MNTeSIG Live! 2021 Presentations

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Working Groups

Consider joining any of the following working group break-out sessions during the conference.

Industry Working Group

Caitlin Cramer – Ivy Tech

Matthias Pleil – University of New Mexico

The Industry Working Group supports knowledge exchange between industry and academia to grow the micro-nanotechnology (MNT) technician workforce pipeline and increase enrollment in MNT education. Our main goal is to in the micro/nanotechnology field. To accomplish this goal, we focus our efforts in three main areas: (1) establishing a strong and engaged Business & Industry Leadership Team (BILT) with diverse regional and industry representation for MNT-EC/MNTeSIG, (2) creating and implementing a diverse program of activities that will connect companies with future technicians, and (3) ensuring alignment of MNT education with evolving industry needs. Join us as we kick off our Year 2 goals to strengthen the relationship between MNT industry and academia through the Micro Nano Technology Education Center (MNT-EC) and MNTeSIG.

Distance Learning Working Group Update

Rick Vaughn

Rio Salado

This flash presentation will provide a brief overview of the purpose, activities, accomplishments, and future directions for the Distance Learning Working Group.

MNT-EC Outreach Working Group Activities

Greg Kepner

MNT-EC

The MNT-EC Outreach Team strives to encourage MNTeSIG member engagement, recruit and retain new members, share resources, provide information, and facilitate networking connections among the MNT community of practice. The Outreach Team will soon debut a new informational bulletin for the MNT community. The bulletin will share upcoming events such as conferences, webinars, and professional development activities along with partner announcements, podcast releases, journal solicitations, news articles, blog posts, and more. The Outreach Team is in the process of planning community led activities for National Nanotechnology Day on October 9 (10-9). Please join us in making this day special and helping raise awareness of nanotechnology and how it is used in everyday products that enrich our lives as well as the promises and challenges of the future. Additionally, the Outreach Team has been compiling lists of educational micro and nanotechnology programs and potential people that might be interested in joining our MNT community of practice. Please join our Outreach Working group meeting during MNTeSIG Live!

The MNT Professional Development Working Group

Robert Ehrmann
Penn State – NACK Center

The mission of the Professional Development Working Group strives for the continuous improvement of the micro and nano technology workforce by identifying, disseminating as well as delivering (as appropriate) professional development. Our target is to enhance knowledge, skills, and abilities so that faculty will integrate existing as well as new information about MNT techniques and trends into courses and programs. This session will be an a very brief overview of the to date activities, accomplishment of this national team group as well as the future plans for this working group.

The MNT Curriculum Working Group

Deb Newberry – MNT-EC

Assessment, consolidation, and improvement of educational content as it applies to community college micro and nanotechnology programs is the primary focus of the MNTEC Curriculum Team. As nanotechnology continues to impact multiple disciplines and industry segments it is critical that the educational content and associated student outcomes keep pace with these changes. This is both the challenge and the opportunity for this team. We evaluate and apply curriculum that has been created under the NSF or NNI umbrella as well as content created by professional organizations. Both the evolution of technology and the pandemic continue to impact not only what is taught but also how it is taught. Finally, the multi-disciplinary nature that is inherent in the application of nanoscale research and advances allows the content and the focus of the curriculum team to move forward to meet the needs of industry for “nano-savvy” employees.

Presentations

Keynote Day 2 - The US Scientific Enterprise Through the Lens of Justice

Kendrick Davis

Key scientific advancements, from the WWII-era to the more present day, have propelled the US into the innovation and economic hub it is today. These benefits have not been shared equitably, and have often enabled systematic exploitation of people of color. Currently, fear of competition with China drives our federal R&D efforts and we risk repeating the same developmental mistakes with new rounds of investments in critical areas. We'll discuss the role that faculty, higher education, and the broader scientific enterprise can play in leveling the playing field.

Hands-on Professional Development at UNM with Your Students

Matthias Pleil
University of New Mexico

The SCME has been providing professional develop in MNT for over a decade. Consider joining us at the University of New Mexico's MTTC Cleanroom for a full week of intensive hands-on

experience doing Microsystems Fabrication. We encourage you to bring your students as well - there are stipends available to support this endeavor.

