University Technology Showcase

Thursday April 7, 2016

Research Focus Areas

Optics, Photonics, and Imaging
Biomedical Technology
Microelectronics, Software and Communications
Energy and Materials

WELCOME

Dear Colleagues,

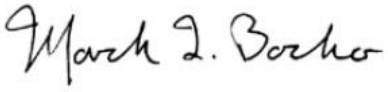
Welcome to the 16th annual University Technology Showcase sponsored by the Center for Emerging and Innovative Sciences at the University of Rochester, a New York State funded Center for Advanced Technology. This year's event features presentations representing a sampling of the high quality applied research 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 business community can learn about work taking place 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 these discussions will lead to continued interactions that will allow companies to tap into the wealth of technology and expertise available at these institutions. The ultimate goal of today's event is to help the region and the State to incubate, grow, and attract businesses, resulting in job growth and economic expansion.

To kick off the meeting this year we are pleased to welcome our two speakers, Dr. Walt Johnson from Xerox PARC East and Mr. Mikael Totterman from Clerio Vision. We're also very pleased to announce that due to the generosity of the Woods Oviatt Gilman Law Firm, we are able to make an award of $500 to the best poster, as judged by today's attendees.

The technology showcase is just one way that CEIS works to foster industry-university collaboration and technology transfer. Our primary role is to provide NYS matching funds for company-sponsored research on campus. Since our inception, CEIS has been very successful in supporting collaborations with nearly 100 university researchers and more than 70 company partners. We also sponsor workshops and seminars that bring people from industry and academia together to discuss opportunities for technology-driven economic development. Feel free to contact Paul or me to learn more about these efforts and discuss ways that CEIS can help you to achieve your objectives.

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/ and complete the survey.

Warm Regards,



Mark Bocko, PhD
Director, CEIS

Paul Ballentine, PhD
Executive Director, CEIS

FEATURED SPEAKERS

Walt Johnson, *Vice President, Director of XEROX PARC*

Dr. Walter Johnson is Vice President and Director of the New York site at PARC, a Xerox Company. He directs a wide range of research activities related to image and video analytics, computational analytics and business process automation and optimization.

A former scientist in PARC's groundbreaking Human-Computer Interaction group, Johnson specialized in intelligent interfaces for mobile and ubiquitous computing applications. His work on a paper user-interface for document processing systems led to a special enterprise-level division being created to capitalize on this competency. Johnson also worked on a tablet computer startup at Silicon Graphics, and on portable document readers at PARC spinout Uppercase, Inc., which was acquired by Microsoft in 2000. He served as VP of Strategic Operations at incubator company 12 Entrepreneuring and, most recently, as SVP of Operations at real-time web-based news platform Skygrid.

Johnson obtained his Ph.D. in Cognitive Psychology from the University of Pittsburgh, and bachelor's degree at the University of Arizona. Johnson has 14 patents.

Mikael Totterman, *CEO of Clerio Vision*

Mr. Totterman is a co-founder and CEO of Clerio Vision, Inc., a technology transfer start-up from the University of Rochester. Previously, he served as the Chairman and CEO of iCardiac Technologies, Inc. a leading provider of cardiac safety testing services to the global pharmaceutical industry. Mr. Totterman co-founded iCardiac in 2006. The company was backed by several venture and angel investors and was sold to Norwest Venture Partners, a leading private equity firm in 2014.

Prior to iCardiac Technologies Mr. Totterman was the Chief Operating Officer of VirtualScopics Inc., a leading developer of image-based biomarkers for improving pharmaceutical development, which went public on the NASDAQ in 2005. During his tenure at VirtualScopics, he raised several of rounds of venture capital funding as well as striking strategic investment relationships with Pfizer, Inc. and GE Healthcare. Earlier in his career, Mr. Totterman also served as a principal at 3Com Ventures, a $250 million technology venture capital fund based in Santa Clara, CA. He has also held positions at Boston Consulting Group as well as Gemini Consulting. Mr. Totterman received his Bachelor's Degree in Engineering from Stanford University where he was a David Starr Jordan Scholar and his Masters of Business Administration from the Amos Tuck School at Dartmouth College.

Rochester Regional Optics, Photonics and Imaging Accelerator (RRPA) Partner Appreciation Award

2016 Recipient

Mark Mayton, Flint Creek Resources

Mark is the founder, president, and technical director of Flint Creek Resources. Flint Creek recycles rare earth-based polishing compounds used in polishing optics, semiconductors, displays, and memory devices. Mark as been a key contributor to the success of the RRPA program. Working with Sydor Optics, Flint Creek was able to double the reclamation rate of cerium oxide. This reduces costs, reduces the need for cerium oxide, and reduces the amount of polishing compound that needs to be disposed into the environment. The company was also able to double it's workforce and quadruple it's customer base. Mark was also able to form strong relationships with other companies in the Rochester photonics cluster and expand the company's business. Prior to founding FCR, Mark was a business manager of Ferro Electronic Materials Systems in Penn Yan. Mark has a B.S. in Ceramic Engineering from Alfred University and an MBA from St. John Fisher College.

SUPPORTERS

NYSTAR
Empire State Development
Division of Science, Technology & Innovation

R·I·T

UNIVERSITY of ROCHESTER

WOODS OVIATT GILMAN LLP
The art of representing people®

MONROE COUNTY FINGER LAKES PTAC
Government Contract Counseling

GENESEE COUNTY GCEDC
Economic Development Center

R·I·T Intellectual Property Management Office

STC SMART SYSTEM TECHNOLOGY AND COMMERCIALIZATION CENTER
SUNY COLLEGES OF NANOSCALE SCIENCE AND ENGINEERING

NYS SCIENCE+TECH LAW CENTER
AT SYRACUSE UNIVERSITY COLLE

UNIVERSITY of ROCHESTER

Promoting Innovation Through
CIRC

URVentures

CENTER FOR ENTREPRENEURSHIP
MASTER OF SCIENCE
TECHNICAL ENTREPRENEURSHIP AND MANAGEMENT

SPELL STUDIOS

FINGER LAKES COMMUNITY COLLEGE
INSTRUMENTATION & CONTROL TECHNOLOGIES
VICTOR CAMPUS CENTER

investing in you
Canandaigua National Bank & Trust

COUNTY OF MONROE STATE OF NEW YORK
Maggie Brooks
County Executive

HIGH TECH ROCHESTER
innovate. incubate. grow.

FAME
Finger Lakes Advanced Manufacturers' Enterprise
Building Minds that Make It

Excell PARTNERS

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

R·I·T | VENTURE CREATIONS

TECHNOLOGY SUPPORTERS

T1	**Woods Oviatt Gilman, LLP**
T2	**Excell Partners**
T3	**SUNY Polytechnic Institute- College of Nanoscale Science & Engineering's (CNSE) Smart System Technology & Commercialization Center (STC)**
T4	**Monroe County Economic Development/Monroe County Finger Lakes Procurement Technical Assistance Center (MCFL/PTAC)**
T5	**Rochester Institute of Technology – MAGIC SPELL STUDIOS**
T6	**High Tech Rochester**
T7	**UR Ventures**
T8	**AIM Photonics**
T9	**Center for Integrated Research Computing (CIRC)**
T10	**RIT Offices of Research Relations, Technology Transfer**
T11	**RIT Venture Creations**
T12	**New York State Science & Technology Law Center (NYS STLC) at Syracuse University College of Law**
T13	**Genesee County Economic Development Center (GCEDC)**
T14	**FLCC's Victor Campus Instrumentation and Control Technologies Program**
T15	**Rochester Institute of Technology AMPrint Center for Advanced Technology**
T16	**University of Rochester Center for Entrepreneurship/Technical Entrepreneurship and Management (TEAM) M.S. Program at the University of Rochester**
T17	**Finger Lakes Advanced Manufacturers' Enterprise (FAME)**
T18	**Rochester Institute of Technology – Drones**
19	**Canandaigua National Bank**

TECHNOLOGY SUPPORTERS

T1 **Woods Oviatt Gilman, LLP**

Woods, Oviatt, Gilman LLP is a full-service law firm and has been serving Western New York since 1852. Our Patent Attorneys represent companies in a variety of intellectual property matters. We have worked with companies in industrial, retail, and medical industries to obtain and protect intellectual property including trade secrets. Additionally, we assist companies in protecting their intellectual property from undesired exploitation by employees, independent contractors and third-parties.

