology Law Center (NYS STLC) at Syracuse University College of Law**

T11   **Center for Integrated Research Computing (CIRC)**

T12   **Monroe County Economic Development /Monroe County Finger Lakes Procurement Technical Assistance Center (MCFL/PTAC)**

T13   **RIT Battery Prototyping Center**

T14   **AHEAD Energy Corporation**

T15   **VERACITY VRCADE**

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T1   **Center of Excellence in Data Science**

The **Center of Excellence in Data Science** (CoE) is an integral component of the Goergen Institute for Data Science (GIDS) at the University of Rochester and is funded by the New York State Department of Economic Development. This NYSTAR CoE program helps to drive regional economic development by supporting research, training and technology creation efforts in a variety of industry sectors that advance technology commercialization and promote job creation. The CoE offers support for companies and other partners in the following areas:

- Research that generates innovative technologies and methods
- Commercialization and incubation of new products and services, and providing access to business acceleration programs
- Consultations and access to advanced computing resources such as an IBM supercomputer, high performance Linux clusters, and a massive visualization lab.

The **Goergen Institute for Data Science** offers a BA/BS and MS degree in data science. The BA/BS program combines computer science, statistics, and a student's choice of advanced application coursework. The MS program in data science allows students to study the broad area of data science or to concentrate their studies in one of the following areas: *computational and statistical methods, health and biomedical sciences,* and *business and social science.* Since the program was launched in 2016, more than 20 projects from ten local and regional companies have been offered to students spanning a broad range of industry segments including consumer retail, healthcare, agriculture, government and finance.

Also housed within GIDS, the **Rochester Data Science Consortium** is a partnership between the State of New York, the University of Rochester and commercial businesses that seeks to leverage world-class research capacity of the University of Rochester in support of high-level job creation within the local economy.

For more information about the CoE visit:
http://www.sas.rochester.edu/dsc/coe/index.html

For more information about GIDS visit:
http://www.sas.rochester.edu/dsc/index.html

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

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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 **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.

T4 **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.

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T5 **FLCC's Victor Campus**

FLCC Instrumentation and Control Technologies program, working with 40+ high-tech businesses; addresses need for adaptable technical worker 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.   The 2-year degree program has had estimated cumulative economic impact of $15 million over the past four years. This May, the fifth cohort will be graduating, bringing the total number of graduates to over 40.

T6 **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 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.

T7 **RIT Offices of Technology Transfer and Research Relations**

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

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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.

T8   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.

T9   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. 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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T10   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.

T11   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.

T12   Monroe County Economic Development

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.

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There is no fee for MCFL PTAC services:
- Assess Readiness
- Analyze Market Opportunities
- Assist with Registrations and Proposal Development
- Identify Bid Leased
- Connect with Government Buyers and Prime Contractors

T13   RIT Battery Prototyping Center

The Battery Prototyping Center (BPC) at Rochester Institute of Technology (RIT) focuses on the development of emerging energy storage technologies through a partnership between RIT and NY-BEST. It features a 1000 square foot dry room with the necessary equipment for battery material development, electrode fabrication, and semi-automated pouch cell assembly. Access to the dry room includes manufacturing and assembly of lithium ion pouch cells (assembly, electrolyte filling, formation cycles, degassing, and sealing), training for your employees on the prototyping line equipment, and prototyping assistance from the dry room's trained personnel. The BPC is uniquely positioned at RIT to provide prototyping services to multiple entities engaged in energy storage while maintaining confidentiality related to industry and university projects. It is a critical resource in the growing energy storage ecosystem of New York State. For more information visit http://www.rit.edu/batteries

T14   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.

T15   VERACITY VRCADE

VeRacity VRcade is Rochester's premier virtual reality destination. Veracity provides a safe and entertaining space to enjoy VR games and experiences for participants of all ages. The VRcade will also be used to educate the community on the current technology and possibilities for future uses of virtual reality by partnering with local universities, developers, and community leaders.

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Founded by Isai Pochtar and partner, Nick Marchioni, the idea was conceptualized at Rochester's Light and Sound Interactive (LSI) in September 2017. Pochtar, a former international banker from New York City, was impressed by the human capital in imaging developed in Rochester by Kodak, Bausch and Lomb, and Xerox. Universities, such as RIT, are making huge advances in these fields, often without a place to test or showcase their ideas to the public. Pochtar believes "that Rochester could be the hub for virtual reality and augmented reality (AR) in the same way that Pittsburgh is becoming a hub for autonomous cars."

VeRacity contains six virtual-reality stations in 1400 square foot. Since virtual reality appears in all directions around the player, each 8' x 8' station is roomy enough to experience the effects unencumbered.

At the heart of the arcade are games. VeRacity features games for all ages and interests: from shooting zombies and attacking space ships, to a lighthearted tour of the world, and from painting and sculpture in a 3-D studio to rigorous athletic activities. "Some of these adventures can really build up a sweat," according to Pochtar.

The VRcade was designed to be an inclusive environment. "We wanted a retro look that everyone would find playful and welcoming, and that didn't cater to gaming stereotypes" according to Pochtar. "We believe strongly that this will be a safe and fun social location to enjoy VR gaming."
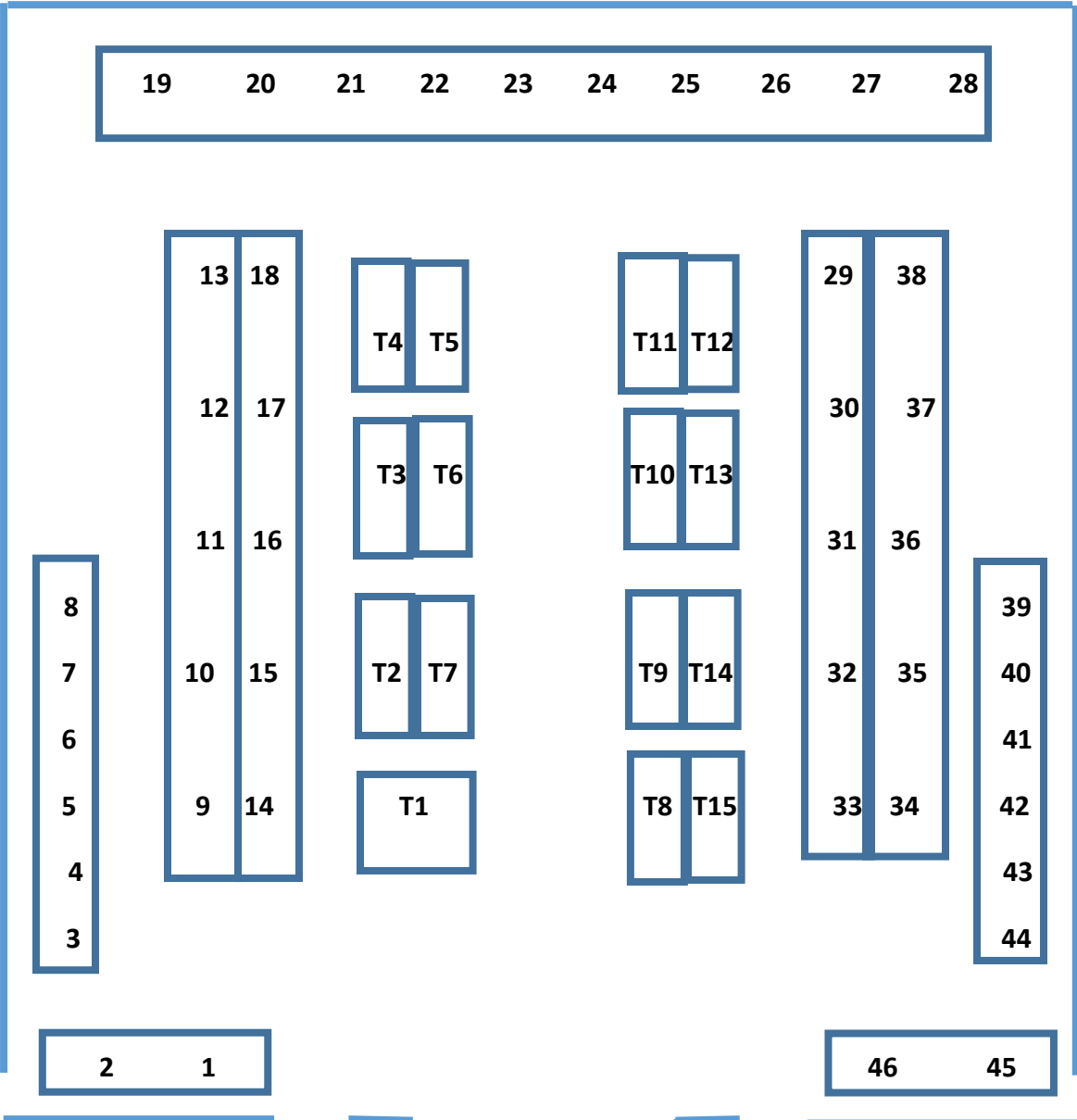
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Chemical Engineering, Mechanical Engineering, Materials Science 35-38	Data Science 39-46

