



Michigan
Technological
University

ANNUAL REPORT **FY17**

July 1, 2017

Min Song, ICC Founding Director

Daniel R. Fuhrmann, Co-Director

Promoting research and learning experiences in the areas of cyber-physical systems, cybersecurity, data sciences, human-centered computing, and scalable architectures and systems for the benefit of Michigan Tech and society at large.

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Executive Summary

On July 1, 2015, Michigan Technological University established the Institute of Computing and Cybersystems (ICC). The institute has grown its diverse membership to 50 dedicated faculty members from 12 different schools and departments who function within five specialized centers. Their expertise and willingness to work across traditional boundaries has allowed the institute to surpass its annual funding goal for the second consecutive year with over \$2 million in new funding through 15 new grants. In addition to focusing on research, members have sat on NSF panels, are the editors of top-tier publications, the recipients of NSF CAREER Awards, and have been quoted in highly respected industry periodicals.

ICC members are not only contributing to Michigan Tech's reputation as a premier research university while at conferences around the world, they are also doing it here on campus. Through the Distinguished Lecturer Series members have the opportunity to bring eminent scholars and creative professionals in the field of computing to campus to share innovative research results and future plans. The ICC hosted two NSF program directors and six professors from universities across the country.

The ICC has also secured two generous alumni donations totaling over \$700K, and \$100K per year for the future (period TBD). These donations have allowed the ICC to put their plans for cutting-edge, collaborative research in motion. They are currently being used to support two visiting faculty members for the 2016-2017 academic year, and the search has begun for an

additional three for the 2017-2018 academic year. The funds are also being used to support seed research projects by ICC investigators.

The ICC is in constant pursuit of ways to raise its visibility, and that of its parent organization, the Alliance for Computing, Information, and Automation (ACIA). A few steps the ICC has taken include:

- Sponsoring IEEE INFOCOM 2016 and 2017, a top-ranked conference on computing in the research community.
- Upholding communication with Michigan Tech alumni, friends and active industry partners through bi-annual in-person status reports to a group of Silicon Valley entrepreneurs. The meetings have been the perfect forum to communicate the ICC's progress and future goals and to receive valuable feedback.
- Delivering information, news and events to a larger audience via Facebook, Twitter, and YouTube and at icc.mtu.edu.

In addition to surpassing funding goals, another goal was surpassed in 2016 with a total of 27 (16 full-time) students supported by ICC grants. These students are earning invaluable experience working with faculty in all areas of computing and cybersystems and for multiple funding sponsors including NSF, U.S. Army Research Office, Google, and NIH, among others. Last fall, three graduate students studying with Dr. Philart Jeon won Best Student Paper Award at the Interna-



Dr. Philart Jeon and his students hosted two demos at the 8th International Conference on Automotive User Interfaces and Interactive Vehicular Applications (AutomotiveUI).



tional Conference on Auditory Display (ICAD) for their work on in-vehicle sonically-enhanced gesture control interfaces.

Last fall, Michigan Tech announced its new graduate degree in Cybersecurity. The degree is unique because it offers the opportunity to pursue cross-disciplinary studies in science, engineering, and technology, while combining theory and applied research in the areas of Trusted Software Engineering (TSE), Critical Infrastructure Protection (CIP), and Network Security Management (NSM). The degree itself resulted from a collaboration between the units of the ACIA, specifically members of the ICC from the Computer Science Department, the Electrical and Computer Engineering Department and The School of Technology.

2016-2017 was a busy and productive year for the ICC. The institute thrived as a result of the continued hard work and collaboration of its members and the generosity of its donors. In just two years a winning framework has allowed researchers from an array of computing related fields to work together to secure grants from some of the country's top funding agencies. These members include NSF CAREER Award winners, members of the Army's Young Investigator Program, and keynote speakers at top-tier professional conferences. The Institute has continued to make strides in achieving its goals, brought faculty and students together to discover innovative new ideas and begun fostering interdisciplinary collaborations and developing multidisciplinary proposals. The Institute has strengthened its relationships with funding agencies, industry, alumni, and donors.

Looking forward, the ICC, its leadership, and members will strive to focus on multifaceted and interdisciplinary projects that address regional and national priorities. They will concentrate on harnessing the power of their fellow members, as well as their national and international academic colleagues and industry partners to discover, explore, and execute new ideas and technologies.

MISSION

The mission of the Institute of Computing and Cybersystems (ICC) is to promote research and learning experiences in the areas of cyber-physical systems, cybersecurity, data sciences, human-centered computing, and scalable architectures and systems for the benefit of Michigan Tech and society at large.