T2 **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 NY, 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 identify 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. [www.excellny.com]

T3 **SUNY Polytechnic Institute - College of Nanoscale Science & Engineering's (CNSE) Smart System Technology & Commercialization Center (STC)**

In 2010, the Smart System Technology & Commercialization Center (STC) was created through a merger of New York State's Center of Excellence, the Infotonics Technology Center (ITC) in Canandaigua, with the SUNY College of Nanoscale Science and Engineering (CNSE). This aligned STC with CNSE's NYS Center of Excellence in Nanoelectronics and Nanotechnology. The merger has created a vertically integrated "one-stop-shop" positioning New York State as the global leader in smart system and smart device innovation and manufacturing. These capabilities are unmatched the world over, providing the capacity, infrastructure and operational capabilities to create immediate job and investment opportunities in all areas of semiconductor and advanced manufacturing, covering a diverse number of markets including aerospace, biomed, display, communications, defense, and energy.

Located just outside of Rochester, NY, STC's $50 million, 120,000-square-foot, state-of-the-art facility includes over 30,000 square feet of certified cleanroom space with 150mm and 200mm MEMS foundry services, complemented by a dedicated 8,000-square-foot MEMS and optoelectronic packaging facility. STC maintains a facility-wide security clearance and is a Defense Department accredited "Trusted" supplier for post-CMOS processing/MEMS integration, microelectronics packaging and assembly, and aggregation services. The Center is also a multi-tenant facility, housing high-tech companies that are commercializing the next generation of biomedical, imaging, and microelectronics device technologies. STC is also a designated Start Up New York site, providing firms that partner and locate at the facility tax-free status for up to 10 years.

T4 Monroe County Economic Development/Monroe County Finger Lakes Procurement Technical Assistance Center (MCFL/PTAC)

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

Monroe County Finger Lakes Procurement Technical Assistance Center (PTAC) serves as the official procurement technical assistance center for the Finger Lakes Region. PTAC helps businesses sell their products and services to federal, state and local governments, and the military marketplace.

There is no fee for MCFL PTAC services:

- Assess Readiness
- Analyze Market Opportunities
- Assist with Registrations and Proposal Development
- Identify Bid Leads
- Connect with Government Buyers and Prime Contractors

www.monroecountyfingerlakesptac.org

T5 Rochester Institute of Technology – MAGIC SPELL STUDIOS

Established in 2013, MAGIC Spell Studios LLC is the commercial, for-profit game studio that is part of Rochester Institute of Technology's Center for Media, Arts, Games, Interaction and Creativity (MAGIC). The studio serves as the publisher for student's and faculty's creative work in the realm of digital media.

Hack, Slash & Backstab: where the dungeon is dark, and your friends aren't friendly…

We've all been there: stack ranking, team projects, student or employee evaluations on a curve – groups of people that need each other, but that are evaluated individually to the detriment of true teamwork. In Hack, Slash & Backstab, we adapt these broken models to a 2-4 player couch co-op dungeon crawler, and use a game setting to seemingly reduce the stakes. Work together as warrior, rogue, wizard and archer to survive a dangerous world. But only one player will be crowned the winner: it becomes a fight to the death, as betrayal and backstab become the tools of choice.

#bewaretheknife Coming in June to Xbox One and Steam.

T6 **High Tech Rochester**

High Tech Rochester (HTR) 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. HTR 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. HTR also runs the Lennox Tech Enterprise Center and the Rochester Bioventure Center in Henrietta, business incubators for high tech start-ups.

T7 **UR Ventures**

At UR Ventures, our mission is to develop UR innovations into valuable products and services to make the world ever better. Unlike a 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.

T8 **AIM Photonics**

The **A**merican **I**nstitute for **M**anufacturing Integrated **Photonics** (AIM Photonics), is an industry driven public-private partnership that focuses the nation's premiere capabilities and expertise to capture critical global manufacturing leadership in a technology that is both essential to National security and positioned to provide a compelling return-on-investment to the U.S. economy. The Institute's goal is to emulate the dramatic successes experienced by the electronics industry over the

past 40 years and transition key lessons, processes, and approaches to the photonic integrated circuit (PIC) industry. AIM Photonics supports Small and Medium Enterprises, providing practical access and technology on-ramps for U.S. industry, government, and academic communities. We are creating a National PIC manufacturing infrastructure, widely accessible and inherently flexible to meet the challenges of the marketplace with practical, innovative solutions.

T9 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 an 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.

T10 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 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/research

T11 RIT Venture Creations

RIT’s Venture Creations Incubator is a place where start-up businesses can advance their concepts on their way to joining the ranks of profitable, viable businesses in New York state.

T12 **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.

T13 **Genesee County Economic Development Center (GCEDC)**

The Genesee County Economic Development Center (GCEDC), formerly known as the Genesee County Industrial Development Agency, was formed in 1970 under Section 18-A of New York State's General Municipal Law and is the County's primary designated agency for the promotion of economic development and economic growth. The agency was reorganized to its current form in 1979. The GCEDC is governed by a seven member, non-compensated, Board of Directors that is made up of business and community leaders that are appointed by the Genesee County Legislature. GCEDC has shovel ready industrial sites:
Industry Focused Shovel-Ready Parks in Genesee County, NY
Agri-Business & Food Processing: The Genesee Valley Agri-Business Park Business Facilities: Industry Focus: The Process of Food touts Genesee County as the place to be for food processors
Life Sciences & Medical Device: The 32 acres Upstate MedTech Park and Dr. Bruce A. Holm Upstate Med & Tech Commercialization Centre
Advanced Manufacturing & Nano-Technology: The Buffalo East Tech Park and Western New York Science Technology and Advanced Manufacturing Park
Warehouse & Distribution: Apple Tree Acres, Gateway II, and O-AT-KA Hills

T14 **FLCC's Victor Campus Instrumentation and Control Technologies Program**

In concert with businesses, the Instrumentation and Control Technologies program at FLCC Victor Campus Center is training adaptable technologists to help accelerate innovations critical for building a robust high-tech ecosystem.

T15 **Rochester Institute of Technology AMPrint Center for Advanced Technology**

A consortium of universities and corporations led by Rochester Institute of Technology has been chosen to receive a state grant to establish a New York State Center for Advanced Technology in Additive Manufacturing and Functional Printing. The center, to be called the AMPrint Center for Advanced Technology,

will be based at RIT. Its focus will be to conduct research and development in 3D printing and additive manufacturing, an industry seen as a key economic driver for the Finger Lakes region and New York state because of its application to a wide range of companies and products.

T16 University of Rochester Center for Entrepreneurship/Technical Entrepreneurship and Management (TEAM) M.S. Program at the University of Rochester

The University of Rochester Center for Entrepreneurship, launched by a grant from the Ewing Marion Kauffman Foundation awarded to the University 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 University of Rochester Center for Entrepreneurship 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.

T17 Finger Lakes Advanced Manufacturers' Enterprise (FAME)

FAME is an initiative of the Finger Lakes Workforce Investment Board and a collaborative public/private partnership of regional stakeholders that are dedicated to investments in human capital. FAME works with dedicated professionals who specialize in workforce development, and understand what it takes to attract and grow the workforce talent in advanced manufacturing. The end result in this investment is a bright, motivated, informed, skilled mind that contributes to the advancement of the sector.

FAME builds minds that make it.