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Poster Presentations

Optics, Photonics and Imaging

1. **Simulating Future Optical Communication Systems**
   Govind P. Agrawal, William A. Wood and Aku Antikainen
   University of Rochester

2. **Scattering properties of ultrafast laser-induced refractive index shaping lenticular structures in hydrogels**
   Kaitlin T. Wozniak[a], Thomas A. Germer[b], Sam C. Butler[c,e], Daniel R. Brooks[a], Krystel R. Huxlin[d], Jonathan D. Ellis[a,c,f]
   [a]The Institute of Optics, University of Rochester; [b]National Institute of Standards and Technology; [c]Department of Mechanical Engineering, University of Rochester; [d]Flaum Eye Institute, University of Rochester; [e]Clerio Vision, Inc; [f]College of Optical Sciences, University of Arizona

3. **Development of Si-MOSFET CMOS Detectors for 170-250GHz**
   Katherine Seery, Zoran Ninkov, Jack Horowitz, Kenneth Fourspring, J. Daniel Newman, Andrew Sacco, Paul P. K. Lee, Moeen Hassanalieragh, Zeljko Ignjatovic, Craig McMurtry, Judith Pipher

4. **Using Quantum Dots to Enable Deep-UV Sensitivity for Standard Silicon Based Imaging Detectors**
   Robert Ichiyama, Alexander Knowles, Zoran Ninkov, Scott Williams, Ross Robinson
   Rochester Institute of Technology

5. **Optimization of Laser System and Raman Spectroscopy of Femtosecond Micromachined Ophthalmic Materials**
   Ruiting Huang[a], Dan Yu,[a,b] Wayne H. Knox,[a,b]
   [a]The Institute of Optics, [b]Center for Visual Science, University of Rochester
   Clerio Vision, Inc., Rochester, NY, USA 14607

6. **Modeling Oblique Propagation of Polarized Light Through an SEO Birefringent Mask**
   Ashan Ariyawansa, Thomas G. Brown, PhD
   University of Rochester

7. **Next generation of Gabor-Domain Optical Coherence Microscopy with fluorescence detection**
   Changsik Yoon[1], Yue Qi[2], Andrea Cogliati[3], Adam Hayes[1], Cristina Canavesi[4], Patrice Tankam[1], and Jannick P. Rolland[1,2,4]
   [1] The Institute of Optics, University of Rochester [2] Dept. of Biomedical Engineering, University of Rochester
   [3] Dept. of Electrical and Computer Engineering, University of Rochester [4] LighTopTech Corp.

Poster Presentations

8. **Quantitative Assessment of Human Corneal Endothelial Cells using GD-OCM**
Yue Qi[1], Amanda Mietus[2], Changsik Yoon[2], Patrice Tankam[2], Holly B. Hindman[3], and Jannick P. Rolland[1,2]*
[1]University of Rochester, Department of Biomedical Engineering
[2]University of Rochester, The Institute of Optics
[3]The Eye Care Center, 325 West Street, Canandaigua

9. **Adversarial Sparse-View CBCT Artifact Reduction**
Haofu Liao, Jiebo Luo
Department of Computer Science, University of Rochester

10. **Controlling Femtosecond Laser Ablation for High-Precision Optics and Photonics Fabrication**
Lauren L. Taylor and Jie Qiao*
*Advanced Optical Fabrication, Instrumentation, and Metrology Laboratory, Chester F. Carlson Center for Imaging Science, Rochester Institute of Technology

11. **Planar Light Guide Concentrated Photovoltaics**
Eryn Fennig, Greg Schmidt, Duncan T. Moore
University of Rochester

12. **Hemianopia Intervention Study: rehabilitation through visual training**
Matthew Cavanaugh, Madhura Tamhankar, Byron Lam, Krystel Huxlin, and Steven Feldon
University of Rochester

13. **Empirical Satellite Characterization for Realistic Imagery Generation**
Nilay Mokashi and Dr. John Kerekes
Rochester Institute of Technology

14. **Multi-Spectral Change Detection Methods: Evaluation on Simulated and Real-World Satellite Imagery**
Jobin J. Mathew, Dr. John P. Kerekes
Digital Imaging & Remote Sensing (DIRS) group at Center for Imaging Science (CIS), Rochester Institute of Technology (RIT)

Biomedical Engineering

15. **Compressive Beamforming for Portable Ultrasound Imaging with the Promise of Super Resolution**
Jovan Mitrovic and Zeljko Ignjatovic
University of Rochester

16. **MRI Tumor Segmentation with Densely Connected 3D CNN**
Chenliang Xu, Lele Chen, Yapeng Tian

Poster Presentations

University of Rochester

17. **Evaluation of Indirect Methods for the Detection of Exosome Capture on Nanomembranes**
James L. McGrath, Kilean Lucas, John Cognetti, Tejas Khire
Department of Biomedical Engineering, University of Rochester

18. **An Improved Mupirocin-based Ointment for the Prevention and Therapeutic Intervention of Bacterial Infections**
Michaelle Chojnacki[1], Alesa Philbrick[1], Ralph Angelo[2] and Paul M. Dunman[1,2]
[1]Department of Microbiology and Immunology, University of Rochester School of Medicine and Dentistry, Rochester, NY; [2]Arcum Therapeutics, Rochester, NY

19. **Characterizing the Antimicrobial Properties of 405 nm Light and the Corning® Fibrance® Light-Diffusing Fiber Delivery System.**
Cynthia Shehatou[1], Tyler Scherzi[1], Andrew Bischer[1], Paul M. Dunman[1], Constantine G. Haidaris[1], and W. Spencer Klubben[2]*
[1]Department of Microbiology and Immunology, University of Rochester School of Medicine and Dentistry; [2]Corning Incorporated, Corning, NY

20. **Computational Analysis of the Re-Centering of Contact Lenses**
Dr. Kara L. Maki and Dr. David S. Ross
Rochester Institute of Technology

21. **Plane Wave and Elastographic Imaging of Aortic Tissue**
Luke Cybulski, Mark Balceniuk, M.D., and Michael S. Richards, Ph.D.
Cardiovascular Engineering Laboratory, University of Rochester School of Medicine, Department of Surgery

22. **Towards Automated Clinical Evaluation of Tendon through Shear Wave Elastography**
Rifat Ahmed[1], Keshia Mora[2], Marvin Doyley[1], Mark Buckley[2], Stephen McAleavey[2]
[1] Department of Electrical and Computer Engineering, University of Rochester
[2] Department of Biomedical Engineering, University of Rochester

23. **High-Frequency Quantitative Ultrasound Systems for Tissue Engineering**
Sarah Wayson[1, 3], Denise C. Hocking[2, 3], Diane Dalecki[1, 3]
[1]Department of Biomedical Engineering, University of Rochester
[2]Department of Pharmacology and Physiology, University of Rochester
[3]Rochester Center for Biomedical Ultrasound

Poster Presentations

Electrical Engineering, Computer Engineering

24. **Audio-Visual Event Localization in Unconstrained Videos**
Yapeng Tian, Jing Shi, Bochen Li, Zhiyao Duan, and Chenliang Xu
University of Rochester

25. **A 10x10 Pixel Array Camera in 350 nm CMOS Technology for room temperature THz Imaging**
Moeen Hassanalieragh and Zeljko Ignjatovic
University of Rochester

26. **Ad Hoc Network Connectivity Maintenance and Data Continuity though WiFi Direct Emulation Using Mininet-Wifi**
Utku Demir, Aaron Faulkenberry, Cristiano Tapparello, Wendi Heinzelman
University of Rochester

27. **A Directed Graph Fourier Transform**
Rasoul Shafipour and Gonzalo Mateos (University of Rochester, NY)
joint work with Ali Khodabakhsh and Evdokia Nikolova (The University of Texas at Austin)

28. **Automatic Lyrics Display System for Live Music Performances**
Karan Vombatkere, Bochen Li, Yiming Zhao, Junyi Fan Prof. Zhiyao Duan
University of Rochester

29. **Skeleton Plays Piano: End-to-end Online Generation of Pianist Body Movements from MIDI Performances**
Bochen Li
University of Rochester

30. **Bridging the gap between nano and macro scales**
Dilnoza Amirkulova , Maghesree Chakraborty
University of Rochester

31. **Quantifying Listener Preference of Flat-Panel Loudspeakers with Objective Measures**
Michael Heilemann David Anderson, Stephen Roessner, and Mark Bocko
University of Rochester

32. **Superconducting single-photon detectors as smart sensors**
Mihiraan Singh, Jordan Cady, Yunus Akbas, Genyu Chen and Roman Sobolewski (PI)
University of Rochester, Rochester, NY 14627-0231
HYPRES Inc., Elmsford, NY 10579