From Fundamentals of Quantum Physics to Solar Cells

Atila Cakmak
Penn State

Semiconductor fundamentals are essential for students who are especially going to be looking for jobs in the vast semiconductor industry. However, teaching the fundamentals entail delivery of quantum mechanics of simple cases all the way up to crystals, which amount to vast amount of derivations, math etc. in a traditional setting. The other route is to expect from the students that they just "accept" the emergence of a bandgap as an example. With the home-developed codes illustratively showing the students how and why semiconductors exhibit their rich physics, we will aim to create a simpler interface for the educators. We will also integrate our efforts with the simulators available on Nanohub and University of Colorado Boulder's interactive simulators to examine simplest Quantum potentials all the way up to Solar Cells.

Teaching Atomic Force Microscopes Interactively

Atila Cakmak
Penn State

Atomic Force Microscopy (AFM) is probably one of the most sought after nanocharacterization skills in the industry. However, the educators are generally limited by the traditional lecture materials to cover the fundamentals in class unless the educational facility could afford offering an AFM for an hands-on experience. We will present an interactive way to cover the fundamentals of both static and dynamic AFM with the aid of the developed AFM educational package. The package is a combination of free educational tools available on internet that the educators can easily utilize and Nanohub's dedicated AFM simulator VEDA. Furthermore, we will introduce how Myscope's Scanning Probe Microscopy Virtual AFM can be efficiently embedded in lectures to give an interactive experience to the students very close to the hands-on one.

J ATE - The Journal of Advanced Technological Education

Peter Kazarinoff
Portland Community College

The Journal of Advanced Technological Education (J ATE) serves as a means of communication and provides a platform for people interested in teaching micro and nano and other advanced technologies. This includes 2-year college faculty, STEM educators in grades 7-14, graduate school faculty, as well as scientists. In this session, you'll learn what J ATE is and how you can submit and publish your work. All MNT^{e}SIG Live! presenters can submit to the Journal and we'll help you through the process of publishing your conference submission. We'll also talk about

opportunities to review your collogues submissions and professional development for journal submitters if you need help along the way.

Feasible Self-assembly demonstration of biomaterials for undergraduate Students

Neda Habibi
Northwest Vista College

Self-assembly is a spontaneous process of formation of¬†ordered structures as a result of specific and local interactions of molecules themselves. These molecules undergo self-association usually forming hierarchical structures at the nanoscale or at the macroscale. Self-assembly is a bottom-up approach where molecules self-associate to make nanostructure. Demonstrating the process of self-assembly helps students to understand how molecules can spontaneously interact to synthesis nano materials and is also an engaging activity for students. Example of these self-assembling building blocks are natural dipeptide molecules. A feasible and versatile self-assembly experiment is demonstrating how nanotubes are formed from a simple natural peptide molecule.

How to Incorporate Distance Learning into Your New or Existing Program

Rick Vaughn
Rio Salado

In this session, we will introduce the process by which we plan and deliver curriculum for a geographically diverse and asynchronous student population. Topics include pathway mapping; College, Governing Board, and accreditor approvals; course development; and online/hybrid instruction.

High Performance Heterogenous Computing for Quantum Computing Simulations for Training the Quantum Workforce

Auro Ashish
Department of Mechanical Engineering,
Puducherry Technological University, India

World over Industry is reporting about Quantum breakthroughs. Similarly, Scientists and Engineers from Research Institutes are claiming the hurdles surpassed in realizing the most talked about Technology of this Millennium i.e., QUANTUM COMPUTING. To take forward this Quantum Revolution, there will be need to nurture Super Quantum Engineer skills in human resource that will form the core of the Quantum Technologies Ecosystem.

This article describes High Performance Heterogeneous Computing for Quantum Computing Simulations for Training the Quantum Workforce to meet the challenges from Disruptive Technologies within a dynamic Academic curriculum framework through Internships to sustain careers in rapidly changing Technology landscapes.

Quantum Workforce Training sole objective is making technology accessible to stake holders in academic, research, industry/consulting and government institutions. Competencies imparted through Quantum Workforce Training aims to accelerate the fundamental and applied research and developing Quantum Computing aware human resource.