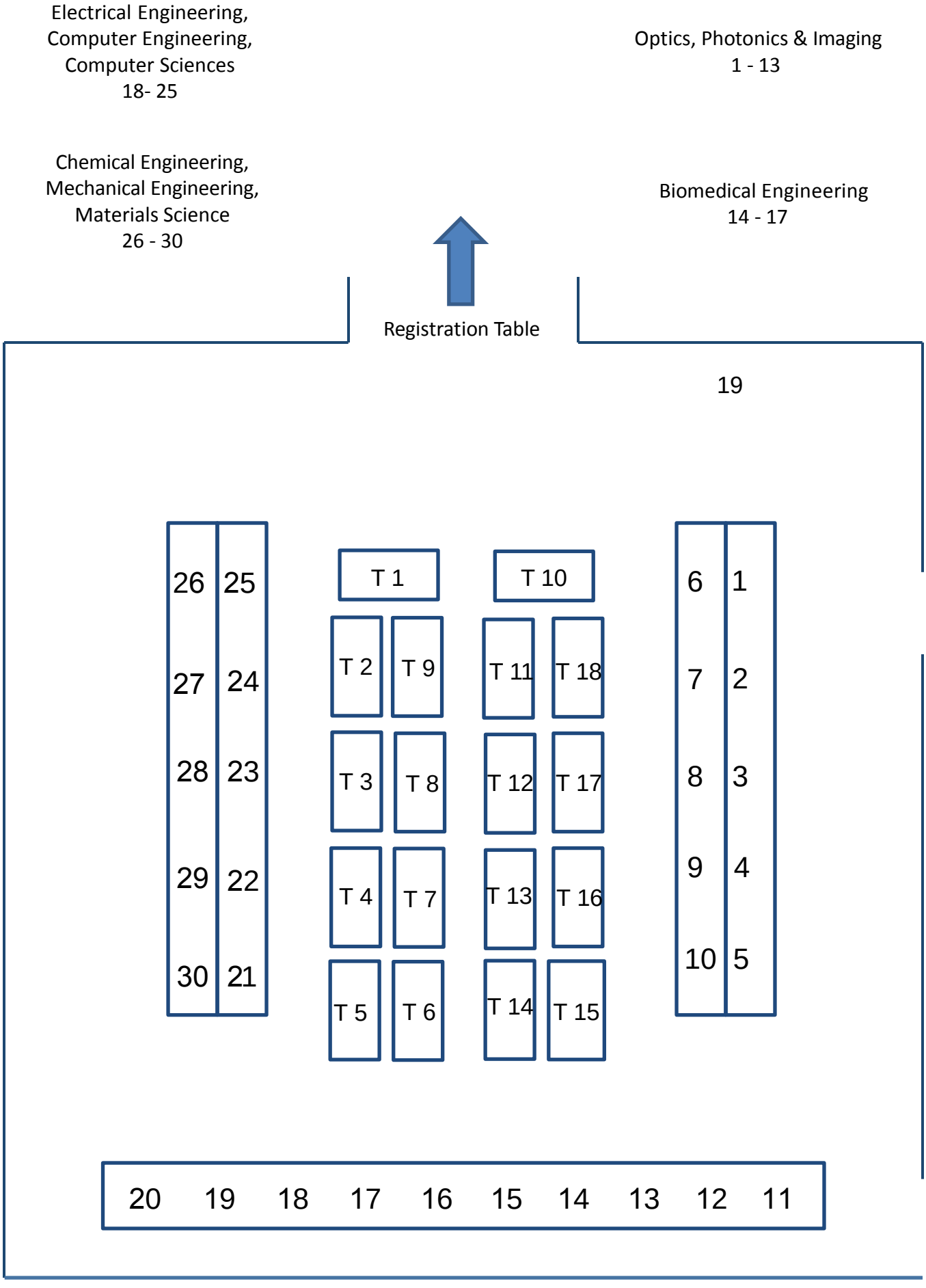
TECHNOLOGY SUPPORTERS

T18 **Rochester Institute of Technology – Drones**

RIT has long been known for its expertise in aerial and satellite photography — a science known as remote sensing. So it's no surprise that RIT has now emerged as one of the world's leading centers for research on drones, small unmanned aircraft. The Digital Imaging and Remote Sensing Lab is the biggest group within the Center for Imaging Science, and about three-quarters of the DIRS students are working on masters and doctorate programs. They're highly sought after by government and industry alike. The Federal Aviation Administration has also turned to RIT. With drone technology advancing faster than regulators can keep up, the FAA has designated six organizations across the country to conduct research to help devise rules for the operation of unmanned aircraft systems (UAS) in the United States. RIT and the Massachusetts Institute of Technology are the lead institutions for one of those six, a coalition of universities and industry called the Northeast UAS Airspace Integration Research Alliance, or NUAIR.

19 **Canandaigua National Bank**

As the only local, full-service, community-owned financial institution in the Rochester area, Canandaigua National Bank & Trust is investing in you, your business, and your community through our products, personal service, technology, and community support. Our Core Values represent who we are and what we do, each and every day. That's what makes us different from our competitors. Before making any business decision, we carefully consider how it will affect the people who rely on us the most: our valued customers, the communities we serve, our employees, and shareholders. Visit CNBank.com for more information.


Electrical Engineering,
Computer Engineering,
Computer Sciences
18- 25
Optics, Photonics & Imaging
1 - 13
Chemical Engineering,
Mechanical Engineering,
Materials Science
26 - 30
Biomedical Engineering
14 - 17
Registration Table
19
26 25
27 24
28 23
29 22
30 21
T 1
T 10
T 2
T 9
T 11
T 18
T 3
T 8
T 12
T 17
T 4
T 7
T 13
T 16
T 5
T 6
T 14
T 15
6 1
7 2
8 3
9 4
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20 19 18 17 16 15 14 13 12 11

Optics, Photonics and Imaging

1. **Characterizing Si-MOSFET CMOS Devices for Terahertz Detection**
   Katherine E. Seery, Jack Horowitz, Zoran Ninkov, Andrew P. Sacco, J. Daniel Newman, Kenneth D. Fourspring, John H. Osborn, Robert D. Fiete, Paul P. K. Lee, Mark V. Bocko, Zeljko Ignjatovic, Jagannath Dayalu, Judith L. Pipher, Craig W. McMurtry

2. **Off-null measurements applied to process monitoring using focused beam scatterometry**
   Anthony Vella, Stephen Head, Thomas G. Brown, Miguel A. Alonso
   University of Rochester

3. **Lensless Measurements of Spatial Coherence in the Fresnel Region**
   Katelynn A. Sharma, Miguel A. Alonso, Thomas G. Brown
   University of Rochester

4. **Non-Contact Dielectric Thin Film Thickness Determination Using Dual-Angle Imaging**
   Jennifer D. T. Kruschwitz[1] and Roy S. Berns[2]
   1. University of Rochester, Institute of Optics
   2. Rochester Institute of Technology, Munsell Color Science Laboratory

5. **Reflectance Color Targets for Colorimetric or Multispectral Microscopic Imaging**
   Jennifer D. T. Kruschwitz[1] and Roy S. Berns[2]
   1. University of Rochester, Institute of Optics
   2. Rochester Institute of Technology, Munsell Color Science Laboratory

6. **Sensitivity Analysis of Ellipsometry Applied to a Thin Film on a Curved Substrate**
   Aizhong Zhang, James M. Zavislan
   University of Rochester

7. **Using Quantum Dots to Enable Deep-UV Sensitivity for Standard Silicon Based Imaging Detectors**
   Robert Ichiyama
   Rochester Institute of Technology

8. **Repetition-rate scaled Ytterbium fiber Femtosecond Lasers for Ophthalmic Micromachining**
   Ruting Huang and Wayne H. Knox
   University of Rochester

9. **Dispersion Engineering in a Femtosecond Micromachining System**
Gustavo Gandara-Montano[1], Len Zheleznyak[1], Daniel Brooks[1], Wayne H. Knox[1,2], Jonathan D. Ellis[1,3]
[1]The Institute of Optics, [2]Center for Visual Science, [3]Department of Mechanical Engineering, University of Rochester

10. **Enhancing the Resonance Stability of a High-Q Micro/Nanoresonator by an Optical Means**
Xuan Su, Institute of Optics
University of Rochester

11. **Wavefront Coding Approach to Laser Suppression**
Jacob Wirth
Rochester Institute of Technology

12. **Multi-task Learning of Biophysical Parameters in Hyperspectral Imagery**
Utsav B. Gewali and Sildomar T. Monteiro
Center for Imaging Science, Rochester Institute of Technology

13. **Nondestructive imaging for quality control in manufacturing and medical imaging**
Cristina Canavesi[1], P. Tankam[2], Jungeun Won[2] and Jannick P. Rolland[1,2]
[1]LighTopTech Corp., [2]The Institute of Optics, University of Rochester

Biomedical Engineering

14. **Biological Impact of LIRIC in the Cornea: Implications of γ-H2AX Staining**
Kaitlin Wozniak[1], Dan Brooks[1], Sara M. Gearheart[1], Scott MacRae[2,3], Holly Hindman[2,3], Margaret DeMagistris[3], Wayne H. Knox[1,3], Jonathan D. Ellis[1,4], Krystel R. Huxlin[2, 3]
[1]The Institute of Optics, [2]Flaum Eye Institute, [3]Center for Visual Science, [4]Department of Mechanical Engineering, University of Rochester