33. **Network Availability Profiling and Analysis**
Nadir Adam, Cristiano Tapparello, Wendi Heinzelman

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Department of Electrical and Computer Engineering,
University of Rochester

34. Overview of Research at the Signal, Data, and Imaging Sciences Laboratory
Mujdat Cetin
Department of Electrical and Computer Engineering,
University of Rochester

Chemical Engineering, Mechanical Engineering, and Materials Science

35. Assessing the link between refractive change and mechanical properties in IRIS contact lenses
Paul D. Funkenbusch[A] ,Kaitlin Wozniak[B] , Daniel R. Brooks[B], Len A. Zheleznyak[B,C] , Sam C. Butler[A,C] ,Jonathan D. Ellis[A,B, D], Wayne H. Knox[B]
[A] Department of Mechanical Engineering
[B] The Institute of Optics, University of Rochester
[C] Clerio Vision, Inc.
[D] College of Optical Sciences, University of Arizona

36. Social and Tactile Augmented Reality in an Undergraduate Chemical Engineering Laboratory
Rainer Barrett, Heta Gandhi, Anusha Naganathan, Danielle Daniels, Yang Zhang, Chibueze Onwunaka, April Luehmann, and Andrew D. White

37. Photophysics of OLED emitters in non-crystallizing hosts
M. Molaire, R. Chakraborty and D. Weiss, Molecular Glasses
T. Yu, H. Liu and L. Rothberg, University of Rochester Department of Chemistry

38. Fiber to Chip Fusion Splicing for Robust, Low Loss Optical Coupling
Juniyali Nauriyal[1], Raymond Yu[1], Meiting Song[1], and Jaime Cardenas[1]
[1]Institute of Optics, University of Rochester, Rochester, NY 14627

Data Science

39. Change Detection in Satellite Images Using Siamese Networks
Faiz Rahman, Bhavan Kumar Vasu, Prof. Andreas Savakis
Rochester Institute of Technology Computer Engineering

***40.*Digital Game Based Learning Tool for Deaf Learners: A Pilot Study**
Noella Kolash
Rochester Institute of Technology

41. Generating Talking Face Landmarks from Speech
S. Emre Eskimez
University of Rochester

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42. **Blindfolded Multi-Random-Forests Evaluation**
    Asma Aloufi, Dr. Peizhao Hu
    Golisano College of Computing and Information Sciences.
    Rochester Institute of Technology

43. **Lip Movements Generation at a Glance**
    Yapeng Tian, Lele Chen, Chenliang Xu
    University of Rochester

44. **Vision-based Position and Attitude Estimation for Autonomous Vehicles**
    Guoyu Lu
    Rochester Institute of Technology

45. **Effects of Format Entry on Consumer Grocery Shopping Habits**
    Vidal Berastain
    University of Rochester

46. **Food Trend Detection on Social Media**
    Yang Gao
    University of Rochester

Poster Presentations

Optics, Photonics and Imaging

1. **Simulating Future Optical Communication Systems**
Govind P. Agrawal, William A. Wood and Aku Antikainen
University of Rochester

As current optical communication networks approach their limits, new innovations are needed to meet the ever-growing demand for information transfer capacity. Multi-mode and multi-core optical fibers have been suggested as promising candidates for next-generation communication systems. Such fibers bring about numerous challenges that the current systems were designed to avoid. Therefore, extensive simulations will need to be performed to identify any possible issues before the new systems are manufactured and deployed. We implemented a numerical light propagation equation solver to simulate the behavior of light in multi-mode and multi-core to aid in the design of future optical networks. Here we demonstrate that the solver correctly accounts for all the relevant phenomena of nonlinear light propagation and present the latest results from it.

2. **Scattering properties of ultrafast laser-induced refractive index shaping lenticular structures in hydrogels**
Kaitlin T. Wozniak[a], Thomas A. Germer[b], Sam C. Butler[c,e], Daniel R. Brooks[a], Krystel R. Huxlin[d], Jonathan D. Ellis[a,c,f]
[a]The Institute of Optics, University of Rochester; [b]National Institute of Standards and Technology; [c]Department of Mechanical Engineering, University of Rochester; [d]Flaum Eye Institute, University of Rochester; [e]Clerio Vision, Inc; [f]College of Optical Sciences, University of Arizona

We have developed a new technique for ultrafast laser refractive correction, called intra-tissue refractive index shaping (IRIS). A 405 nm femtosecond laser is focused and scanned below the surface of transparent ophthalmic materials (cornea, contact lenses, intraocular lenses), inducing a spatially-varying refractive index change that corrects vision errors. In contrast with traditional laser correction methods, such as laser *in-situ* keratomileusis or photorefractive keratectomy, which operate via photoablation, IRIS changes the refractive index of transparent materials. A concern with any laser eye correction technique is additional scatter induced by the process, which can adversely affect vision, especially at night. The goal of this investigation is to identify sources of scatter induced by IRIS and to mitigate possible effects on visual performance in ophthalmic applications. Preliminary light scattering measurements on patterns written into hydrogel showed four sources of scatter: (1) scattering from scanned lines; (2) scattering from stitching errors, resulting from adjacent scanning fields not being aligned to one another; (3) diffraction from Fresnel zone discontinuities; and (4) long-period variations in the scans that created distinct diffraction peaks, likely due to inconsistent line spacing in the writing instrument. Knowing the nature of these different scattering errors allows us to modify the design of IRIS structures to optimize visual performance in human clinical trials.

Poster Presentations

3. **Development of Si-MOSFET CMOS Detectors for 170-250GHz**
   Katherine Seery, Zoran Ninkov, Jack Horowitz, Kenneth Fourspring, J. Daniel Newman,
   Andrew Sacco, Paul P. K. Lee, Moeen Hassanalieragh, Zeljko Ignjatovic, Craig McMurtry,
   Judith Pipher

Rochester Institute of Technology (RIT), in collaboration with the University of Rochester and Harris Corporation, are developing room-temperature Si-MOSFET (Silicon Metal Oxide Semiconductor Field Effect Transistor) CMOS devices for use in large focal plane array imaging and detection of THz radiation. Test structures are designed locally and fabricated (350nm and 65nm process) using the MOSIS facility. These devices utilize asymmetry in both the antenna connection and source-drain size to optimize responsivity. Results of NEP and Responsivity are presented from 170 to 250 GHz transmission testing of three generations of chip designs (GEN-II, GEN-IV, and GEN-V) with single test structure FETs with several antenna configurations and a range of extended source regions.

4. **Using Quantum Dots to Enable Deep-UV Sensitivity for Standard Silicon Based Imaging Detectors**
   Robert Ichiyama, Alexander Knowles, Zoran Ninkov, Scott Williams, Ross Robinson

Deep UV sensitization of silicon-based CMOS and CCD detectors using printed quantum dots will be presented. Quantum dots (QD) overcome many of the limitations inherent in Lumogen which is the current state of the art in detector high-energy sensitization . QD, moreover, provide enhanced advantages over Lumogen. The QD peak fluorescence wavelength, for example, is tunable, and may be fabricated to match the peak sensor quantum efficiency. We found that CdSe quantum dots synthesized with water-dispersible ligands enables formulation of ink jet printable water-based inks compositions. Uniform QD thin-layers have been ink jet printed into variety of substrates including CMOS detector chips. Surface characterization including scanning electron microscopy, vacuum-ultraviolet absorption spectroscopy, and quantum yield will be presented. Using a water-based QD system, we have been able to minimize the impact that organic residues impart on this imaging technology.

5. **Optimization of Laser System and Raman Spectroscopy of Femtosecond Micromachined Ophthalmic Materials**
   Ruiting Huang[a], Dan Yu,[a,b] Wayne H. Knox,[a,b]
   The Institute of Optics, [b]Center for Visual Science, University of Rochester, Rochester, NY, USA 14627
   Clerio Vision, Inc., Rochester, NY, USA 14607

We studied the effects of system repetition rates and wavelengths on femtosecond micromachining ophthalmic materials. Relying on a KMLabs laser which allows for varying repetition rates and wavelengths, we successfully inscribe grating lines and phase bars inside contact lenses using repetition rates in the range from 1 MHz to 60 MHz and wavelengths at 1035 nm and 517 nm. Results show a much lower power is required to

obtain the same phase change at lower repetition rates than at higher repetition rates. Additionally, 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). Raman scattering has inherently narrow vibrational bands, and is resonance enhanced, allowing observation of the vibrational spectrum of a specific chromophore in a complex system. The Raman system we have built enable us to accurately probe the chemical and structural change in various ophthalmic materials and cornea with a nanoscale resolution. Our previous results have demonstrated that micromachining-induced phase change is closely related to the water content change in hydrogels, therefore, mapping water content locally helps to investigate the femtosecond laser micromachining mechanisms.