OBJECTIVES

- Bring faculty and students across campus together to discover innovative new knowledge in the field of computing
- Foster interdisciplinary collaborations and enable faculty to develop multidisciplinary proposals and conduct impactful research which otherwise would not be possible
- Create a platform for broad sets of national and international collaborations to make valuable contributions to the field
- Promote Alliance for Computing, Information, and Automation (ACIA) external visibility

Accomplishments (FY16 and FY 17)

28 Grants \$5,912,606 in Funding 59 Students Supported

New Research Grants (FY17)

PI: Jeremy Bos, DataS

Title: Imaging Theory and Mitigation in Extreme Turbulence-Induced Anisoplanatism

Sponsor: Air Force Office of Scientific Research: 2016 Young Investigator Program (YIP)

Amount of Support: \$429,886

PI: Yu Cai, CyberS

Title: Developing Hands-on Cybersecurity Curriculum with Real-world Case Analysis

Sponsor: National Security Agency

Amount of Support: \$149,184

PI: Zhuo Feng, SAS

Title: CAREER:Leveraging Heterogeneous Manycore Systems for Scalable Modeling, Simulation and Verification of Nanoscale Integrated Circuits

Sponsor: National Science Foundation

Amount of Support: \$73,618

PI: Timothy Havens, DataS

Title: Heterogeneous Multisensor Buried Target Detection Using Spatiotemporal Feature Learning

Sponsor: U.S. Department of Defense - Army Research Office Funding

Amount of Support: \$95,300

Co-PI: Timothy Schulz, DataS

PI: Tim Havens, DataS

Title: Signal Processing for Active Phased Array Systems with Simultaneous Transmit and Receive Capability

Sponsor: MIT Lincoln Laboratory

Amount of Support: \$15,000

Co-PI: Timothy Schulz, DataS

PI: Tim Havens, DataS

Title: Phase 1-2 Bridge: Multi-static GPR for Explosive Hazards Detection

Sponsor: U.S. Army (subcontract from Akela, Inc.),

Amount of Support: \$83,359

PI: Shiyang Hu, CPS

Title: CAREER: Integrated Research and Education in Physical Design Automation for Nanotechnology and VLSI Co-design

Sponsor: National Science Foundation

Amount of Support: \$118,059

PI: Myoungsoon (Philart) Jeon, HCC

Title: Novel Interaction Design in Electric/Autonomous Vehicles

Sponsor: Hyundai Motors

Amount of Support: \$130,236

PI: Myoungsoon (Philart) Jeon, HCC

Title: Development of the Safety Assessment Technique for Take Over in Automated Vehicles

Sponsor: KATRI (Korea Automotive Testing & Research Institute)

Amount of Support: \$75,721

PI: Myoungsoon (Philart) Jeon, HCC

Title: NRI: Music-Based Interactive Robotic Orchestration for Children with ASD

Sponsor: National Institutes of Health: National Robotics Initiative Program through George Washington University

Amount of Support: \$165,195

PI: Shane Mueller

Title: DARPA's Explainable AI Grant (XAI)

Sponsor: DARPA

Amount of Support: \$70,700

PI: Soner Onder, SAS

Title: REU: XPS: Collaborative Research: Sphinx: Combining Data and Instruction Level Parallelism through Demand Driven Execution of Imperative Programs

Sponsor: National Science Foundation

Amount of Support: \$15,876

PI: Michael Roggemann, DataS

Title: Wave Optics of Deep Atmospheric Turbulence From Underlying Physics Towards Predictive Modeling, Mitigation and Exploring

Sponsor: University of Dayton Research Institute

Amount of Support: \$51,859

PI: Ye "Sarah" Sun, CPS

Title: Understanding and Mitigating Triboelectric Artifacts in Wearable Electronics by Synergic Approaches

Sponsor: National Science Foundation

Amount of Support: \$330,504

Co-PI: Shiyang Hu

PI: Zhenlin Wang, SAS

Title: Effective Sampling-Based Miss Ratio Curves: Theory and Practice

Sponsor: National Science Foundation

Amount of Support: \$390,639

Project Spotlight:

Jeremy Bos Awarded YIP Grant

Jeremy Bos is a 2016 recipient of the Young Investigator Program (YIP) through the Air Force Office of Scientific Research. Bos, an assistant professor of electrical engineering studying atmospheric optics at Michigan Technological University, wants to help the Air Force see better. The problem is turbulence.

Twinkling stars and mirages over hot roads are examples of atmospheric turbulence we see every day; the distortion comes from the way light interacts with shifting air. Sometimes turbulence causes the image to appear blurred. Other times it can be like looking at your reflection in rippling water. Scientists and engineers describe these effects mathematically using what they call blurring functions. When every pixel in an image has the same blurring function, the distortion is said to be "isoplanatic". In this case the image is just blurred. In the case of the rippling water, different parts of the image are distorted differently. In this case it is "anisoplanatic"

"In my work, I'm looking at the case where every single pixel in an image has a different blurring function," Bos says. Bos calls this "extreme anisoplanatism".

Distortion takes many forms: the turbulence in the second logo is ten times greater than the rest but is isoplanatic; the rest of the blurred logos show anisoplanatism shifting from low to high to extreme levels. Distortion takes many forms: the turbulence in the second logo is ten times greater than the rest but is isoplanatic; the rest of the blurred logos show anisoplanatism shifting from low to high to extreme levels.