15. **Variable porosity temporary skin substitutes coupled with a new anti-scarring agent**
Collynn Woeller[1], Aubrey Woodroof, Richard Phipps[1]
[1]Department of Environmental Medicine, University of Rochester

16. **Modeling Miniaturized Extracorporeal Blood Therapies Enabled by Ultrathin Silicon Nanomembranes**
Tucker Burgin
University of Rochester

17. **Pathway towards in-vivo LIRIC: Modeling and Optimizing the LIRIC Writing Process**
Paul D. Funkenbusch, Kaitlin Wozniak, Len A. Zheleznyak, Jonathan D. Ellis University of Rochester

Electrical Engineering, Computer Engineering, and Computer Sciences

18. **Efficient hardware implementations of MK-3 algorithm**
Steve Farris and Michael Kurdziel, Harris Corporation
Alan Kaminsky and Stansislaw Radziszowski, Department of Computer Science, RIT
Marcin Lukowiak, Department of Computer Engineering, RIT
Gordon Werner, B. Thomas Golisano College of Computing and Information Sciences, RIT

19. **Design Guidelines for Flat-Panel Loudspeakers with Modal Crossover Networks**
David Anderson
University of Rochester

20. **Piano Music Transcription with Fast Convolutional Sparse Coding**
Andrea Cogliati, Dr. Zhiyao Duan, University of Rochester, and Dr. Brendt Wohlberg, Los Alamos National Laboratory.

21. **Flash-Lamp Annealed Polycrystalline Silicon (FLAPS)**
Karthik Bhadrachalam, Paul Bischoff, Tarun Mudgal, Denis Cormier and Karl D. Hirschman*
*Electrical and Microelectronic Engineering,*Industrial and Systems Engineering, Rochester Institute of Technology*
Robert G. Manley, Science and Technology Division, Corning Incorporated

22. **Threaded Engram Database (TED)**
Stephen Zilora
Rochester Institute of Technology

23. **Enabling and Optimizing Resource Constrained Mobile Ad-Hoc Clouds**
Colin Funai
Electrical and Computer Engineering, University of Rochester

24. **MOTIVE: MANET Optimization Through Interaction, Visualization and Evaluation**
Cristiano Tapparello, Colin Funai, Justin Fraumeni, Theodore Reiss, Yukun Chen and Wendi Heinzelman
University of Rochester

25. **The Effective Access Technology Discovery Program - An Alliance with the Al Sigl Community of Agencies and RIT**
Stan Rickel, Elizabeth DeBartolo, Dan Phillips, Adam Podolec, Crystal Mendoza, Mariana Pinheiro, Matthew Mack, Austin Zuercher, Richard DeMartino
Rochester Institute of Technology

Chemical Engineering, Mechanical Engineering, and Materials Science

26. **Computational Tools For a Gear Design**
Alfonso Fuentes-Aznar[(a)], Ignacio Gonzalez-Perez[(b)]
Department of Mechanical Engineering, Rochester Institute of Technology Department of Mechanical Engineering, Polytechnic University of Cartagena, Cartagena, SPAIN

27. **Tribology Laboratory at KGCOE**
Dr. Patricia Iglesias Victoria
Mechanical Engineering Department, Rochester Institute of Technology

28. **Improving Engine Emissions and Performance using Gaseous Fuels**
James Lee, Rochester Institute of Technology

29. **A Study on Process, Strength and Microstructure Analysis of Low Temperature BiContaining Solder Pastes Mixed with Lead-free Solder Balls**
Sakthi Cibi Kannammal Palaniappan and Prof.Dr.Martin.K.Anselm Center for Electronics Manufacturing and Assembly (CEMA), Rochester Institute of Technology

30. **Investigations on Silicon-Based and Metal-Oxide Semiconductor Materials and Processing Techniques for Thin-Film Electronics**
T. Mudgal, N. Edwards, K. Bhadrachalam, P. Bischoff, P. Ganesh, A. Bharadwaj, C. O'Connell and K.D. Hirschman, Electrical & Microelectronic Engineering Department Rochester Institute of Technology
R.G. Manley, Corning Incorporated, Science and Technology

Optics, Photonics and Imaging

1. **Characterizing Si-MOSFET CMOS Devices for Terahertz Detection**

Katherine E. Seery, Jack Horowitz, Zoran Ninkov, Andrew P. Sacco, J. Daniel Newman, Kenneth D. Fourspring, John H. Osborn, Robert D. Fiete, Paul P. K. Lee, Mark V. Bocko, Zeljko Ignjatovic, Jagannath Dayalu, Judith L. Pipher, Craig W. McMurtry

Rochester Institute of Technology (RIT), in collaboration with the University of Rochester and Harris Corporation, are developing Si-MOSFET (Silicon Metal Oxide Semiconductor Field Effect Transistor) CMOS devices for use in detection and imaging of THz radiation. Test structures are designed locally and fabricated using the MOSIS facility. Results will be presented for second generation designed FETs (SPIN-2). The detector testing involved 15 individual test transistors with various designs and antenna lengths. Parametrically testing the structures warm and cold will confirm the mechanism for THz detection and the effect of the antennas on the frequency response.

2. **Off-null measurements applied to process monitoring using focused beam scatterometry**

Anthony Vella, Stephen Head, Thomas G. Brown, Miguel A. Alonso
University of Rochester

We present a novel strategy for the simultaneous estimation of several structural parameters of deeply subwavelength structures, based on the use of the scatterometry of focused beams with spatially-varying polarization distributions. This enables smaller test structure sizes and faster, potentially more sensitive measurements in silicon wafer nanostructure metrology, for example. In this technique, the polarization distribution of the illumination is designed such that, following scattering by the structure and filtering by a uniform analyzer, the resulting measured intensity distribution is very small. This type of off-null configuration separates the signal from a large amount of background, enabling the accurate estimation of the desired structure parameters. The input polarization distribution is achieved using a single spatial light modulator polarization generation system coupled with an imaging polarimeter. We present an overview of the system layout and experimentally measured output intensities in an off-null condition.

3. **Lensless Measurements of Spatial Coherence in the Fresnel Regio**n

Katelynn A. Sharma, Miguel A. Alonso, Thomas G. Brown
University of Rochester

Characterizing the coherence of a source is crucial to modern optical systems in fields such as medicine, photolithography, illumination, and telecommunications. We

investigate a simple scheme that uses no lenses or long distances in the measurement. Three variations of this method are discussed and compared: one using an aperture, one using an obstacle, and one using both. This work builds on a previously presented method using obstacles and a lens to observe the far-field intensity.

4. Non-Contact Dielectric Thin Film Thickness Determination Using Dual-Angle Imaging

Jennifer D. T. Kruschwitz[1] and Roy S. Berns[2]
1. University of Rochester, Institute of Optics
2. Rochester Institute of Technology, Munsell Color Science Laboratory

Digital cameras have become a constant in daily life due to their accessibility and low cost. Adapting a digital camera to perform similarly to a spectrophotometer can help to keep lab costs down. There are two types of imaging methods typically used, a direct or indirect method. The direct method uses a monochrome camera and a sufficient number of bandpass filters to directly measure the spectral reflectance at each image pixel. The indirect method uses a regular three channel, RGB camera and a small number of filters, then estimates the spectral reflectance with the use of statistical models. This spectral estimation method is often referred to as an empirical or learning-based method, requires a training target, and is very useful if the spectral sensitivities of the camera are not known. The bandpass filters increase the number of digital camera channels so there is more information that can be used in the model's transformation. The bandpass filters for the indirect method induce a color change between multiple images. This color change corresponds to a vector in RGB color space. The transformation used will be able to calculate spectral reflectances of different colors based on the length and direction of that vector. Bandpass filters are not the only way to create a color change when comparing two or more images. The reflected color of a dielectric thin film changes with thickness and with incident angle. If a film of a given thickness could be measured at two or more incident angles, one would be able to create that color vector, where vector length and direction could be associated with film thickness. This project Dual-angle imaging is a method that can be used to leverage color change versus incident angle to determine the physical thickness of a dielectric thin film using a digital camera.