6. **Modeling Oblique Propagation of Polarized Light Through an SEO Birefringent Mask**
   Ashan Ariyawansa, Thomas G. Brown, PhD
   University of Rochester

Birefringent masks formed by stress engineering, called stress-engineered optics (SEO), have been shown to be useful for pupil engineering in imaging systems and for new ways of measuring polarization. We present two methods to model the propagation of polarized light through an SEO. First, we use a differential equation solving method, which utilizes the analytic expression for the Jones matrix of the SEO leading to a numerical solution for the output electric field. Then we present a geometric method to obtain similar results with far less computational cost. Finally, a comparison is done between the measured data and the simulations.

7. **Next generation of Gabor-Domain Optical Coherence Microscopy with fluorescence detection**
   Changsik Yoon[1], Yue Qi[2], Andrea Cogliati[3], Adam Hayes[1], Cristina Canavesi[4], Patrice Tankam[1], and Jannick P. Rolland[1,2,4]
   [1] The Institute of Optics, University of Rochester   [2] Dept. of biomedical engineering, University of Rochester
   [3] Dept. of Electrical and Computer Engineering, University of Rochester   [4] LighTopTech Corp.

There has been an increasing demand among scientists and practitioners to couple the information of the biochemical composition of cells with their morphology. The fusion enables (1) to improve the specificity and sensitivity of conventional fluorescence imaging system and (2) to grant a deterministic metric in the diagnosis of the target, embedded in the sample, for a conventional non-fluorescence imaging system. In 2018 CEIS University Technology Showcase, we display the basic concepts of Gabor-Domain Coherence Microscopy (GD-OCM) and Laser Scanning Confocal Fluorescence Microscopy (LSCFM) then report our technical progress in the combination of GD-OCM with LSCFM in research.

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8. **Quantitative Assessment of Human Corneal Endothelial Cells using GD-OCM**

Yue Qi[1], Amanda Mietus[2], Changsik Yoon[2], Patrice Tankam[2], Holly B. Hindman[3], and Jannick P. Rolland[1,2]*
[1]University of Rochester, Department of Biomedical Engineering,
[2]University of Rochester, The Institute of Optics
[3]The Eye Care Center, 325 West Street, Canandaigua

Corneal endothelium failure is the main reason of corneal transplantation (keratoplasty) in the United States. The current standard imaging system used for evaluating the endothelial cells of a donor cornea is Specular Microscopy, which is limited by a small field of view in large part and inability to volumetrically imaging cornea. Gabor-Domain Optical Coherence Microscopy (GD-OCM) was employed to investigate the donor corneal endothelial cells and to provide volumetric imaging of cornea at the same time. The focus of this study is to investigate the viability of using GD-OCM for the corneal endothelium at a clinical level. In this study, we demonstrated a pathway for GD-OCM to assess corneal endothelial layers.

9. **Adversarial Sparse-View CBCT Artifact Reduction**

Haofu Liao, Jiebo Luo
Department of Computer Science, University of Rochester

We present an effective post-processing method to reduce the streak artifacts from cone-beam CT (CBCT) images reconstructed from a fraction of projections. The proposed method is based on the state-of-the-art image-to-image generative models with perceptual loss as regulation. Unlike the traditional CT artifact reduction approaches, our method is trained in an adversarial fashion which yields more perceptually realistic outputs while preserving the anatomy. To address the streak artifacts that are inherently local and appear across various scales, we further propose a novel discriminator architecture based on feature pyramid networks and a differential-modulated focus map to induce the adversarial training. Our experimental results show that the proposed method greatly corrects the cone-beam artifacts from clinical CBCT images reconstructed using 1/3 of projections and outperforms strong baseline methods both quantitatively and qualitatively.

10. **Controlling Femtosecond Laser Ablation for High-Precision Optics and Photonics Fabrication**

Lauren L. Taylor and Jie Qiao*
Advanced Optical Fabrication, Instrumentation, and Metrology Laboratory, Chester F. Carlson Center for Imaging Science, Rochester Institute of Technology

Femtosecond lasers have high pulse intensities which enable non-thermal-ablation-based material removal. The high precision of the ablation process enables various optics and photonics fabrication applications including structuring and polishing of conventional and freeform optical elements, direct writing of photonics elements (optical waveguides, gratings, etc.) in bulk material, and microwelding of optical/photonics materials for the integration and packaging of photonic devices. However, the fabrication versatility and

quality depend upon precise control of the invoked physical mechanisms specific to the removal and/or modification of material, e.g., nonthermal-ablation-based material removal via solid-vapor phase transition and/or melting/heat-based processing via solid-liquid-vapor phase changes. In pursuit of deterministic optics and photonics fabrication using femtosecond lasers, we have investigated the controllability of femtosecond laser ablation of semiconductor materials including silicon, germanium, and silicon carbide. Numerical and experimental sensitivity studies of ablation to laser parameters including repetition rate, pulse energy, and scanning speed have been conducted to evaluate the threshold for material removal, predict and control the onset of thermal effects, and characterize the impact of laser parameters on the characteristic size and rate of ablation. A processing metric, which considers the combined impact of different laser parameters, was established to evaluate the ablation efficiency, achieving specific ablation conditions and/or preventing the onset of thermal effects. This work presents a path for achieving deterministic femtosecond laser ablation for versatile, high-precision optics and photonics fabrication.

11. **Planar Light Guide Concentrated Photovoltaics**
    Eryn Fennig, Greg Schmidt, Duncan T. Moore
    University of Rochester

In recent years, there has been an interest in developing concentrating photovoltaic (CPV) systems for building integrated installations. Many design forms have been explored and evaluated for their ability to collect sunlight as well as be aesthetically pleasing and cost effective enough to satisfy consumers. One type of building integrated photovoltaic system incorporates a Fresnel CPV design that consists of an array of Fresnel lens modules. This type of array can be enclosed between two panes of window glass to limit exposure to the elements. Fresnel CPV systems may use two-axis tracking to collect the direct sunlight for power generation while the diffuse light enters the building. With this design configuration, the solar cell and its heat sink block a portion of the diffuse light. The long focal length Fresnel lens also requires significant mounting infrastructure that increases the cost as well as continually obstructs the line of sight through the window as the modules rotate to track the sun.
Planar light guide (PLG) CPV would be a welcome drop-in replacement to the Fresnel system used in a two-axis tracking façade design. PLG concentrators require four components: a microlens array, a low index total internal reflection layer, a guiding layer, and an injection layer. Each lenslet in the microlens array focuses light onto an injection facet situated underneath the apex of the lens. These facets totally internally reflect the light into the guiding layer and direct the light down the guide to a high efficiency solar cell located at one edge of the system. This poster outlines the design and performance of a 25 x 100 mm prototype array including a hands-on demonstration with an early prototype.

12. **Hemianopia Intervention Study: rehabilitation through visual training**
    Matthew Cavanaugh, Madhura Tamhankar, Byron Lam, Krystel Huxlin, and Steven Feldon
    University of Rochester

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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 considered irreversible. However, research studies have shown that vision can partially recover in hemianopic fields using gaze-contingent visual discrimination training. Preliminary data show this new approach reduces 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 precludes FDA approval. 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 begin enrollment in April 2018. This trial will occur at three sites and will include two training arms in order to determine if gaze-contingent visual training technology is a suitable treatment for hemianopia.

13. **Empirical Satellite Characterization for Realistic Imagery Generation**
    Nilay Mokashi and Dr. John Kerekes
    Rochester Institute of Technology

There is an increasing interest in the use of machine learning deep networks to automatically analyze satellite imagery. However, there are limited annotated satellite imagery datasets available for training these networks. Synthetic image generation offers a solution to this need, but only if the simulated images have comparable characteristics to the real data. This work deals with analysis of commercial satellite imagery to characterize their imaging systems for the purpose of increasing the realism of the synthetic imagery generated by RIT's Digital Imaging and Remote Sensing Image Generation (DIRSIG) model. The analysis was applied to satellite imagery from Planet Labs and Digital Globe. Local spatial correlation was leveraged for noise estimation and the EMVA1288 standard was used for noise modeling. Sharp edges in natural scenes were used together with the slanted edge method for estimation of the sensor optical systems' point spread function (PSF).

14. **Multi-Spectral Change Detection Methods: Evaluation on Simulated and Real-World Satellite Imagery**
    Jobin J. Mathew, Dr. John P. Kerekes
    Digital Imaging & Remote Sensing (DIRS) group at Center for Imaging Science (CIS), Rochester Institute of Technology (RIT).