With his YIP award, a highly competitive program for early career scientists and engineers through the Air Force, Bos is piecing together images affected by anisoplanatism over long distances.

"The objective is to see better and farther," Bos says, adding that imaging isn't the only application; his work will also improve long-range optical communication systems. Yet another application "... defending against threats using laser light."

Whether as a shield around an aircraft or a Star Wars-style laser beam, the technology comes down to manipulating light.

"But in order to do these things, you have to account for the atmosphere," Bos says, "and when you're dealing with anisoplanatism—that's a wicked, hard problem."

The problem is a classic signal-to-noise issue. If the signal is an accurate image, then the distortion caused by turbulence is noise. With enough signal, the image can be recreated: each tipped or tilted pixel in a distorted

image can be put back. Bos likens his work to the inverse of the technology used to stream videos online, "Video encoding technology tries to predict how portions of an image frame change from one frame to another. In my work, I look at many distorted images of the same scene and try and match each pixel to its true location."

He adds that clearing up the noise from turbulence will do more than resolve two-dimensional images. It also provides information about the atmosphere as a three-dimensional space.

"If I can characterize the atmosphere tomographically—like doctors do with CT scans—then I can use other techniques to back out the turbulence," he explains. With this information, Bos says he can "send laser beams farther and data faster."

"Receiving the YIP is a great honor and underscores the importance of basic imaging research in the area of extreme anisoplanatism," Bos says. Daniel Fuhrmann, ICC co-director, and chair of the Department of Electrical and Computer Engineering, says he's delighted but not surprised about Bos' award.

"Jeremy's contributions to the department are key to our long-term strategies for achieving success in research and teaching," Fuhrmann says. "He is already making his presence known at Michigan Tech in significant ways, in both applied optics and robotics."

Mike Roggemann, a professor of electrical engineering at Michigan Tech and Bos' mentor in optical engineering, agrees that Bos' work studying turbulence is crucial.

"The optical effects of ever-present atmospheric turbulence limit the performance of imaging and laser beam projection systems that must work in its presence," Roggemann says. "Even after decades of study, there are still unanswered questions about the underlying statistical nature of the turbulence."

Bos' work in mitigating extreme anisoplanatism will help clear the air.



Source: Michigan Tech News

Focus on Education:

Members Recognized for Excellence in Teaching

Members Nominated for the 2017 Distinguished Teaching Award

Three ICC members are finalists in the 2017 Distinguished Teaching Awards presented by The William G. Jackson Center for Teaching and Learning. Nominees are recognized for their outstanding contributions to the instructional mission of the University. Based on more than 50,000 student ratings of instruction responses, ten finalists have been identified for the 2017 awards. The ICC member finalists in the Associate Professor/Professor Category are Mari Buche (DataS) and Yu Cai (CyberS). Assistant Professor Jeffrey Wall (CyberS) is the finalist from the Assistant Professor/Lecturer/Professor of Practice Category.



Dr. Nilufer Onder delivers a lecture in her undergraduate class, Formal Models of Computation.

Nilufer Onder Recognized for Exceptional Teaching Performance

Nilufer Onder (DataS), has been identified as one of only 91 instructors at Michigan Tech who received an exceptional "Average of 7 dimensions" student evaluation score during fall semester 2016. Nilufer's scores were 4.95 (Excellent Teacher) and 4.71 (Average of 7 dimensions). These are in the top 10% of similarly sized sections across all courses/sections on campus. Only 111 sections university-wide (out of more than 1050 evaluated) were rated this highly by students.

ICC aids in Establishment of MS in Cybersecurity

This fall, Michigan Tech began offering a new M.S. in Cybersecurity degree program, which is led by the Department of Computer Science. Several ICC members were integral in its creation.

The program will attract domestic and international students pursuing cross-disciplinary graduate study in theories combined with the knowledge of science, engineering, and technology that will help advance the workforce in information security.

Media Engagement

Mind Music Machine (tri-M) Lab Featured in the ACM Magazine, Interactions

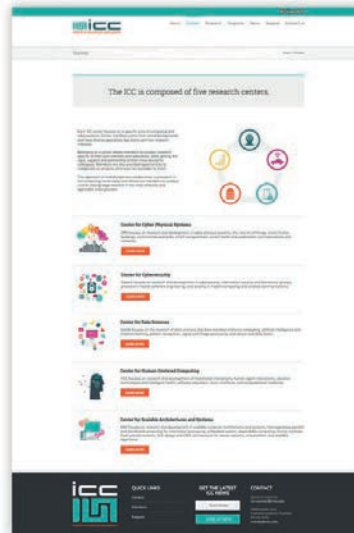
The ACM magazine, Interactions, featured HCC Center Director, Philart Jeon's, Mind Music Machine (tri-M) Lab in January. The Tri-M Lab is a transdisciplinary research group based in the departments of Cognitive and Learning Sciences and Computer Science at Michigan Tech. The research goal of the lab is to understand the mechanisms of the human mind and design better interactions between people and technologies. Researchers utilize various instruments, including computer vision technologies, display wall, digital audio workstation, driving simulators, neurophysiological equipment, and robots.