Quantum Workforce Training will enable dynamic response to technological changing scenarios to develop Super Quantum Engineer skill sets for sustainable future career of students.

The main highlights of High Performance Heterogeneous Computing for Quantum Computing Simulations for Training the Quantum Workforce are as follows: (I) Theoretical Conceptual Frameworks (II) Classical Computing Hardware Frameworks (III) Scientific Computing Programming Language Frameworks

Nanotechnology and Agriculture: A Unique and Positive Combination

Deb Newberry
Newberry Technology Associates

Feeding an increasing world population while continually reducing the resources and land available to produce the necessary amount of food has been a challenging combination for many years. Through the use of improved seeds and plants that produce a higher crop yield and the use of various fertilizers and chemical means that address the loss of crops due to natural and man-made issues, food production has managed to keep pace with the population growth. These approaches have been the trend, response, and solution for the last several decades.

More recently nanotechnology has emerged from semiconductor fabrication and medical research facilities and caught the attention of the agriculture and food production communities. Nanotechnology is being applied to sensors deployed in the fields to monitor soil moisture and chemical content providing targeted use of water and fertilizers. Sensors based on nanotechnology are being developed to ensure the purity of irrigation water. Bacterial contamination of this water is a leading cause of E. coli found in leafy vegetables resulting in recalls and food loss. Nanoparticles are finding multiple applications: Ag nanoparticles can reduce bacterial diseases on leaves and Cu can reduce fungus infestations.

This presentation will review some of the research evaluating the applications of nanotechnology to the need for greater food production. As applications are discussed, consideration will be given to education requirements, which may now require a combination of horticulture, nanoscience, chemistry, and environmental understanding.

The Talking Technicians Podcast Highlights MNT Technicians

Peter Kazarinoff
Portland Community College

Talking Technicians is MNT-EC's podcast that highlights working technicians in the micro nano technology industry. Each episode features an interview with a working technician. Learn how the podcast episodes are made, how you can incorporate podcast episodes into your courses, and how to help the podcast by suggesting a great technician who can share their story in a future episode.

Using Photonics to Determine the Wavelength of Red Light

Greg Kepner
MNT-EC

Have you ever wondered how to calculate light wavelength using photonics? Participants will observe a laboratory activity from start to finish using an MPEC (Midwest Photonics Education Center) Photonics Kit to calculate the wavelength of red light. Red laser light will be passed through a diffraction grating producing a specific pattern on a target. Measurements of the pattern will be taken. Through mathematical analysis, the wavelength of the red laser light will be calculated.

Providing Equitable Access to STEM Education Through the 2+2+2 Matriculation Model

Kenie Moses

Southern University at Shreveport, Louisiana (SUSLA), designated as a HBCU (Historically Black College and University), is the community college of the Southern University and A&M College System. As part of a system-wide approach to academic program effectiveness and economic impact, SUSLA conducted a systematic review, assessment, and revision of its curricula. SUSLA's evaluation also identified an urgent need for an active, sustained outreach and recruitment program designed for the engagement of rural, underrepresented minorities, and females to increase their competences in critical STEM disciplines. The comprehensive evaluation, guided by employer-partner input, community college and 4-year university collaborations, and published workforce data, identified a pressing need to develop an Engineering Technology program. To that end, SUSLA developed a 2+2+2 Matriculation Model within the Engineering Technology program of study designed as a gateway to enable early education, persistence to post-secondary credentials of value, and high-quality career outcomes. Programs with similar demographics may be able to use this as a model which aims to do four things: 1) facilitate the early engagement of students decreasing the number of academically under-prepared learners entering college, 2) expand post-secondary educational opportunities to improve outcomes fostering economic opportunity 3) increase the enrollment, persistence and graduation of early education and under-served populations in STEM and, 4) facilitate a reduction in time to degree.

Poster Sessions

Remote Undergraduate Research: Bridging the Gap Between Community College and University Students

Sophia Barber
Pasadena City College

A collaborative effort between Pasadena City College and Purdue University provides an undergraduate research program that invites students within the STEM field to partake in a remote undergraduate research experience. This unique remote environment conducted completely through on-line platforms, such as through email, text messaging, and Zoom meetings not only requires minimal funding, but allows for student recruitment and participation throughout the United States, thus eliminating the geographical barriers that divide students participating in undergraduate research opportunities.