This work is an evaluation of methods for detecting and quantifying changes in two multi-spectral satellite images taken at different times. The objective of this project was to understand how various change detection algorithms perform and to identify characteristics that might lead to an improved change detection algorithm. A comparison of algorithm performance on both real and simulated imagery is included. The real-world dataset (Digital Globe WorldView-2) required accurate registration and manual truth labelling, while the simulated satellite imagery was generated with perfect registration and

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a truth mask of the changes. An array of algorithms from conventional to statistical, distribution-based, graph-based and other approaches were evaluated. The Receiver-Operating-Characteristic (ROC) curve and Area-Under-Curve (AUC) metrics were used for quantitative algorithm evaluation. Finally, a Python-based GUI (Graphical User Interface) toolbox was created to encapsulate the algorithms and evaluation procedure, which may be helpful in benchmarking other algorithms.

Biomedical Engineering

15. **Compressive Beamforming for Portable Ultrasound Imaging with the Promise of Super Resolution**
    Jovan Mitrovic and Zeljko Ignjatovic
    University of Rochester

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. The results of the ex vivo imaging of 3 anechoic cysts with the radius of 10 mm, 6 mm and 4 mm, at 5 MHz frequency show that the contrast ratio not only doesn't change using the proposed method compared to the traditional B-mode with full aperture, but even improves. This could potentially lead to a fully portable medical ultrasound with super resolution capabilities.

16. **MRI Tumor Segmentation with Densely Connected 3D CNN**
    Chenliang Xu, Lele Chen, Yapeng Tian
    University of Rochester

Glioma is one of the most common and aggressive types of primary brain tumors. The accurate segmentation of subcortical brain structures is crucial to the study of gliomas in that it helps the monitoring of the progression of gliomas and aids the evaluation of treatment outcomes. However, the large amount of required human labor makes it difficult to obtain the manually segmented Magnetic Resonance Imaging (MRI) data, limiting the use of precise quantitative measurements in the clinical practice. In this work, we try to address this problem by developing a 3D Convolutional Neural Network~(3D CNN) based model to automatically segment gliomas. The major difficulty of our segmentation model comes with the fact that the location, structure, and shape of gliomas vary significantly among different patients. In order to accurately classify each voxel, our model captures multi-scale contextual information by extracting features from two scales of receptive fields. To fully exploit the tumor structure, we propose a novel architecture that hierarchically segments different lesion regions of the necrotic and non-enhancing tumor~(NCR/NET), peritumoral edema~(ED) and GD-enhancing tumor~(ET).

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Additionally, we utilize densely connected convolutional blocks to further boost the performance. We train our model with a patch-wise training schema to mitigate the class imbalance problem. The proposed method is validated on the BraTS 2017 dataset~\cite{DBLP:journals/tmi/MenzeJBKFKBPSWL15} and it achieves Dice scores of 0.72, 0.83 and 0.81 for the complete tumor, tumor core and enhancing tumor, respectively. These results are comparable to the reported state-of-the-art results, and our method is better than existing 3D-based methods in terms of compactness, time and space efficiency.

17. **Evaluation of Indirect Methods for the Detection of Exosome Capture on Nanomembranes**
    James L. McGrath, Kilean Lucas, John Cognetti, Tejas Khire
    Department of Biomedical Engineering, University of Rochester

Exosomes are small (50 - 120 nm) extracellular vesicles found in nearly all body fluids (eg. urine, blood, saliva). They are secreted by cells, including tumor cells, and carry molecular information about their cell of origin. Numerous teams in academia and industry are identifying tumor-biomarkers on exosomes as a means to detect early-stage cancer in 'liquid biopsies.' Purifying exosomes from body fluids without protein contaminants is particularly important when the biomarkers being sought are also proteins. Current methods for purifying intact exosomes are labor-intensive, multi-step purifications, that require large starting volumes (> 50 mL) to produce small quantities (< 1 mL) of high purity exosomes. Even these purifications have detectable quantities of non-exosome proteins that can compromise biomarker detection.

We have recently developed a technique for purification of exosomes on nanoporous nitride (NPN) membranes. NPN is the second generation of ultrathin, silicon-based nanoporous membranes ('nanomembranes') developed at Rochester. The highly permeable membranes have pores similar in size to exosomes and a unique pore geometry that promotes exosome capture in tangential flow filtration. The tangential flow configuration enables the exosomes to be washed with buffer after capture and recovered with a simple backwash to produce an ultra pure preparation. While captured exosomes can observed directly on NPN by fluorescence or electron microscopy, this requires destructive disassembly of the fluidic devices. A method for detecting pore occupancy by exosomes during the purification process is needed to optimize our methods.

In this project we evaluate two indirect methods for detecting occupied NPN pores during a tangential filtration process: transmembrane pressure and transmembrane electrical resistance. In these proof-of-principle studies we use polystyrene nanoparticles as surrogates for exosomes. Both metrics increase as pores are occupied by exosomes and saturate as the membrane reaches capacity. While transmembrane pressure rise appears appears to be a more robust and sensitive metric than transmembrane electrical resistance in our preliminary findings, we are still evaluating alternative electrical configurations and measurements including impedance spectra.

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18. **An Improved Mupirocin-based Ointment for the Prevention and Therapeutic Intervention of Bacterial Infections**

Michaelle Chojnacki[1], Alesa Philbrick[1], Ralph Angelo[2] and Paul M. Dunman[1,2]
[1]Department of Microbiology and Immunology, University of Rochester School of Medicine and Dentistry, Rochester, NY; [2]Arcum Therapeutics, Rochester, NY

Mupirocin is a celebrated antimicrobial agent that has been effectively used to thwart bacterial infection, having emerged as the standard of care for reducing infections in burn wound, dialysis, and surgical patient populations. However, the emergence of bacterial mupirocin resistance has reduced the agent's efficacy, necessitating the development of new treatment options. Earlier work found that the combination of mupirocin + neomycin (MN) displays synergistic antimicrobial performance that is superior to that of mupirocin alone and overcomes mupirocin resistance. Four proprietary MN formulations have been created and optimized for MN drug compatibility, active ingredient ratio, stability, and antimicrobial activity in the laboratory setting. Herein we establish the antimicrobial performance of these formulations in a murine model of *Staphylococcus aureus* wound infection, as a means to identify the top-performing formulation(s) to advance for MN product development

19. **Characterizing the Antimicrobial Properties of 405 nm Light and the Corning® Fibrance® Light-Diffusing Fiber Delivery System.**

Cynthia Shehatou[1], Tyler Scherzi[1], Andrew Bischer[1], Paul M. Dunman[1], Constantine G. Haidaris[1], and W. Spencer Klubben[2]*
[1]Department of Microbiology and Immunology, University of Rochester School of Medicine and Dentistry; [2]Corning Incorporated, Corning

Blue-violet (405nm) light displays antimicrobial activity toward bacterial pathogens of immediate and emerging healthcare concern. However, product development has been hampered by the absence of an applicable light delivery system. Chiefly among these, the light delivery device must be in direct proximity to- and deliver uniform illumination of- the offending pathogen, necessitating development delivery devices capable of irradiating a variety of surfaces, some of which may be physically constrained and non-uniform. Corning® Fibrance® Light-Diffusing Fiber may provide a novel 405nm light delivery system, with remarkable therapeutic and economical potential that may overcome light delivery issues. Our goals are to explore and validate the antimicrobial potential of Fibrance light delivery. To that end, herein the range of pathogens and therapeutic context with which 405nm light kills bacteria.

20. **Computational Analysis of the Re-Centering of Contact Lenses**

Dr. Kara L. Maki and Dr. David S. Ross
Rochester Institute of Technology

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

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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.

21. **Plane Wave and Elastographic Imaging of Aortic Tissue**
    Luke Cybulski, Mark Balceniuk, M.D., and Michael S. Richards, Ph.D.
    Cardiovascular Engineering Laboratory, University of Rochester School of Medicine,
    Department of Surgery

Abdominal aortic aneurysms (AAA) constitute a significant health problem and current methods for assessing the need for surgical repair are unreliable. It is the goal of this work to obtain a screening tool to further inform the state of these vascular pathologies by providing information related to their biomechanics. In this work, we use high frame-rate, plane wave ultrasound (US) imaging of aortic tissue mimicking phantoms made from a hydrogel material. From the US images, we obtain estimates of the pulse wave velocity (PWV) of a pressure wave propagating within the vessel, like that generated by a heart contraction. The PWV is then directly related to the stiffness of the tissue, and for straight, homogenous vessels, this relationship is described by the Moens-Korteweg equation. We have further developed a novel optimization technique of displacement estimation that uses image registration with implemented regularization. Additionally, we developed a robust optimization technique for PWV estimation that uses the measured axial displacements to fit a model of the propagating wave, with additional regularization. These algorithms were tested on US data collected from homogenous, tube-like phantoms with varying stiffness dictated by the concentration of the polyvinyl alcohol (PVA). The estimated PWV's were then compared to independent estimations from two pressure catheters. For 10% PVA, we obtain PWV measurements of $4.87 \pm 1.04, 4.67 \pm 0.43\ m/s$ from the US and catheters, respectively. For 15% PVA, we measure $8.94 \pm 1.43, 9.32 \pm 0.44\ m/s$ from the US and catheters, respectively. For 20% PVA, we measure $12.40 \pm 3.65, 16.73 \pm 1.43\ m/s$ from the US and catheters, respectively. Our measurements suggest that we can accurately measure a large range of PWV's, but that high PWV's can lead to increased error and underestimation of the true value. In addition to the phantom study, we will be presenting preliminary clinical results of AAA patients.