5. Reflectance Color Targets for Colorimetric or Multispectral Microscopic Imaging

Jennifer D. T. Kruschwitz[1] and Roy S. Berns[2]
1. University of Rochester, Institute of Optics
2. Rochester Institute of Technology, Munsell Color Science Laboratory

Reflectance color targets made up of color mirror coated microlenses can be used colorimetrically as a traditional color target for photography, or spectrally for

multispectral imaging applications. These targets will never fade and can be made additionally for ultraviolet and infrared imaging applications. This research focused on

microscopy uses such as identifying the spectral reflectance of pigment particles in paintings. Other color imaging uses for these targets include ophthalmic imaging of the human retina and dermatological imaging of anomalies on the surface of human skin.

6. Sensitivity Analysis of Ellipsometry Applied to a Thin Film on a Curved Substrate

Aizhong Zhang, James M. Zavislan
The Institute of Optics, University of Rochester

Ellipsometry is a non-invasive optical method mainly used to investigate the thickness and refractive index of thin films on a substrate. It directly measures the polarization state change before and after light reflection upon a sample. Conventional ellipsometry is limited to thin films on flat surfaces, even though the speed and accuracy have been greatly improved over the years. This study aims to extend the scope of ellipsometry to curved surfaces. We theoretically analyze the sensitivity of a general ellipsometric system to measure thin film on a curved surface, and to lay the foundation for our design and further experimental setup.

7. Using Quantum Dots to Enable Deep-UV Sensitivity for Standard Silicon Based Imaging Detectors

Robert Ichiyama
Rochester Institute of Technology

Sensitivity to ultraviolet (UV) light is becoming more important for imaging sensors. For example current generation lithography for integrated circuit production is exposed with 193nm light with future generations moving to even shorter wavelengths down to 13.5nm. Silicon based sensors have poor sensitivity to blue and UV light. Absorption by the gate and clock structures on the front surface prevents a significant portion of the UV light from reaching the active region of the detector. The standard and expensive method to improve blue and UV response is to polish the sensor until it is very thin and illuminate the detector through the back side. As an alternative to back thinning, the sensor may be coated with a fluorescent material to convert blue and UV light into a wavelength to which the underlying sensor is sensitive. The most common coating material is the organic dye used in highlighter pens, Lumogen. Being an organic dye, it can degrade with time, UV total dose and vacuum exposure.

Quantum dots offer a more robust alternative to Lumogen. The color at which they fluoresce is tunable and the dots can be fabricated so that the emitted light is at a wavelength close to that most efficiently detected by the sensor. As shown in Figure 1. A

method has been developed to coat sensor chips with layers of quantum dots for UV light detection without leaving organic residues. Patents pending.

8. Repetition-rate scaled Ytterbium fiber Femtosecond Lasers for Ophthalmic Micromachining

Ruting Huang and Wayne H. Knox
University of Rochester

The femtosecond micromachining process in ophthalmic materials depends on the laser repetition rate in a complex manner, requiring optimization. We explore several approaches, both passive and active, for obtaining variable repetition rate femtosecond compact fiber laser sources, including new kinds of intracavity dispersion compensation.

9. Dispersion Engineering in a Femtosecond Micromachining System

Gustavo Gandara-Montano[1], Len Zheleznyak[1], Daniel Brooks[1], Wayne H. Knox[1,2], Jonathan D. Ellis[1,3]
[1]The Institute of Optics, [2]Center for Visual Science, [3]Department of Mechanical Engineering, University of Rochester

Dispersion control becomes critical in the use of 400 nm femtosecond laser pulses in micromachining of ophthalmic materials. As the complexity of the system increases, it is necessary to model, measure, and correct accumulated dispersion due to a variety of optical components. Wedemonstrate compensation of a large amount of included dispersion using a compact multi-Brewsterprism compressor.

10. Enhancing the Resonance Stability of a High-Q Micro/Nanoresonator by an Optical Means

Xuan Su, Institute of Optics
University of Rochester

High-quality optical resonators underlie many important applications ranging from optical frequency metrology, precision measurement, nonlinear/quantum photonics, to diverse sensing such as detecting single biomolecule, electromagnetic field, mechanical acceleration/rotation, among many others. All these applications rely essentially on the stability of optical resonances, which, however, is ultimately limited by the fundamental thermal fluctuations of the devices. The resulting thermo-refractive and thermo-elastic noises have been widely accepted for nearly two decades as the fundamental thermodynamic limit of anoptical resonator, limiting its resonance uncertainty to a magnitude ~10-14 at room temperature. Here we report a novel approach that is able to significantly improve the resonance stability of an optical resonator. We show that, in

contrast to the common belief, the fundamental temperature fluctuations of ahigh-Q micro/nanoresonator can be suppressed remarkably by pure optical means without cooling the device temperature, which we term as temperature squeezing. An optical wave with only a fairly moderate power launched into the device is able to produce strong

photothermal back action that dramatically suppresses the spectral intensity of temperature fluctuations by five orders of magnitudes and squeezes the overall level (root-mean-square value) of temperature fluctuations by two orders of magnitude. The proposed approach is universally applicable to various micro/nanoresonator platforms and the optimal temperature squeezing can be achieved with an optical Q around 106-107 that is readily available in various current devices. The proposed photothermal temperature squeezing is expected to have profound impact on broad applications of high-Q cavities in sensing, metrology, and integrated nonlinear/quantum photonics.

11. Wavefront Coding Approach to Laser Suppression

Jacob Wirth
Rochester Institute of Technology

A Wavefront coding approach is taken to protect sensors from powerful laser radiation. Various phase plate designs, such as axicon, vortex, and random phase plates, are tested to reduce the peak intensity of coherent sources while maintaining as much information from the scene as possible. Such a system would be advantageous over previous methods as it could be passive unlike a shutter, on directional unlike a coronagraph, and continue to work after laser radiation is present unlike a saturable absorber.

12. Multi-task Learning of Biophysical Parameters in Hyperspectral Imagery

Utsav B. Gewali and Sildomar T. Monteiro
Center for Imaging Science
Rochester Institute of Technology

Remotely extracting information about the biophysical properties of the materials in an environment has a variety of applications in forestry, agriculture, mining, environmental monitoring and space exploration. In this study, we investigate Gaussian processes (GP's) for predicting the values of biophysical parameters (e.g., concentration of chemicals, vegetation parameters) of the material measured from a ground based, airborne or spaceborne hyperspectral imagery. The main contributions of this study lies in the application of multi-task learning GPs to the problem of parameter estimation and the development of a new non-stationary covariance function, called exponential spectral angle mapper (ESAM), designed specifically for modeling hyperspectral data. ESAM was designed considering that the spectral angle is a better measure of similarity for hyperspectral data. Possible applications of our method include estimation of various minerals, soil chemicals, forest parameters (e.g., biomass) or atmospheric pollutants over a large area using airborne or spaceborne hyperspectral imaging. Furthermore, models

learned on data collected on earth could be used for estimating contents of life-supporting chemicals in alien planets using data collected from a planetary rover or a space probe.

Hyperspectral imaging, also called imaging spectroscopy, is the process of capturing reflected or emitted energy at each pixel in an image of a scene over hundreds of contiguous, narrow bands in the electromagnetic spectrum, commonly in the visible and infrared spectral regions. Each pixel of a hyperspectral image is a continuously varying reflectance (or radiance) as a function of wavelength. A variety of material's characteristics can be estimated from its reflectance spectrum as the interaction between the incident light and a material depends on the absorption bands of that material, manifested by its atomic or molecular structure. One major problem with hyperspectral datasets is that they are generally high dimensional (hundreds of bands) having few labelled examples.

We compared the multitask methods presented in [1] and [2]. Two datasets were used in these tests. One of them contained the contents of chlorophyll-a, chlorophyll-b, moisture and carbohydrate as the targets and the other contained leaf chlorophyll content, fractional vegetation cover and leaf area index as the targets. It was seen that using the multi-tasking GP's, we could improve the performance produced by single GP's on some of the targets in these datasets. Also, our covariance function, ESAM, outperformed the commonly used squared exponential and polynomial covariance functions for both single and multi-task GP's. Fig 1. shows a chlorophyll content distribution map of a scene created using multi-task GP[1] model with ESAM covariance function, which achieved best estimation performance ($r^2 = 0.9503$).