This innovative research opportunity has focused on creating distance education STEM modules to update statistical analysis and graphing curriculum for laboratory STEM courses, two pivotal skills needed for success in science and engineering courses, yet often neglected in course materials. This type of research, coupled with K-12 outreach and student mentoring, has never before been conducted by community college students on the national scale and is a step forward in working to improve remote STEM education and promote engineering and other STEM fields collectively, while also bridging the gap between the undergraduate research opportunities provided to community college and university students. Data will be shared on the effectiveness and increased student engagement through the remote undergraduate research experience.

Feasibility study for an OAI tabletop Mask Aligner at Rio Salado College

Wesley McIver
Rio Salado College (Tempe, AZ)

Rio Salado College purchased a model OAI Model 200 "Table Top Series" mask aligner in 2017. It has been non-operational for almost 4 years. With funding from NSF, the author spent a week with technicians at the University of New Mexico in an Undergraduate Research Experience. This poster outlines recommendations and operating conditions to utilize the mask aligner for future workshops and cohorts of students in Rio Salado College's Micro Nano Technology degree and certificates.

Understanding and Creating Elastomer Microneedles

Swaroop Sayyaparaju
Rio Salado Community College (Tempe, AZ)

Microscopic Needles, commonly referred to as micro needles, are micron-sized needles that are used to perform a variety of transdermal functions. Due to their microscopic size, micro needles are increasingly being used for their painless yet effective application abilities. Specifically, intraocular and intracochlear delivery of vaccines and medications are emerging as the most popular delivery methods.

There are a multitude of ways to create microneedles, depending on the type and specific function. Although it is not the strongest nor the most effective type, solid polymer microneedles are the most basic variation and are the easiest to design or produce in the lab. The process of creating a polymer microneedle can be split into two parts: creating the silicon master mold in the lab and then adding the polymer material to create the final polymer microneedle. The goal of this project is to outline a specific procedure that details the creation of polymer microneedles. The entire resulting procedure can be distributed in a lab kit to aid with learning about microneedles. The lab kit may also contain the equipment for the second part (polymer curing) of the process so that students can create the polymer microneedle themselves, regardless of location.

Modeling a Micro Pressure Sensor

Kyaw Ya
Ivy Tech Community College

Pressure sensors are used across many different industries from automotive to biomedical. Using the Modeling a Micro Pressure Sensor kit from the Support Center for Microsystems Education (SCME), we explored the basic function of a pressure sensor by building a Wheatstone bridge to test how applied pressure is related to output voltage. Electronic industries are trending towards micro and nano-systems, and by testing how pressure sensors work, we gain insight into how these devices can be used in micro and nano-applications.

Gold@Silver Nanoparticle for Cell Specific Cancer Therapies

Janet Teng
Pasadena City College

Antibody conjugated nanoparticles have a multitude of uses in cancer and infectious disease identification and treatment at the cellular level, including enhanced drug delivery, biomedical imaging, and phototherapy.

We aim to create a gold-silver nanoparticle hybrid so that the best properties of both the gold and silver nanoparticles can be more effective together, treating disease while also allowing gold's inherent properties to limit the negative toxic impacts that silver nanoparticles pose to the human body. Once synthesized, these gold-silver nanoparticle hybrids will then be conjugated to cancer-specific antibodies. While this is an ongoing project, much promise has been shown in the recent breakthroughs that have been found. The avenues of both passive absorption and covalent linkage are both being thoroughly explored to see which will garner the best results in attempting to conjugate, optimize, and link the core-shell nanoparticles to the cancer-specific antibodies. The project will then enter its next phase of employing ultrafast spectroscopy microscopy in the visible and infrared spectrums to capture the dynamics of the energy transfer from nanoparticles to antibodies.

Maskkito Nano Scrubbings Mask

Harrison Warren
Henry Ford College

The Maskitto is an emerging enterprise on wearable technology. In specific our wearable headset mask uses a two-stage process to clean the air the consumer breathes. Nanofiltration capable of removing debris and contaminants coupled with UV-C energy to eliminate even smaller harmful microbes and viruses. The Maskitto is a step into the future. HMI (human integrated Machines) allowing for safer day-to-day interactions for professionals and civilians alike as well as the satisfying ease of mind.