22. **Towards Automated Clinical Evaluation of Tendon through Shear Wave Elastography**
    Rifat Ahmed[1], Keshia Mora[2], Marvin Doyley[1], Mark Buckley[2], Stephen McAleavey[2]
    [1] Department of Electrical and Computer Engineering, University of Rochester
    [2] Department of Biomedical Engineering, University of Rochester

Musculoskeletal (MSK) conditions are the leading cause of disability and the leading cause of physician office visits in the United States. Diseases associated with the musculoskeletal system affect 50% of individuals over age 18 and 75% of individuals over age 65, with an

increased incidence expected due to both an aging population and increasing involvement in physical activities. Though MRI can provide accurate diagnosis of MSK conditions, it is expensive and not widely available. Ultrasound shear wave elastography (USWE) is a promising technology with high potential to address this need. Existing implementations of USWE are not well suited to characterization of MSK tissues, particularly tendon. We report results in using USWE for the characterization of tendon both *in vivo* and *ex vivo*. This platform has been characterized to allow USWE imaging in humans while remaining within FDA guidelines for acoustic output intensity. We demonstrate transverse wave excitation and tracking in tendon using a conventional linear array ultrasound transducer. Angular dependence of ultrasound backscatter coefficient in tendon is demonstrated.

23. High-Frequency Quantitative Ultrasound Systems for Tissue Engineering

Sarah Wayson[1, 3], Denise C. Hocking[2, 3], Diane Dalecki[1, 3]
[1]Department of Biomedical Engineering, University of Rochester
[2]Department of Pharmacology and Physiology, University of Rochester
[3]Rochester Center for Biomedical Ultrasound

The goal of the field of tissue engineering is to fabricate living tissues using cells and extracellular matrix components in order to restore function to damaged organ systems. Developing technologies to quantitatively monitor the spatiotemporal distribution of cells and extracellular matrix microstructure in engineered tissue constructs is essential for new advances in tissue engineering. The overall goal of this project is to develop high-frequency quantitative ultrasound imaging techniques to non-destructively characterize collagen microstructure and organization in engineered tissues. This project combines expertise in biomedical ultrasound and tissue engineering with the development of high-frequency, non-destructive ultrasound imaging systems and quantitative imaging techniques.

Electrical Engineering, Computer Engineering

24. Audio-Visual Event Localization in Unconstrained Videos

Yapeng Tian, Jing Shi, Bochen Li, Zhiyao Duan, and Chenliang Xu
University of Rochester

In this work, we explore a novel problem of audio-visual event localization in unconstrained videos. We define an audio-visual event as an event that is both visible and audible in a video segment. We collect an Audio-Visual Event(AVE) dataset to systemically investigate three temporal localization tasks: supervised and weakly-supervised audio-visual event localization, and cross-modality localization. We develop an audio-guided visual attention mechanism to explore audio-visual correlations, propose a dual multimodal residual network (DMRN) to fuse information over the two modalities, and introduce an audio-visual distance learning network to handle the cross-modality localization. Our experiments support the following findings: joint modeling of auditory and visual modalities outperforms independent modeling, the learned attention can capture semantics of sounding objects, temporal alignment is important for audio-visual

fusion, the proposed DMRN is effective in fusing audio-visual features, and strong correlations between the two modalities enable cross-modality localization.

25. **A 10X10 Pixel Array Camera in 350 nm CMOS Technology for room-temperature THz Imaging**
Moeen Hassanalieragh, Zeljko Ignjatovic
University of Rochester

In this paper, 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 initial tests show 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

26. **Ad Hoc Network Connectivity Maintenance and Data Continuity though WiFi Direct Emulation Using Mininet-Wifi**
Utku Demir, Aaron Faulkenberry, Cristiano Tapparello, Wendi Heinzelman
University of Rochester

Potential of Mobile Ad Hoc Networks (MANETs) has led to development of many protocols in order to control and optimize of such networks. However, automatic creation and evolution of ad hoc networks has yet to be exploited. Recently, a novel ad hoc protocol named WiFi Direct has been proposed and standardized by the WiFi Alliance with the objective of facilitating the interconnection of nearby devices. WiFi Direct provides high performance direct communication among devices, includes different energy management mechanisms. However, the current WiFi Direct implementations require user interaction for setting up and maintaining the connection. Moreover, despite the potential, no work has been conducted involving large scale networks. In this work, we explore the potential of 26.WiFi Direct in an emulator environment, called mininet-wifi. We analyze the performance of three automatic group owner selection schemes and compare them with the case in which devices form a WiFi Direct network with redundant group owners through second interfaces in nodes. Experimental results show that emulator data matches with real life device data and networks with redundant group owner exhibit superior performance in terms of network data continuity. This is the first work examining auspicious potential of WiFi Direct in detail in an emulation environment.

Poster Presentations

27. A Directed Graph Fourier Transform
Rasoul Shafipour and Gonzalo Mateos (University of Rochester, NY)
joint work with Ali Khodabakhsh and Evdokia Nikolova (The University of Texas at Austin)

We study the problem of constructing a graph Fourier transform (GFT) for directed graphs (digraphs), which decomposes graph signals into different modes of variation with respect to the underlying network. Accordingly, to capture low, medium and high frequencies we seek a digraph (D)GFT such that the orthonormal frequency components are as spread as possible in the graph spectral domain. To that end, we advocate a two-step design whereby we: i) find the maximum directed variation (i.e., a novel notion of frequency on a digraph) a candidate basis vector can attain; and ii) minimize a smooth spectral dispersion function over the achievable frequency range to obtain the desired spread DGFT basis. Both steps involve non-convex, orthonormality-constrained optimization problems, which are efficiently tackled via a provably convergent, feasible optimization method on the Stiefel manifold. We also propose a heuristic to construct the DGFT basis from Laplacian eigenvectors of an undirected version of the digraph. We show that the spectral-dispersion minimization problem can be cast as a supermodular optimization over the set of candidate frequency components, whose orthonormality can be enforced via a matroid basis constraint. This motivates adopting a scalable greedy algorithm to obtain an approximate solution with quantifiable worst-case spectral dispersion. We illustrate the effectiveness of our DGFT algorithms through numerical tests on real-world graphs. Moreover, we showcase a successful denoising application on graphs, whereby we adopt the proposed basis to decompose and then low-pass filter average temperatures recorded across the United States.

28. Automatic Lyrics Display System for Live Music Performances
Karan Vombatkere, Bochen Li, Yiming Zhao, Junyi Fan, Prof. Zhiyao Duan
University of Rochester

Live musical performances (e.g., choruses, concerts, and operas) often require the display of lyrics for the convenience of the audience. This requires following the performance and controlling the lyrics display in real time. In practice, this is usually controlled by a staff member of the concert who has been very familiar with the performance. In this paper, we present our effort in implementing a computational system to automate this real- time lyric display process using music following techniques. The idea is to use a real-time Dynamic Time Warping (DTW) algorithm to align the musical performance with a reference recording (e.g., a rehearsal recording or a cover song for the same piece) in real time, and display the lyrics that have been pre-aligned with the reference recording. In this paper, we present a Java implementation of this system on a PC using a multithread audio recording and processing framework and a graphical user interface. Preliminary results show that the system can successfully deal with different performance speed and display lyrics appropriately.

Poster Presentations

29. Skeleton Plays Piano: End-to-end Online Generation of Pianist Body Movements from MIDI Performances

Bochen Li
University of Rochester

Generating expressive body movements of a pianist for a given symbolic sequence of key depressions is important for music interaction, but most existing methods cannot incorporate musical context information and generate movements of body joints that are further away from the fingers such as head and shoulders. This work addresses such limitations by directly training an online end-to-end deep neural network to map a MIDI note stream and additional metric structures to a skeleton sequence of a pianist playing a keyboard instrument. Experiments show that (a) the model is capable of learning the motion behavior of a specific player, (b) incorporation of metric information yields in 4% smaller error; and (c) no significant difference between the generated and real human motions is observed by human subjects in 75% of the pieces.