Keynote Paper Featured on Top Industry Websites

CPS Center Director, Shiyun Hu and collaborators, published a keynote paper in IEEE Transactions on CAD, entitled, "Design Automation of Cyber-Physical Systems: Challenges, Advances, and Opportunities" which was featured in the Michigan Tech News and then as a headline on NSF Science360 and the NSF Computer and Network Systems (CNS) website.

ICC Member Appears in Professional Engineer (PE) Magazine

Chee-Wooi Ten was quoted in an article entitled, *Imminent Danger*, that looks at how cyberthreats that are putting critical infrastructure at risk. The article appeared in the National Society of Professional Engineers March/April 2017 issue of Professional Engineer. The magazine, which is published six times per year, covers news and commentary on professional issues that directly impact professional engineers.



Find Us Online

Through our growing online presence, we strive to engage with students and connect with alumni and fellow researchers and educators. Our website and social media pages continue to be a good source of ICC news and events throughout the year. Our new informational video provides a solid overview of our mission, research and accomplishments. Connect with us through one of the below platforms, or scan the QR code to view the video.



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Focus on Funding:

Donor Support Yields Growth



The ICC was founded on donor support and continues to grow because of generous contributions from alumni and benefactors. Michigan Tech alumnus and philanthropist, Dave House has again shown his support of the ICC's mission this year with the second round of a two-part donation from The House Family Foundation in the amount of \$335K. Last year's gift helped to support the salaries of two visiting faculty members, and this year's donation will support three additional visiting personnel beginning in Fall 2017. These visiting members are expected to conduct impactful research, collaborate with institute members, help create new opportunities for external funding, and generally raise the visibility of the Institute.

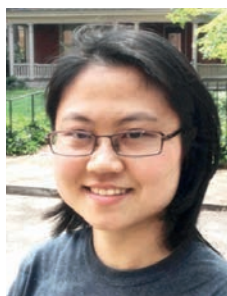
Visiting Professors



Christian Wagner, Center for Data Sciences

Biography: Christian Wagner is an Associate Professor visiting from The University of Nottingham, UK. He has served as the director of digital economy in the Digital Catapult Researcher in Residence Programme in London, UK. He has published more than 80 peer-reviewed articles, including prize-winning papers in international journals and conferences, most recently being awarded runner-up for both the best regular and best student papers at the IEEE International Conference on Fuzzy Systems 2016 in Vancouver, Canada. He has attracted around £1 million as principal investigator and £6 million as co-investigator in the last six years.

Current Research: Since joining the ICC in August of 2016, Christian Wagner has been working with Timothy Havens on the topic of Big Data. They are currently developing an NSF proposal which examines enabling interaction with and control over big data algorithms. Wagner has seven conference publications, three Special Sessions and one tutorial accepted for the 2017 International Conference on Fuzzy Systems. He has submitted three more publications to peer-reviewed journals, and has been invited to speak at three U.S. universities, including Carnegie Mellon. In addition, Wagner has been developing a joint ICC-LUCID/Horizon, open source, browser-based data aggregation platform, similar to JuzzyOnline, but for data fusion. The software is currently being adapted by a Michigan Tech student.



Zhi Zheng, Center for Human-Centered Computing

Biography: Zhi (Jenny) Zheng received her PhD (2016) and M.S. (2013) from Vanderbilt University in Electrical and Computing Engineering. She received her B.S. (2008) in Biomedical Engineering, and her M.S. (2011) in Pattern Recognition and Intelligent Systems from Xidian University. Her broad research interests include Human-Machine Interaction, Social Robotics, and Human-Centered Computing.

Current Research: Since joining the ICC in September 2016, Jenny Zheng has been collaborating with Philart Jeon and working with members in the Mind Music Machine lab on human-machine interaction projects. These include an NIH R01 project on robot-mediated interactions for children with ASD, as well as a robot-mediated STEAM (STEM + Art) education project. Specifically, she developed interaction cue detection methods, such as a facial expression based emotion recognition program and a large range non-invasive gazing tracking method. Zheng is also actively working on grant proposals. As a Co-PI, she has written and submitted an NSF NRI2.0 grant with Jeon and Min Song. Currently, she is working on an NIH grant proposal on sensory fusion in human-machine interaction. She has been mentoring graduate and undergraduate students on these projects and had a few co-authored peer-reviewed papers submitted. In addition, she has two conference workshop proposals submitted with Jeon and other collaborators at Vanderbilt University, Georgia Tech, George Washington University, University of Applied Sciences Ingolstadt, and the University of Salzburg. One has been accepted by Robotics: Science and Systems (RSS 2017), which is a top robotics conference. Zheng will organize a workshop that will be held in July at MIT.