[1] E. V. Bonilla, K.M. Chai, and C. Williams, "Multi-task Gaussian Process Prediction.", Advances in Neural Information Processing Systems (2008).
[2] B. Rakitsch et al., "It is all in the noise: Efficient multi-task Gaussian process inference with structured residuals.", Advances in Neural Information Processing Systems (2013).

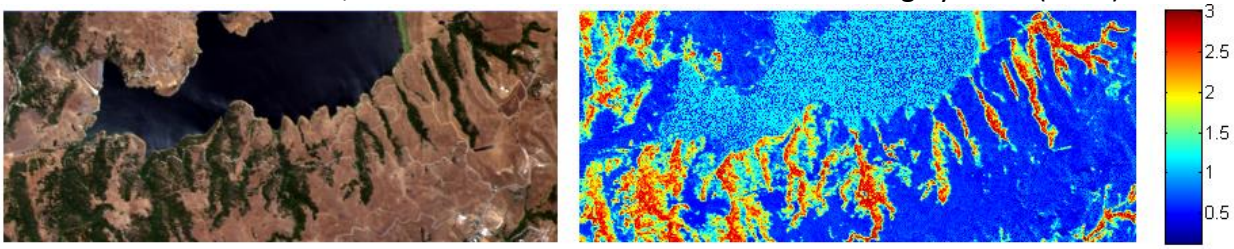


Figure 1. (L) An image of Moffett field from hyperspectral image acquired by JPL's AVIRIS sensor. (R) Leaf Chlorophyll Content (µgm/cm^2) distribution map estimated using multi-task GP[1] with ESAM.

13. Nondestructive imaging for quality control in manufacturing and medical imaging

Cristina Canavesi[1], P. Tankam[2], Jungeun Won[2] and Jannick P. Rolland[1,2]
[1]LighTopTech Corp., [2]The Institute of Optics, University of Rochester

High-resolution, nondestructive 3D imaging is needed for quality control in manufacturing and for monitoring of diseases in clinical applications, including skin surgery and corneal transplants. An optical instrument based on a biomimetic microscope design and numerical algorithms for Gabor-domain fusion was developed. Through integration of a custom MEMS scanner module for robust and repeatable imaging, the full characterization of a volume of 1 x 1 x 0.6 mm^3 at a resolution of 2 µm is completed in less than 1.5 minutes. The instrument was used to characterize contact lenses both in air and in solution, and to qualify corneal tissue.

Biomedical Engineering

14. Biological Impact of LIRIC in the Cornea: Implications of γ-H2AX Staining

Kaitlin Wozniak[1], Dan Brooks[1], Sara M. Gearheart[1], Scott MacRae[2,3], Holly Hindman[2,3], Margaret DeMagistris[3], Wayne H. Knox[1,3], Jonathan D. Ellis[1,4], Krystel R. Huxlin[2, 3]
[1]The Institute of Optics, [2]Flaum Eye Institute, [3]Center for Visual Science, [4]Department of Mechanical Engineering, University of Rochester, Rochester, NY 14627

LIRIC, formerly known as intra-tissue refractive index shaping (IRIS), is a novel approach being developed for vision correction. It utilizes a femtosecond laser to write custom refractive index (RI) patterns inside living corneal tissue. Histological analysis was conducted to detail the biological impact of LIRIC on corneal tissue. Five feline eyes underwent LIRIC; three were treated with LASIK, and four with PRK. The debridement of the epithelium in PRK, which induces corneal swelling and an associated, local change in osmolarity, caused positive γ-H2AX staining in keratocytes that populate the most superficial layers of the stroma. There was no γ-H2AX staining in the rest of the PRK stroma or in LASIK. In LIRIC, strong γ-H2AX-positive cells are seen adjacent to the area of RI change, supporting the notion that LIRIC may be associated with a localized osmolarity change that induces repairable DNA damage in keratocytes adjacent to the zone of RI change.

15. Variable porosity temporary skin substitutes coupled with a new anti-scarring agent

Collynn Woeller[1], Aubrey Woodroof, Richard Phipps[1]
[1]Department of Environmental Medicine
University of Rochester School of Medicine and Dentistry

Excessive scar formation is often a consequence of wound healing after injury from chemical or physical burns of the skin. Debilitating scarring results in pain, loss of tissue function, and in severe cases, even death. To date, there are few, if any, effective treatments to prevent excess scarring, and new treatments are needed. One option in skin wound healing is the use of temporary skin substitutes that aim to allow the natural healing process with minimal scar formation. Here, temporary skin substitutes (Biobrane, PermeaDerm, and PermeaDerm derivatives) were tested for their ability to promote

human fibroblast and stem cell growth without the accumulation of excess contractile myofibroblasts, the key effector cells that mediate scarring. For the first time we couple a temporary skin substitute (Permeaderm) with our recently discovered, novel anti scarring agent, salinomycin. Our results show that both human fibroblasts and stem cells grow more evenly on Permeaderm than Biobrane. Furthermore, addition of salinomycin to the Permeaderm matrix dramatically reduced expression of the myofibroblast markers α-smooth muscle actin and fibronectin. These data demonstrate the robust ability of Permeaderm to allow human cell growth and uncover that addition of an anti-scarring agent can prevent accumulation of myofibroblasts. These data also reveal the power of salinomycin to act as an anti-scarring therapeutic.

16. Modeling Miniaturized Extracorporeal Blood Therapies Enabled by Ultrathin Silicon Nanomembranes

Tucker Burgin, University of Rochester

Extracorporeal blood therapies such a hemodialysis and extracorporeal membrane oxygenation(ECMO) have seen little innovation over the last several decades despite poor outcomes for patients reliant on these technologies. Because a key property of any membrane is its thickness, our group is studying the potential of molecularly-thin membranes to revolutionize extracorporeal membrane therapies, which have traditionally depended upon collagen or synthetic polymer membranes with large surface areas and with thicknesses on the scale of microns. These therapies involve the channeling of a patient's blood next to a semi-permeable membrane separating it from another fluid, in order to supplement or replace the activities of biological membranes. Therapeutic transport in these devices is exercised predominantly by diffusion, aprocess that is described by an inverse square law relating a distance to the average time a diffusing particle requires to travel that distance. As such, small changes in membrane thickness or other device dimensions can have significant effects on device performance -- and large changes can cause dramatic paradigm shifts. In this poster, we describe our research into analytical and computational modeling towards the application of ultrathin nanoporous silicon membranes (nanomembranes) with thicknesses on the scale of tens of nanometers to diffusion-mediated medical devices. Such devices enable a myriad of notable benefits

when compared to traditional approaches, such as reduced device size, improved clearance specificity, and reduced membrane fouling, culminating in treatments that are predicted to be both more convenient and more efficacious than traditional alternatives.

17. **Pathway towards in-vivo LIRIC: Modeling and Optimizing the LIRIC Writing Process**
Paul D. Funkenbusch, Kaitlin Wozniak, Len A. Zheleznyak, Jonathan D. Ellis University of Rochester

LIRIC is a multi-photon absorption process that is used to locally change the refractive index of cornea tissue and hydrogels for contact lenses and intra-ocular lenses. The LIRIC process requires a high numerical aperture beam with a known optical quality that is scanned rapidly through the material. This process depends on numerous parameters, including NA, beam quality, pulse width, laser repetition rate, focal spot velocity, and local material properties. We have established a preliminary model of the LIRIC process and are performing designed experiments to determine the coupling between the parameters and build an effective model of the material response to LIRIC within the process parameter space. The overall objective is to optimize the LIRIC writing process for both hydrogel and cornea tissue applications.

Electrical Engineering, Computer Engineering, and Computer Sciences

18. **Efficient hardware implementations of MK-3 algorithm**
Marcin Lukowiak, Rochester Institute of Technology

Authenticated encryption (AE) algorithms provide both data confidentiality and integrity. While a number of AE algorithms exist, they can be inefficient or difficult to use. Recently, significant efforts have focused on the development of secure, robust, efficient, and easy to use AE algorithms. MK-3 is one such algorithm. It has been developed through a joint effort between Rochester Institute of Technology (RIT) and the Harris RF Communications. It uses the duplex construction, which builds on the sponge primitive popularized by Keccak, the SHA-3 competition winner. MK-3 is intended for hardware implementations with a novelty being the use of 16-bit substitution boxes. In our work we analyze a fully parallel hardware implementation of MK-3 on Field Programmable Gate Arrays (FPGAs) and compare its performance to similar AE algorithms. We also lay the groundwork for future design optimizations.