Microneedle Fabrication and Applications

Alfonso Meraz
Pasadena City College

Microneedles are tiny needles designed and used for various applications such as drug delivery, cosmetic care, and microscopy. Research in this field has continued to advance from biomedical engineering and the increasing applications of bio-microelectromechanical systems (Bio-MEMS). Microneedles were initially developed for painless drug delivery systems but have continued to be of particular interest to the medical community because of advancing technologies and new research into their uses. The flexibility of the material used to create microneedles provides them with advantages for specific applications. Materials range from ceramics, polymers, and silicon. In addition to the type of material implemented, there are many different fabrication methods of microneedles.
These fabrication methods using silicon wafers are similar to fabricating sensors and other MEMS devices. In particular, silicon provides an easy-to-use material for etching specific designs of microneedles. There are methods for protruding and etched microneedles on silicon wafers, creating moldings for applying different materials for their specific intended use. The development of the microneedles during this project was successful. We also applied a bio-compatible polymer, PDMS, to our fabricated moldings to demonstrate potential microneedle applications.

Best Practices in Preparing For The CCIC Innovation Challenge In A Virtual World

Kit Cheung
Pasadena City college

The Community College Innovation Challenge (CCIC) aims to encourage community college students to develop both entrepreneurship and stem skills that would help them in their future careers whether it be research, business or other career paths. The goal of the challenge is to use STEM and business strategies to make a difference in the world. CCIC involves a 4-day virtual innovation boot camp that provides students an opportunity for mentoring and coaching in strategic communication and entrepreneurial skills. Students are required to come up with a STEM related innovation and persuade judges to invest in the team and its product using business strategies taught during the bootcamp. In order to best prepare for the CCIC virtually,

through zoom, the background of breast cancer as the most commonly diagnosed cancer, and current nano-based drugs in the market were researched. Also, interviews with persons with knowledge of nanomedicine and nanotechnology were conducted. Besides this, a new innovative therapy in solving breast cancer globally was created and called the NanoBio mAB. This therapy involves a silver core nanoparticle wrapped in gold that augments the effectiveness of monoclonal antibody therapy leading to a more efficient, lower cost, and more accessible cancer therapy treatment for the public. To further support the ideas for the challenge, feasibility of market viability, current research progress, and project goals were researched and emphasized. It is essential to look at various aspects like the market and the innovation itself for better success in the challenge, especially in a virtual setting.

Effects of heavy metal carcinogens in the soil on human health and the effectiveness of phytoremediation using SoCal friendly hyperaccumulators

Kirk Richard Dolar
Pasadena City College

Inductively coupled plasma mass spectrometry and X-ray fluorescence analyses of soils from residential areas near Exide Technologies in Vernon, California has revealed the presence of Group I carcinogenic heavy metals (Pb, As, Cd, Cr, Be, Ni) with concentration levels exceeding EPA regulations and safe limits within the soil. Exide Technologies is an abandoned battery recycling plant designated by the EPA as a superfund site. Phytoremediation using the hyperaccumulators Helianthus annuus and Calystegia Macrostegia were used on soil samples collected from the area surrounding the Exide Technologies facility to safely extract the heavy metal carcinogens. Both Helianthus annuus and Calystegia Macrostegia were potted and cultivated in the soil samples for a total of 20 weeks before an additional ICP-MS analysis was conducted to test the efficacy of each hyperaccumulator. This project aims to survey the effects of heavy metal carcinogens presence in the soil on human health as well as provide a safe and clean remedial solution to extracting the carcinogens from the soil.

Building Virtual World in Second Life for MEMS Education

Andrew Bell
Ivy Tech

Second Life (SL) is a virtual world (VW) that was develop in 2003. The possibility of using virtual reality using Second Life was explored by many colleges for nursing, music, chemistry, biology, health care, geology, art, history, space (NASA), STEM and even engineering. My personal journey started June 15, 2008 as part of my coursework at Stevens Institute of Technology. Then in 2012 Linden Labs, the owners of SL, decided to eliminate the educational discount and many colleges left. The once growing group of educators sought greener less expensive pastures but they left their proverbial footprints in VW. In 2015, educators from Ulster University, UK, published an online article entitled , Engineering Education Island: Teaching Engineering in Virtual Worlds. Then on May 18, 2017 I rediscovered SL and began to formulate the plan to use the Ulster article as a general roadmap to establish an Ivy Tech Engineering Island in 2020.