Seed Grant Sparks Research



Michigan Tech alumnus Paul Williams has taken an interest in research and collaboration in the past as a major benefactor of the Paul and Susan Williams Center for Computer Systems Research. Now Williams has shown his support for the ICC's commitment to multidisciplinary research and collaboration by donating \$50k in 2016, and \$100k/yr for the future (period TBD). The Williams funds will be used to fund seed projects by ICC investigators via an internal competitive proposal process.

This year Williams requested that his support go towards robotics and artificial intelligence. Honoring his request, the ICC has awarded Shiyang Hu, Director of the Center for Cyber-Physical Systems, a grant for his proposal entitled, "Establishing Assistive Driving Cyber-Physical System Infrastructure through Leveraging Wearable Robotics and Artificial Intelligence."

Society Leadership

Shiyang Hu (CPS) served as one of the Founding Co-Chairs for the first technical committee related to Cyber-Physical Systems (CPS) across all IEEE societies, the IEEE Technical Committee on Cybernetics for Cyber-Physical Systems. This new technical committee aims at promoting interdisciplinary research and education in the field of CPS.

Shiyang Hu was named editor-in-chief of the Institute of Technology's (IET) new journal on Cyber-Physical Systems: Theory and Application. IET is the largest engineering society in Europe with more than 180,000 members and Hu will lead a team of associate editors who are leading experts worldwide, including several from Carnegie Mellon, Stanford, University of Illinois, National Taiwan University and University of Tokyo.

Shiyang Hu delivered a keynote talk at the Ninth IEEE International Conference on Cyber, Physical and Social Computing (CPSCoM 2016). CPSCoM, sponsored by IEEE Computer Society, is a major CPS technical conference in IEEE and is a premier forum to bring together researchers to present the state-of-the-art research results and exchange ideas in the area of CPS. In the ninth year of the successful CPSCoM conference series, the organizing committee invited three world-leading CPS experts to deliver the keynote speeches. Hu delivered the talk entitled "Smart Energy Cyber-Physical System Security: Threat Analysis and Defense Technologies."

Min Song (CyberS) has been appointed the Institute of Electrical and Electronics Engineers (IEEE) Communications Society Director of Conference Operations for 2016-2017. The IEEE Communications Society promotes the advancement of science, technology and applications in communications and related disciplines. It fosters presentation and exchange of information among its members and the technical community throughout the world. The Society maintains the highest standard of professionalism and technical competency.

Additional Leadership

Bo Chen

Associate Editor, IEEE Transactions on Intelligent Transportation Systems

Timothy Havens

Associate Editor, IEEE Transactions on Fuzzy Systems
General Chair – FUZZ-IEEE 2019

Shiyang Hu

EiC, IET Cyber-Physical Systems: Theory & Application
Associate Editor, IEEE Trans. on CAD
Associate Editor, IEEE Trans. on Industrial Informatics
Guest Editor, IEEE Trans. on Computers
Guest Editor, IEEE Trans. on Big Data

Chee-Wooi Ten

Editor, IEEE Transactions on Smart Grid
Editor, Elsevier Journal Sustainable Energy, Grids and Networks (SEGAN)

Min Song

Member, INFOCOM Standing Committee
TPC Vice-Chair, GLOBECOM 2015
General Chair, INFOCOM 2016
EiC, EAI Transactions on Wireless Spectrum
Editor, Journal of Computer Networks

Myounghoon (Philart) Jeon

Associate Editor, MIT Presence: Teleoperations and Virtual Environments
Guest Editor, MIT Journal Presence Special Issues on "Arts, Aesthetics, and Performance in VR and Telepresence"

Keith Vertanen

Associate Editor, International Journal of Human Computer Studies
Associate Chair, IUI 2015, MobileHCI 2014
Associate Chair for CHI 2017

Awards

Graduate Students: Jason Sterkenburg, Steven Landry and Joshua Johnson

Advisor: Philart Jeon

Award: Best Student Paper Award Received at the International Conference on Auditory Display (ICAD)

Paper Title: Towards an In-Vehicle Sonically-Enhanced Gesture Control Interface: A Pilot Study

Graduate Student: Hanieh Deilamsalehy

Advisor: Timothy Havens

Award: PhD Finishing Fellowship, Summer 2017

Undergraduate Student: Brian Flanagan

Advisor: Timothy Havens

Award: 2nd Place, Undergraduate Research Expo 2017 for, "The Effects of Uncertain Labels on Damage Assessment in Remotely Sensed Images"

Researcher: Shiyun Hu, SAS

Award: ACM Distinguished Speaker

ACM is the world's largest educational and scientific computing society with nearly 40 special interest groups (SIGs) which all together share an ACM Distinguished Speaker Program. The program recognizes a very small group of leading experts across all disciplines within ACM and sponsors them for their distinguished lectures worldwide.