19. **Design Guidelines for Flat-Panel Loudspeakers with Modal Crossover Networks**

David Anderson
University of Rochester

Creating loudspeakers from vibrating flat plates has long been a goal of acousticians and loudspeaker enthusiasts, due to benefits in weight, size, and efficiency over traditional designs. Unfortunately, while it is simple to force a plate into vibration, the backlog of failed commercial flat-panel loudspeakers testifies to the difficulty of actually making them sound good. Modal Crossover Networks are a revolutionary method of tuning the vibrational characteristics of plates using a tuned array of drivers attached to the panel, for the first time allowing them to compete with traditional rigid-cone loudspeakers. Presented here are design guidelines for such a speaker and measurement results from a 58.4 x 43.2 cm acrylic panel prototype with 18 drivers.

20. Piano Music Transcription With Fast Convolutional Sparse Coding

Andrea Cogliati, Dr. Zhiyao Duan, University of Rochester, and Dr. Brendt Wohlberg, Los Alamos National Laboratory.

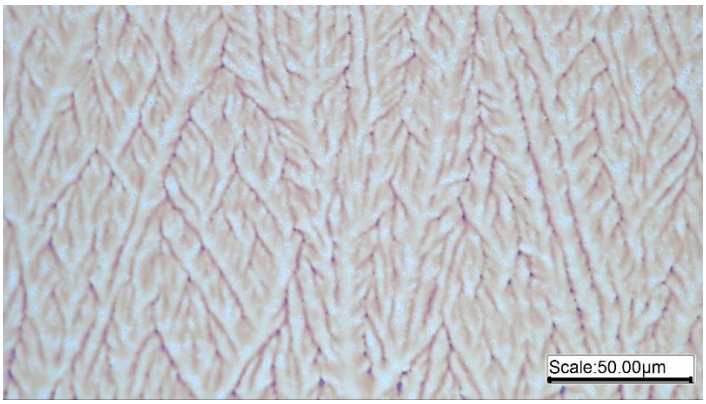
Automatic music transcription (AMT) is the process of converting an acoustic musical signal into a symbolic musical representation. Most existing algorithms for AMT operate in the frequency domain, which introduces the well known time/frequency resolution trade-off of the Short Time Fourier Transform and its variant. We propose a time-domain transcription algorithm based on an efficient convolutional sparse coding algorithm in an instrument and environment specific scenario. The proposed method outperforms a current state-of-the-art AMT method by over 20% in F-measure, achieving a median F-measure of 93% on synthetic piano and over 80% on acoustic piano.

21. Flash-Lamp Annealed Polycrystalline Silicon (FLAPS)

Karthik Bhadrachalam, Paul Bischoff, Tarun Mudgal, Denis Cormier and Karl D. Hirschman*
Electrical and Microelectronic Engineering
Rochester Institute of Technology
Robert G. Manley
Corning Incorporated

Many technologies have emerged in the recent past to make high performance TFTs for AMLCD and AMOLED displays. Excimer Laser Annealing (ELA) is currently used to realize Low Temperature Polycrystalline Silicon (LTPS) for high performance TFTs. Flash Lamp Annealing (FLA) involves crystallization using a short pulse of high intensity light from a xenon glow discharge. This technique maintains a low substrate temperature and would reduce production costs, and can easily scale for large panel manufacturing.

This work presents an approach of creating polysilicon using a NovaCentrix PulseForge 3300 xenon flash lamp system. Amorphous silicon (a-Si) was deposited using PECVD on Corning Eagle XG glass substrate wafers, and patterned into a variety of polygon features before FLA exposure. Optical images following FLA exposure identify a significant change in the surface morphology of the film, suggesting a polycrystalline structure. This has been confirmed using electron backscatter diffraction (EBSD), with the majority of grains found to be in the 4-7 µm range.



Optical micrograph of FLA crystallization

22. Threaded Engram Database (TED)

Stephen Zilora
Rochester Institute of Technology

The relational database model is a very robust and efficient paradigm for handling structured data. The strength in the model is drawn from the defined relationships among the data entities, but this strength is also the model's weakness. The reliance of the model on predetermined relationships makes it difficult to discover new relationships. In contrast to this, human memory can be thought of as a collection of interconnected data bits. As early as 1921, Richard Semon proposed the idea that memory was a collection of "engrams", or experiences. More recently, significant research has been done on the role our senses play in the organization and connection of apparently disparate ideas. This structure of experiences and connections allows us to discover new relationships and patterns easily, but it does not have the efficiency or predictability of the relational database model. This tradeoff can be justified in many situations. The Threaded Engram Database (TED) is designed to permit the storage and retrieval of data in a manner based on human memory. Our initial implementation of the model is directed at meetings or gatherings. These engrams are connected by threads of Who, What, Where, and When. This framework will allow the analysis of domains such as recommender systems,

epidemiological systems, and personal and business relationships, uncovering linkages previously hidden.

23. Enabling and Optimizing Resource Constrained Mobile Ad-Hoc Clouds

Colin Funai
Electrical and Computer Engineering, University of Rochester

Wireless ad hoc networks are infrastructure-less networks developed to meet the needs of a variety of applications where infrastructure-based wireless networks are difficult to deploy and maintain. Given the increasing availability of mobile devices that natively support ad hoc communication protocols, we explore different techniques for efficient resource management of large scale ad hoc networks. Our research includes developing techniques to: 1) create multi-hop ad hoc networks by interconnecting commercially available mobile devices, 2) acquire device and network information, and 3) utilize the acquired information to optimize the network operation, including network maintenance as well as task distribution within the multi-hop ad hoc network.

24. MOTIVE: MANET Optimization Through Interaction, Visualization and Evaluation

Cristiano Tapparello, Colin Funai, Justin Fraumeni, Theodore Reiss, Yukun Chen and Wendi Heinzelman

Although ad hoc networks' independence from infrastructure based communication make them ideal for facilitating communication in military and disaster relief scenarios, these very situations benefit greatly from high situational awareness, which is often not readily available in ad hoc networks. Hence, we have created a system to visualize pertinent network information, allowing network operators to quickly identify bottlenecks, locate lost or disconnected nodes, and re-assign network roles in response to a node's current situation. By coupling this information with geographical information, displaying the nodes and connections on a map, operators can more easily trouble shoot errors that arise from environmental or network conditions.

25. The Effective Access Technology Discovery Program - An Alliance with the Al Sigl Community of Agencies and RIT

Stan Rickel, Elizabeth DeBartolo, Dan Phillips, Adam Podolec, Crystal Mendoza, Mariana Pinheiro, Matthew Mack, Austin Zuerche, Richard DeMartino
Rochester Institute of Technology

One of the challenges any capstone design program faces is the identification of suitable projects for its students. In the area of Effective Access Technology, where the customers

are often individuals in the community, this can be an even greater challenge, as universities can not necessarily rely on employer contacts or alumni in industry for project proposals. However, in some cases, it is essential that industry partnerships be formed to enable realization of proposed solutions. The Rochester Institute of Technology, in collaboration with the Al Sigl Community of Agencies and several area agencies providing services to people with disabilities, has piloted an embedded student discovery program that puts students in an environment where they interact closely with clients and caregivers to identify user needs. These students have the opportunity to identify potential projects that address these needs and the engineering background to recognize possible interdisciplinary solution paths. These project ideas result in proposals that can be refined and reviewed for implementation through a variety of on-going programs at RIT including opportunities for commercialization and entrepreneurship. This poster outlines this project discovery method as well as some examples of project implementations.