30. Bridging the gap between nano and macro scales

Dilnoza Amirkulova , Maghesree Chakraborty
University of Rochester

All atom (AA) molecular dynamics (MD) simulations use laws of classical Physics to help us understand how atoms in molecules interact. AA-MD simulations has been used to study microscopic phenomena that are challenging to investigate directly with experiments. Generally, simulations are validated by calculating macroscopic or bulk behaviours like the diffusion coefficient or NMR spectra from MD data and comparing those to experimentally derived data. In many cases the experimental data do not match simulation results. This disagreement between experiments and simulation is usually addressed by iteratively reparameterizing the simulation to reflect the real system more closely. Experiment directed metadynamics and experiment directed simulation are two new ways of incorporating experimental results to bias the simulation so that the MD results mirror experimentally results closely. The difference between these methods and the usual approach of using experimental data is that the data is used more as an input to the MD simulations instead of being used as a feedback strategy to guide reparameterization of the simulation setup. Another challenge for AA-MD is to simulate very large systems over long period of time to understand meso-scale phenomena like peptide or protein self assembly which require immense computational resources. A way of circumventing this issue is to use low-resolution representations of molecules by joining atoms into bigger particles that still reflect the general behaviour of the AA system well. This technique is called coarse-graining (CG). There is no unique way of mapping AA to CG representation. Although CG-MD has been used for various systems like folding proteins, lipid bilayer, etc. there is no systematic protocol which one can follow to single out a CG mapping that best mimics the AA model. We have developed a graph based approach where multiple CG mapping operators can be encoded in a graph. This technique can potentially serve as the basis to automate the selection of CG mapping operators.

Poster Presentations

31. Quantifying Listener Preference of Flat-Panel Loudspeakers with Objective Measures

Michael Heilemann David Anderson, Stephen Roessner, and Mark Bocko
University of Rochester

We present a perceptual evaluation of flat-panel loudspeakers derived from objective data. The data consists of seventy amplitude response measurements taken around the orbit of the loudspeaker. These measurements were used to derive frequency response curves representing the direct sound, the "listening window" in front of the speaker, the early reflections off of the surrounding walls, the total sound power, and the predicted in room response. A set of statistical measures such as narrow band deviation, smoothness, and low-frequency extension were applied to specific curves according to a formula developed by researchers at Harman International to predict listener preference ratings for loudspeakers. A commercial flat-panel speaker, and a flat-panel speaker with a modal crossover network enabled/disabled were measured in this study along with a conventional bookshelf speaker as a control. The modal crossover speaker scored at least ten points higher than the other flat-panel speakers, and displayed a flat low-frequency response. However, for flat-panel speakers to produce the same preference ratings as traditional speakers, structural improvements must be made to reduce the narrow band deviation at high-frequencies.

32. Superconducting single-photon detectors as smart sensors

Mihiraan Singh, Jordan Cady, Yunus Akbas, Genyu Chen and Roman Sobolewski (PI)
University of Rochester, HYPRES Inc.

Superconducting single-photon detectors (SSPDs) are nanostructured devices made from ultrathin superconducting (typically, NbN, NbTiN or WSi) nanostripes and operated at liquid helium temperature. They exhibit almost 100% detection efficiency, what in combination with ultralow dark counts, high (MHz) counting rates, and extremely low timing jitter makes them the best-performance simple-photon counters currently available. Besides being very efficient photon counters at the telecommunication wavelengths (1310 and 1550 nm), SSPDs can, in general, operate in a broad wavelength range from ultraviolet to mid-infrared. The main thrust of the "Smart Sensor for Classical and Quantum Data Links" project sponsored by HYPRES Inc. is development of a smart version of the SSPD device that could be implemented in various single-photon sensing applications. We demonstrate that SSPDs can be successfully used in photon-number and photon-energy resolving experiments. We present a new operation regime of SSPDs by integrating them with a read-out consisting of a low-noise cryogenic high-electron-mobility transistor and a high-load resistor. Our scheme enables to obtain information on energy of the incident photons, as well as demonstrates the photon-number-resolving capability of meander-type SSPDs. It also allows us to distinguish the origin of dark counts from the actual photon response in SSPDs. We also explore SSPDs integrated with Josephson-junction–based mixed-signal circuits to provide readout, tuning, and control of the detector. These digitally assisted will have performance characteristics far surpassing those of the traditional,

analog SNSPDs. We will target high-value applications in quantum networks for quantum information applications including high data rate quantum key distribution. Our smart sensor should also find many applications in classical data channels for energy-efficient computing, LIDAR, and laser communications.

33. Network Availability Profiling and Analysis
Nadir Adam, Cristiano Tapparello, Wendi Heinzelman
Department of Electrical and Computer Engineering, University of Rochester

With the increasing number of wireless networks available, and mobile devices with access to the Internet, it is essential to obtain the best connection, whether this is a direct path through Wi-Fi or cellular networks, or an indirect path via one or multiple devices using peer to peer standards such as Wi-Fi Direct. In this work, we develop an Android application that utilizes the Wi-Fi and data scanning functions to periodically obtain all the available Wi-Fi networks in the area and their attributes, such as their signal level, in addition to obtaining the upload/download speeds of the network. Furthermore, we provide analysis of the collected data, such as the network availability percentage and available number of APs as a function of location. Finally, we draw conclusions and propose realistic relay selection methods based on the experimental data.

34. Overview of Research at the Signal, Data, and Imaging Sciences Laboratory
Mujdat Cetin
Department of Electrical and Computer Engineering,
University of Rochester

We provide an overview of current research at the Signal, Data, and Imaging Sciences Laboratory at the University of Rochester. Our work focuses on the development of principled, automated, and efficient algorithms for information extraction from sensor data. We present samples of our work in several areas including computational radar imaging, (bio)image analysis, and brain-computer/machine interfaces.

Chemical Engineering, Mechanical Engineering, and Materials Science

35. Assessing the link between refractive change and mechanical properties in IRIS contact lenses
Paul D. Funkenbusch[A,] Kaitlin Wozniak[B] , Daniel R. Brooks[B] , Len A. Zheleznyak[B,C] , Sam C. Butler[A,C] , Jonathan D. Ellis[A,B, D] , Wayne H. Knox[B]
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[D] College of Optical Sciences, University of Arizona

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IRIS is a multi-photon absorption process that can be used to locally modify hydrogel materials (as well as corneal tissue) to produce optical corrections. In IRIS a beam with a known optical quality is scanned rapidly through the material. During previous work on IRIS writing in contact lenses, it was observed that the lenses sometimes had slight ripples on the surface, which could influence optical quality, even though the IRIS-treated section was not on the surface. It was hypothesized that these could be the result of mechanical changes in the contact lens material. In this project, we are investigating the potential link between the IRIS writing process and property changes in the written material.

36. Social and Tactile Augmented Reality in an Undergraduate Chemical Engineering Laboratory

Rainier Barrett, Heta Gandhi, Anusha Naganathan, Danielle Daniels, Yang Zhang, Chibueze Onwunaka, April Luehmann, and Andrew D. White
University of Rochester

Augmented reality (AR) has the potential to be a versatile tool for education enrichment. We have constructed an AR table to supplement traditional chemical engineering laboratory education. This AR table uses computer vision software to simulate a chemical reactor plant, building student intuition in a hands-on way that cannot be replicated with a real-life lab experience.

37. Photophysics of OLED emitters in non-crystallizing hosts

M. Molaire, R. Chakraborty and D. Weiss, Molecular Glasses
T. Yu, H. Liu and L. Rothberg, University of Rochester Department of Chemistry

New, non-crystallizable host materials developed by Molecular Glasses demonstrate superior stability and efficiency in organic light-emitting diodes (OLED). We characterize the photophysics of standard phosphors and TADF materials in these hosts and compare them to standard hosts to try to understand the differences. We study the dye loading and excitation energy dependence of the photoluminescence and photoluminescence decay dynamics to ascertain the role, if any, of triplet-triplet annihilation in the decay of the excited state. We also report on differential scanning calorimetry experiments to ascertain whether the non-crystalline nature of the new hosts leads to improved dispersion of the emissive dopant.

38. Fiber to Chip Fusion Splicing for Robust, Low Loss Optical Coupling

Juniyali Nauriyal[1], Raymond Yu[1], Meiting Song[1], and Jaime Cardenas[1]
[1]Institute of Optics, University of Rochester

Silicon photonic devices are poised to enter high volume markets such as data communications, optical phased arrays, and telecommunications; however, permanently attaching a fiber to the photonic chip with high optical efficiency remains a challenge . Multiple methods have been demonstrated to increase the coupling efficiency between an optical fiber and a chip while simultaneously decreasing packaging cost and increasing

throughput for high volume manufacturing. However, current coupling methods are lousy, bandwidth limited or involve complex fabrication steps.

We present a novel method of permanent optical coupling between a fiber and a chip using fusion splicing which is robust, low loss, and scalable to high volume manufacturing. We fusion splice a cleaved optical fiber to an oxide taper at the edge of the chip, which is optimized to minimize the loss and is reinforced using a UV curable optical adhesive. The oxide tapers are fabricated using photo-lithography and isolated from the silicon substrate to prevent loss to the substrate. We characterize the losses along the chip and the fiber for a c-band and measure a loss of 3dB per facet. We also demonstrate that no loss was added by the oxide tapers.