Researcher: Philart Jeon, HCC

Award: Best Paper Award at the International Conference on Auditory Display (ICAD)

Paper Title: Aesthetic Computing for Representation of the Computing Process and Expansion of Perceptual Dimensions: Cases for Art, Education and Interfaces

Researcher: Scott Kuhl

Award: The Michigan Tech Century II Endowed Equipment Fund (C2E2)

Scott Kuhl received the C2E2 award in the amount of \$1,600. The award will help Scott purchase affordable head-mounted displays (HMDs) to support research, education, and outreach.

ICC 2017 Achievement Awards

This year the ICC presented the ICC Achievement Award to two researchers for their outstanding research and honorable contributions to the institute in 2017. Zhuo Feng from the Center for Scalable Architectures and Systems (SAS) and Shane Mueller from the Center for Human-Centered Computing (HCC) were this year's recipients.



Zhuo Feng is Associate Professor in the Department of Electrical and Computer Engineering. He has received funding with a total of \$1.1 million as the sole PI from NSF on three separate grants. His publications include 16 journal papers (14 IEEE/ACM Transactions) and 34 ACM/IEEE conference papers. He received a Faculty Early Career Development (CAREER) Award from the National Science Foundation (NSF) in 2014, a Best Paper Award from ACM/IEEE Design Automation Conference (DAC) in 2013, and two Best Paper Award Nominations from IEEE/ACM International Conference on Computer-Aided Design (ICCAD) in 2006 and 2008.



Shane Mueller is Associate Professor in the Department of Cognitive and Learning Sciences and has an expertise in Cognitive and Computational Modeling. He has been recently awarded DARPA's Explainable AI Grant to develop naturalistic theories of explanation with AI systems and a computational cognitive model of explanatory reasoning. In addition to this effort, he has served as Co-PI on several proposals in collaboration with other HCC members from KIP, CS, and Math departments. He has continuously published his works in top journals and conferences, such as IEEE and Cognitive Modeling Communities and organized several conferences. Other significant achievements include developing PEBL: The Free Psychology Experiment Building Language for HCI and Psychology Researchers, which is widely used across the world.

Zhaohui Wang wins NSF CAREER Award

Node by node, engineer Zhaohui Wang has a plan for improving underwater acoustics networks to maximize information delivery.

From monitoring whale populations to tactical surveillance, underwater acoustic communication networks are handy systems to have in place. But their greatest feature—being underwater—is also their greatest challenge. With a prestigious CAREER Award from the National Science Foundation (NSF), Wang, an assistant professor of electrical and computer engineering, sets sail with a solution.

Underwater Acoustic Communication

A major challenge in any communication system is getting a signal from a transmitting node to a receiving node. It's like a technical version of the game Telephone, but instead of laughable mistakes, valuable information can be lost.

"For communications, what really matters is the signal power to noise power ratio," Wang says, explaining that maximizing the ratio underwater depends on other two factors.

First, bodies of water are not serene or static; they're landscapes rich with sound. The ambient soundscapes of the ocean floor or Lake Superior or even small inland lakes are full of background noise, which can both interfere with an acoustic signal or a signal can interfere with natural sound, such as whale whistles. Also, underwater environments change seasonally, daily or even hourly, which can also alter a signal's strength by the time it reaches the receiver.

Wang's goal is to not only improve node-to-node communication but create an adaptive network that learns its underwater environment.

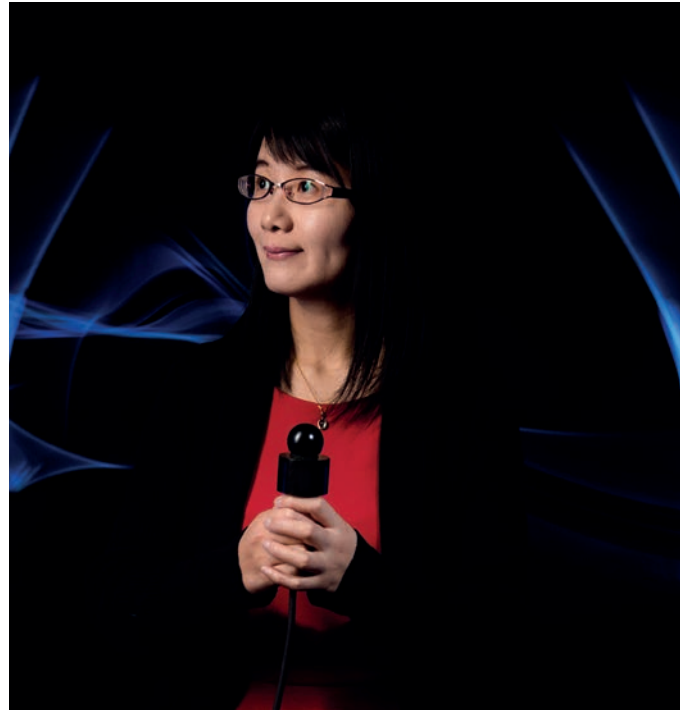
Underwater Learning

The problem Wang points out is that she can't sit in her office and constantly monitor subtle changes in ice cover or animals moving close to a node.