Chemical Engineering, Mechanical Engineering, and Materials Science

26. Computational Tools For Advanced Gear Design

Alfonso Fuentes-Aznar[(a)], Ignacio Gonzalez-Perez[(b)]

(a) Department of Mechanical Engineering, Rochester Institute of Technology

(b) Department of Mechanical Engineering, Polytechnic University of Cartagena, Cartagena, SPAIN

The Gear Research Laboratory at RIT, in collaboration with researchers of the Polytechnic University of Cartagena in Spain, is developing state of the art computational tools for advanced gear design. The poster will include a graphical overview of the different tools that have been integrated in the custom made software IGD. We offer a virtual generator of any type of gear with which the most accurate geometry of gears can be obtained and analyzed before the expensive process of manufacturing of prototypes. Tools for analysis and diagnostic of gear drives include the application of enhanced approaches of tooth contact analysis and finite element analysis for stress determination. Additional tools to achieve the optimal design include freeform surface generation, backlash analysis, design finder or the smart design module, to cite only a few. The Gear Research Lab is poised to contribute to Rochester's long tradition and recognized global leadership in gear design and manufacturing in support of our corporate partners and our community.

27. Tribology Laboratory at KGCOE

*Dr. Patricia Iglesias Victoria**,** Mechanical Engineering Department*

Rochester Institute of Technology

No human activity could be conducted without the expenditure of energy. Indeed, energy consumption is strongly linked with a country's rate of economic growth and level of pollution [1, 2]. The machines and devices that we use in our daily lives require energy to operate; a significant portion of this energy is wasted through friction in the moving parts

of mechanical and electromechanical components. In addition, wear is one of the major causes of mechanical failure of engineering equipment [3]. In order to reduce friction losses and increase the efficiency and service life of machinery, a better understanding of friction and wear mechanisms that occur in the moving parts of the system is needed [4]. Currently it is estimated that between 1 and 1.55% of a country's GDP (Gross Domestic Product) could be saved by reducing friction and wear losses in mechanical components [2]. Researchers have estimated that 11% of the energy annually consumed in the U.S. in the areas of transportation, turbomachinery, power generation and industrial processes could be saved through new advances in lubrication and tribology [2]. Needless to say, even minor advances in these areas could lead to significant economic and environmental benefits.

This poster summarizes some of the resources available at the Rochester institute of Technology to characterize the tribological properties of materials, and to develop new strategies to enhance friction and wear resistance of interacting surfaces in relative motion.

28. Improving Engine Emissions and Performance using Gaseous Fuels

James Lee, Rochester Institute of Technology

The performance and exhaust emissions of a commercially available, propane fueled, air cooled engine with Electronic Fuel Injection (EFI) were investigated by varying relative Air to Fuel Ratio (λ), spark timing, and Compression Ratio (CR). Varying λ and spark timing was accomplished by modifying the EFI system using TechniCAL Industries' engine development software. The CR was varied through using pistons with different bowl sizes. Strong relationships were recorded between λ and spark timing and the resulting effect these parameters have on engine performance and emissions. Lean operation (λ>1) has the potential to significantly reduce NOx production (3,000 PPM down to 300 PPM). Unfortunately, it also reduces engine performance by up to an order of magnitude (31 Nm down to 3 Nm). Moving spark initiation to earlier in the compression stroke, 10˚ to 40˚ Before Top Dead Center (BTDC), improved engine performance considerably (25% improvement in brake torque) in the presence of excess air. Unfortunately, advancing the spark also caused NOx production to increase. The effects the parameters have on engine performance are significant enough that the same engine can be used for vastly different applications with changes only to the control software. Compression ratio has a less significant effect on engine performance, but increasing CR does result in an increase engine torque. Increasing CR from 9:1:1 to 11:1 resulted in an increase in engine torque of approximately 10% for the operating parameters tested.

29. A Study on Process, Strength and Microstructure Analysis of Low Temperature BiContaining Solder Pastes Mixed with Lead-free Solder Balls

Sakthi Cibi Kannammal Palaniappan and Prof.Dr.Martin.K.Anselm Center for Electronics Manufacturing and Assembly (CEMA), Rochester Institute of Technology

As the traditional eutectic SnPb solder alloy has been outlawed, the electronic industry has almost completely transitioned to the lead-free solder alloys [1] [2]. The conventional SAC305 solder alloy used in lead-free electronic assembly has a high melting and processing temperature with a typical peak reflow temperature of 245°C which is almost 30°C higher than traditional eutectic SnPb profile. Some of the drawbacks of this high melting and processing temperatures are yield loss due to component warpage which has an impact on solder joint formation like bridging, open defects, head on pillow [3], and other drawbacks which include circuit board degradation, economic and environmental factors [4], and brittle failure defects in the circuit board like pad cratering. To overcome this, a detailed study has been carried out on low temperature lead-free solder paste that utilizes Bi bearing alloys. Three low temperature lead-free solder pastes, Sn-58Bi, Sn-57Bi-1Ag and Sn-40Bi-Cu-Ni with the melting temperatures of 138°C (which is 45°C below eutectic SnPb and 79°C below SAC) were printed on Cu-OSP finish test boards and then SAC305, Sn99CN and Sn100C solder spheres were assembled using the Bi bearing solder paste deposited. The range of Bi concentrations for various mixtures used in this study was calculated to be 2 to 4 wt%. These mixtures were then reflowed under two different low temperatures reflow profiles, (a) traditional SnPb profile with a peak temperature 217°C and (b) a low temperature Bi profile with a peak temperature 177°C (recommended by paste manufacturer). After the assembly process, the mixed solder joints were shear tested to study the failure modes and shear strength at rate of 27.50mils/sec were used. Then, cross sectioning was done to evaluate the possible microstructural changes at room temperature and after aging conditions that may have lead to the changes in failure mode observed in shear testing. The isothermal aging condition used in the study is 125°C for 200 hours which mimics 21 years of field storage at 25°C degrees using Arrhenius extrapolation for Cu6Sn5 intermetallic formation. Our study suggests that SnPb reflow profile had better mechanical strength than the bismuth reflow profile because of the higher peak temperature in SnPb reflow profile. One of the significant observations in the shear testing was brittle failure mode before and after aging. Most failures were in the pad boundary intermetallics. The size and distribution of the various intermetallic precipitates in the bulk solder joints were also investigated. Thus, this paper describes that by generating a robust reflow assembly process for tin- bismuth solder paste, the failures modes can be improved and the shear strength can be increased, which may improve product yield in production. Bibliography [1] "Understanding Lead-free Electronics Packaging, Material Selection, Process, Defects, Reliability and

Implementation," Center for Electronics Manufacturing and Assembly, Rochester Institute of Technology,, 2005. [2] J. S. Hwang, "A Strong Lead-free Candidate: the Sn/Ag/Cu/Bi System," Surface Mount Technology, August 2000. [3] L. Kondrachova, S. Aravamudhan, R. Sidhu and D. Amir, "Fundamentals of the Non-Wet Open BGA Solder Joint Defect Formation," in International Conference on Soldering and Reliability (ICSR), 2012. [4] R. Aspandiar, K. Byrd, T. Kok Kwan, L. Campbell and S. Mokler, "Investigation of Low Temperature Solders to Reduce Reflow Temperature, Improve SMT Yields and Realize Energy Savings," in IPC APEX EXPO, 2015.

30. Investigations on Silicon-Based and Metal-Oxide Semiconductor Materials and Processing Techniques for Thin-Film Electronics

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Low-temperature polysilicon (LTPS) has emerged as a dominant technology for high performance TFTs used in LCD and OLED display products, however there are challenges in scaling excimer-laser annealing (ELA) techniques for backplane manufacturing on large glass panels. This work presents two approaches towards achieving higher performance thin-film electronics that are compatible with large panel manufacturing.

Flash-lamp annealing (FLA) is an alternative technique for crystallization of amorphous silicon (a-Si) which can be scaled to large substrates and reduce time & complexity in the process. This work investigates FLA for crystallization of thin-films of a-Si deposited on glass substrates. The FLA system used in this work is a NovaCentrix PulseForge 3300, which anneals the material using a series of short but intense bursts of broad spectrum light from xenon flash lamps. High peak power over microseconds time scale can provide control over the depth of heating to avoid damage when processing on substrates such as glass or plastic. Large-grain polysilicon has been achieved using this technology; the electronic quality of the material is under investigation.

Metal-oxide thin-film transistors (TFTs) are of high interest in display and imaging array applications which require higher performance over a-Si TFT processes. These materials have demonstrated significantly higher electron mobility than hydrogenated amorphous silicon (a-Si:H), without the added process complexity required by traditional LTPS manufacturing. Sputter-deposited Indium-Gallium-Zinc-Oxide (IGZO) is a candidate material under investigation. Material properties and the device performance of fabricated TFTs with specific process variations will be presented.

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