The Pandemic, new interest and lower cost have brought back the need for rediscovering how educators used SL in the old days. This presentation will describe Ivy Tech Community College use and discovery of the potential for using SL for MEMS and Engineering Education. Ivy Tech Engineering Island was purchased in April, 2020 and has been successfully used in many of the engineering technology courses during the pandemic for student presentation. It is our hope to build a virtual cleanroom so that students that do not have direct access to a cleanroom can develop an understanding of this technology.

Exploring Silicon Dioxide Etch Patterns

Walter Chambers
Rio Salado College

Silicon dioxide is an important material in micro- and nano-technology. In the fabrication of MEMS devices, thin films of silicon dioxide are used as structural and sacrificial layers. It can also be used as a hard mask to protect layers of silicon, and as a diffusion mask to protect materials during implant or diffusion processes. In this research activity, two silicon wafers were wet etched in a solution of hydrofluoric acid, buffered with ammonium hydroxide. Each wafer was added to the solution and etched in specific patterns to explore the relationship between oxide thickness and color due to thin film interference.

Undergraduate Research Experience - Microfabrication of a Pressure Sensor

Irma Vazquez
University of New Mexico

The microfabrication of a Pressure Sensor in a cleanroom provides undergraduate students with a meaningful hands-on technology experience. Students fabricated a micro pressure sensor in UNM's Manufacturing Training and Technology Center (MTTC) cleanroom using surface and bulk micromachining techniques. During this accelerated undergraduate research experience (URE), students were exposed to new career pathways which encourages them to consider the field of micro nano technology. The purpose of fabricating a Pressure Sensor is to show the process and techniques commonly utilized in fabricating microelectromechanical systems (MEMS), including semiconductors, as well as its broad range of applications. After initial cleanroom protocol training, the students individually fabricated the Pressure Sensor with guidance from teaching assistants and professors. A chrome gold and nichrome on silicon nitride membrane pressure sensor with a Wheatstone bridge piezoresistive circuit were completed and characterized. The undergraduate experience was completed with a tour of a microtechnology company (HT Micro) including their cleanroom. Overall, the students gained a robust introduction to microfabrication and its career opportunities.

Micro/Nano Techniques Towards Fabrication of Microneedles and Microfluidic Channels

Pallavi Sharma
University of New Mexico

Microneedles have recently gained researcher‚Äôs attention due to their vast range of applications such as drug and vaccine delivery, derma-therapy and biotherapeutics. During an

Undergraduate Research Experience (URE) summer program, different types of microneedles were designed and fabricated to demonstrate the fabrication processes and methods to the students. The microneedle molds were fabricated using an anisotropic bulk etching process which employs the unique property of potassium hydroxide (KOH) anisotropic etching of silicon which is highly dependent of the different crystallographic planes. The fabrication focused on three types of microneedles: i) cavity-based ii) protruding microneedles and iii) pillar needles. Polydimethylsiloxane (PDMS) was used as a flexible cast for soft lithography of the protruding needles. Surface micromachining methods (i.e., additive manufacturing) were demonstrated for microfluidics channels using the negative photoresist SU8. The project integrates different disciplines such as biology, engineering, and chemistry to promote interest in microsystems. Throughout the experience, challenges were encountered such as under-etching or overdeveloping. Ideating solutions to these challenges throughout the process and completing the devices provided students with an extensive introduction to microsystem technologies.

Making MEMS: A Micro Pressure Sensor Process

Marina Achterman
Pasadena City College

This is a study on various procedures of producing MEMs. This presentation highlights specific assays regarding fabrication processes.

Micro Pressure Sensor: What It Is and How It Is Used

Oneal Douglin
Pasadena City College

What is a Micro Pressure Sensor and how they are used? This poster details the processes used at the University of New Mexico Manufacturing Technology Training Center to fabricate them.