"The environment changes and we typically do not know how it changes; we cannot see what happens from afar," Wang says. "So, we have to be able to let the underwater system learn such dynamics."

The key to building such a network is using techniques like passive listening—hydrophones that detect changes in the soundscape—along with active probing—using the signal itself to assess the sound transmission loss between nodes. Then using machine learning principles—repeatedly running data through the system—will help Wang model, understand and even predict underwater dynamics in real time. Doing so helps design adaptive

and eco-friendly acoustic communication and networking strategies.



Under Ice Communication

Guy Meadows, the director of the Great Lakes Research Center where Wang runs her experimental work, says underwater communication is critical to keep tabs on equipment, especially under ice.

Zhaohui Wang won an NSF CAREER Award to study underwater communication networks.

"The Great Lakes Research Center has several needs to remotely communicate with sensors during the icy months in the Great Lakes where long cables strung from shore are not feasible," Meadows says. "Wang is solving this problem."

Dan Fuhrmann, the chair of the Department of Electrical and Computer Engineering, recalls the first time Wang went out for an under-ice test; she asked Fuhrmann what he knew about drilling holes in the ice and he asked what she knew about ice fishing. Despite not even knowing the northwoods sport existed, Wang was out on the ice a week later drilling holes, which Fuhrmann considers a testament to her dedication.

"Her research activity is quite remarkable," Fuhrmann says. "In this proposal, Wang describes an ambitious plan to bring state-of-the-art tools in signal processing and machine learning to the difficult problem of underwater acoustic communication."

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Events

NSF Proposal Writing Panel

On April 22 the ICC hosted an NSF Proposal Writing Panel Discussion. The panel included Michigan Tech faculty who have sat on NSF panels and have insight on writing an NSF proposal. The panel consisted of the following ICC members: Laura Brown (DataS), Nina Mahmoudian (CPS), Soner Onder (SAS), Chee-Wooi Ten (CPS) and Xinli Wang (CyberS). Durdu Guney, from Michigan Tech's Department of Electrical and Computer Engineering was a guest panelist.



Scott Kuhl (HCC) hosts a Virtual & Augmented Reality Demo during World Usability Day 2017.

World Usability Day 2016

The Center for Human-Centered Computing hosted World Usability Day at Michigan Tech on November 10, 2016. Across campus researchers who "design with humans in mind" showcased their work to the community through a series of demos, lectures and tours. On World Usability Day those who are working to ensure that "services and products important to life are easier to access and simpler to use" gather around the world. It's a chance for advocates, students, professionals, government officials and leaders to showcase their work, exchange information, and share critical feedback.

First Annual ICC Retreat

The first annual ICC Retreat was held on April 21. ICC members and Michigan Tech administration gathered to hear a progress update and announce the ICC 2017 Achievement Award recipients.

Select Conference Activities

Jeremy Bos (DataS) is the chair for Laser Propagation in Atmospheres and Oceans a conference held at SPIE Optics and Photonics.

Philart Jeon (HCC) attended ArtsIT 2016 Conference at Aalborg University, Denmark and received the Best Paper Award.

Min Song (CyberS) attended the IEEE Communication Society Board of Governors meeting at Kuala Lumpur, Malaysia. The meeting was held in conjunction with IEEE International Conference on Communications.

Min Song (CyberS) attended IEEE INFOCOM 2016 in San Francisco in early April. Min acted as General Chair of the conference.

Shiyan Hu (CPS) attended IEEE INFOCOM 2016 and led a workshop entitled, "Cross-Layer Cyber-Physical Systems Security (CPSS)".

Saeid Nooshabadi (SAS) delivered a tutorial at NEWCAS 2016 conference in Vancouver, BC on "Development of Massively-Parallel Multimedia Algorithms and Applications in the Integrated Multi-Core/GPU Platform".

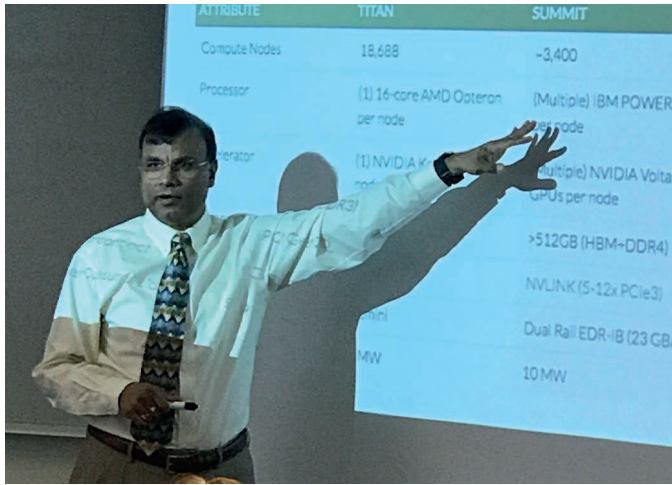
Soner Onder (SAS) served on International Symposium on Computer Architecture (ISCA2016) Program Committee.