We envision that this method can be fully automated to enable highly efficient fiber to chip coupling in high volume applications. The method is compatible with active and passive (using fiducial on the chip) alignment. Our calculations show that we can improve the coupling loss to 0.2dB per facet using tapered or narrow core fibers. Our results also show that the coupling loss associated with the cleaved fiber depends on the type of nitride tapers used and can be decreased nearly 1dB.

Data Science

39. Change Detection in Satellite Images Using Siamese Networks
Faiz Rahman, Bhavan Kumar Vasu, Prof. Andreas Savakis
Rochester Institute of Technology Computer Engineering

We present a patch-based algorithm for detecting structural changes in satellite imagery using a Siamese neural network. The two channels of our Siamese network are based on the VGG16 architecture with shared weights. Changes between the target and reference images are detected with a fully connected decision network that was trained on DIRSIG simulated samples and achieved a high detection rate (95.9% accuracy). Alternatively, a change detection approach based on Euclidean distance between deep convolutional features achieved very good results (93.4% accuracy) with minimal supervision.

40. Digital Game Based Learning Tool for Deaf Learners: A Pilot Study
Noella Kolash
Rochester Institute of Technology

Deaf American Sign Language (ASL) users often learn English as a second language (L2). L2 learners often experience difficulties learning statistics. A Digital Game-Based Learning tool was developed—viz. MarsU—to aid the learning of statistics. MarsU was administered to 6 deaf students for a usability study. A pre- and post-test was administered to measure learning along with the Test of Silent Contextual Reading Fluency, Motivated Strategies for Learning Questionnaire, System Usability Scale, and Net Promoter. The entire session was

recorded using two screen recorders and two web cameras to capture interaction with the game and task of instructions. Preliminary results show most participants did not understand the purpose of the game. The lengthy text-based tutorial was not helpful and participants could not recall the information in the tutorial. Several participants did not collect samples, which would inform their decisions toward winning the game. Preliminary results suggest the development of tutorials specifically designed for deaf learners is needed.

41. Generating Talking Face Landmarks from Speech
S. Emre Eskimez
University of Rochester

The presence of a corresponding talking face has been shown to significantly improve speech intelligibility in noisy conditions and for hearing impaired population. In this paper, we present a system that can generate landmark points of a talking face from an acoustic speech in real time. The system uses a long short-term memory (LSTM) network and is trained on frontal videos of 27 different speakers with automatically extracted face landmarks. After training, it can produce talking face landmarks from the acoustic speech of unseen speakers and utterances. The training phase contains three key steps. We first transform landmarks of the first video frame to pin the two eye points into two predefined locations and apply the same transformation on all of the following video frames. We then remove the identity information by transforming the landmarks into a mean face shape across the entire training dataset. Finally, we train an LSTM network that takes the first- and second-order temporal differences of the log-mel spectrogram as input to predict face landmarks in each frame. We evaluate our system using the mean-squared error (MSE) loss of landmarks of lips between predicted and ground-truth landmarks as well as their first- and second-order temporal differences. We further evaluate our system by conducting subjective tests, where the subjects try to distinguish the real and fake videos of talking face landmarks. Both tests show promising results.

42. Blindfolded Multi-Random-Forests Evaluation
Asma Aloufi, Dr. Peizhao Hu
Golisano College of Computing and Information Sciences
Rochester Institute of Technology

Machine learning techniques are commonly used in many applications to extract information from datasets and predict possible future outcomes and behaviors. User data used in machine learning model training and prediction often include highly sensitive data such as age, race, income, or address. Therefore, the data need to be protected using strong cryptographic methods. One of the recent cryptographic methods, which shows promising results, is an encryption technique called homomorphic encryption. This type of encryption supports computations on encrypted data without decryption. In order to support machine learning in our work, we construct cryptographic algorithms for common functions that serve as building blocks of various machine learning techniques. Comparing between two

values is one example of a common function used in machine learning techniques. We leverage a non-interactive comparison circuit and design an algorithm to compare between two encrypted values using homomorphic encryption. We will demonstrate the use of this algorithm in a secure evaluation of a random forests in the outsourced and multi-party setting, where a cloud server can evaluate obliviously on individually encrypted random forest models delegated by multiple model owners. We will discuss the efficiency and application of this protocol.

43. Lip Movements Generation at a Glance
Yapeng Tian, Lele Chen, Chenliang Xu
University of Rochester

Cross-modality generation is an emerging topic that aims to synthesize data in one modality based on information in a different modality. In this paper, we consider a task of such: given an arbitrary audio speech and one lip image of arbitrary target identity, generate synthesized lip movements of the target identity saying the speech. To perform well in this task, it inevitably requires a model to not only consider the retention of target identity, photo-realistic of synthesized images, consistency and smoothness of lip images in a sequence, but more importantly, learn the correlations between audio speech and lip movements. To solve the collective problems, we explore the best modeling of the audio-visual correlations in building and training a lip-movement generator network. Specifically, we devise a method to fuse audio and image embeddings to generate multiple lip images at once and propose a novel correlation loss to synchronize lip changes and speech changes. Our final model utilizes a combination of four losses for a comprehensive consideration in generating lip movements; it is trained in an end-to-end fashion and is robust to lip shapes, view angles and different facial characteristics. Thoughtful experiments on three datasets ranging from lab-recorded to lips in-the-wild show that our model significantly outperforms other state-of-the-art methods extended to this task.

44. Vision-based Position and Attitude Estimation for Autonomous Vehicles
Guoyu Lu
Rochester Institute of Technology

Autonomous vehicle framework relies on localization algorithms to position itself and navigate to the destination. In this paper, we explore a light-weight visual localization method to realize the vehicle position and attitude estimation based on images. We apply SLAM and an offline map correction method to generate a high precision map, which composes 3D points and feature descriptors. For each image, we extract the features and match against the map to explore correspondences. In the correspondences search process, we rely on the previous position estimation result and the feature matching performance to dynamically determine the search scope, which significantly improves both the localization accuracy and speed. We also provides an interface to substitute with different features, including our deep feature. Simply based on a single CPU thread support, experiments on the benchmark KITTI dataset demonstrate the superior results of our method.

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45. Effects of Format Entry on Consumer Grocery Shopping Habits
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In the last two decades, industry experts have described U.S. grocery retailing as mature, saturated, and extremely competitive. A key component of recent industry developments is the appearance of multiple retailers with very clear and differentiated positions. Practitioners regard these new competitors as retailer types or formats, and leading examples include (i) limited assortment retailers such as Aldi, Lidl, Trader Joes, Grocery Outlet and Save-a-lot, which emphasize a limited number of varieties (esp. brands) of frequently purchased goods, (ii) organic or natural foods retailers such as Whole Foods, Fresh Market, and Earth Fare, which provide environmentally friendly and non-GMO products, and (iii) warehouse clubs such as Sam's Club, Costco, and BJs, which serve discounted, large, and bundled package sizes and charge membership fees.
Suppose a retailer of an alternative format opens a new store in a given local market. Do customers replace an existing store they previously shopped or do they add this new store, effectively increasing the number of stores in which they shop? Is the answer the same when the entrant is an organic retailer as when the entrant is a warehouse club? And what about expenditure patterns? Suppose a warehouse club opens a new store. Does it induce consumers to buy more or less, or to simply redistribute purchases among a larger set of outlets? Do consumers buy more private labels or substitute primarily with existing private label purchases elsewhere? Even more specifically, are there product categories that are threat categories, namely, more likely to have consumers switch from national brands in a traditional supermarket to private label brand in a new retailer type? If consumers increase their cross-shopping habits in response to new retail type entries, do they also change their response to price promotions? Each of these questions has limited or no causal evidence in the existing literature, which is indicative of how little attention the literature has given to the underlying consumer response to these important industry shifts. We document for the first time the causal effects of retailer-type entries on consumer shopping behaviors. We adapt the novel technique of synthetic controls developed in Abadie (2003) to the setting of ragged individual-level panel data common in marketing contexts.
Our results suggest that limited assortment is speeding up the adoption of private label across categories, while wholesale clubs induce a reduction of the number of shopping trips performed by the households. Organic specialists do not seem to substitutes for any other format and when consumers start shopping in a discounter they seem to become less responsive to the effect of price promotions.

46. Food Trend Detection on Social Media
Yang Gao
University of Rochester

Content posted on social media have been reporting everything from daily life stories to the latest local and global news and events. Monitoring and analyzing this rich and continuous

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user-generated content can yield unprecedentedly valuable information, enabling users and organizations to acquire actionable knowledge. This research project aims at detecting and predicting food trend based on an enormous amount of data from social media. First of all, we create a list of food ingredients, all of which are unigram. Then user-generated content that contains any of those ingredients is collected from social media sites including Facebook, Instagram and Twitter. Second, co-occurrence analysis is used to measure the association between two food ingredients. By analyzing the evolution of such association, we aim to detect the emergence of new food trend.

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