Keith Vertanen (HCC) held a workshop at the ACM Conference on Human Factors in Computing Systems (CHI 2016). The workshop was titled "Inviscid Text Entry and Beyond".

Philart Jeon (HCC) and his students attended the 8th International Conference on Automotive User Interfaces and Interactive Vehicular Applications (AutomotiveUI). They hosted a tutorial on "In-vehicle auditory interactions: Design and Application of Auditory Displays, Speech, Sonification and Music." Jeon and international collaborators hosted a workshop on "Ethically Inspired User Interfaces for Decision Making in Automated Driving." They also hosted two demos at the conference.

Distinguished Lecturer Series

The ICC brings the most eminent scholars and creative professionals in the field of computing to the campus to exchange state-of-the-art research results and discuss future research directions.



Dr. Kaylan Perumalla presents at the ICC Spring Distinguished Lecturer Series.

September 2016 - **Keith Marzullo**, Dean of the College of Information Studies (iSchool) at The University of Maryland, Former White House Office of Science and Technology Policy Director of Networking and Information Technology Research and Development (NITRD) Program, Former NSF Division Director for the Computer and Network Systems (CNS) Division in the Computer and Information Science and Engineering (CISE) Directorate presented, "The Center of the Big Bang."

October 2016 - **Kamau Bobb**, NSF Program Officer, Computer & Information Science & Engineering, presented, "CS for All: Considering the Implications of 'for All'."

October 2016 - **David Pan**, Professor of ECE at The University of Texas at Austin, presented, "Bridging IC Design & Technology Gaps for Future Integrated Systems."

December 2016, **Zhiru Zhang**, Assistant Professor, School of Electrical and Computer Engineering at Cornell University, presented, "Enabling Software-Defined Reconfigurable Computing."

March 2017, **Matt W. Mutka**, Professor and Chairperson, Computer Science and Engineering, Michigan State University, presented, "Indoor Positioning via Mobile Sensing."

April 2017, **Kalyan S. Perumalla**, Distinguished R&D Staff Member, Group Leader, Oak Ridge National Laboratory, presented, "Effective Exascale Computing using Computational Cloning."

Seminar Series

The ICC invites notable faculty members from Michigan Tech and beyond to share their research with the computing community.

September 2016 - **Christian Wagner**, ICC Visiting Professor, presented, "Capture Analysis and Interpretation of Uncertain Data."

October 2016 - **Hyungchul Yoon**, Assistant Professor, Civil & Environmental Engineering, presented, "Enabling Smart City Resilience: Post-Disaster Response and Structural Health Monitoring."

November 2016 - **Zhi (Jenny) Zheng**, ICC Visiting Research Assistant Professor, presented, "Socially Assistive Robotics for Young Children with Autism Spectrum Disorder: Novel Platforms for Early Detection and Intervention."

November 2016, **Tim Wilkin**, Deakin University, Senior Lecturer and Computer Science Course Director, School of Information Technology, presented, "Recent Developments in Robust Averaging Methods for Data Science."

March 2017, **Zhuo Feng**, Associate Professor, Electrical and Computer Engineering, presented, "Scalable Spectral Sparsification of Graph Laplacians, Integrated-Circuits and Data Networks."

April 2017, **Hairong Wei**, Associate Professor, School of Forest Resources and Environmental Science, Department of Computer Science (Adjunct), Department of Mathematics (Adjunct), presented, "Computational Algorithms for Discovering Novel Biological Knowledge from Big Gene Expression Data."

April 2017, **Zhaohui Wang**, Assistant Professor, Electrical and Computer Engineering, presented, "Signal Processing and Machine Learning for Underwater Acoustic Communication Networks."



Zhaohui Wang presents at the ICC Spring Seminar Series.

Member Spotlight:

Myounghoon (Philart) Jeon



Myounghoon (Philart) Jeon, Director of the Center for Human-Centered Computing, has again proved to be a major asset to the ICC through his exemplary achievements in research, collaboration, and outreach.

As an Associate Professor in the Department of Cognitive and Learning Sciences and the Department of Computer Science and director of the Mind Music Machine (tri-M) Lab, his research areas encompass Human-Computer Interaction (HCI), Human-Robot Interaction (HRI), Auditory Displays, Affective Computing, Assistive Technologies, Aesthetic Computing, and Automotive Interface Design.

Jeon has strong industry relations, partnering with Toyota, Hyundai-Kia Motors, Equos Research, Panasonic Automotive, as well as, diverse governmental support,

including Department of Transportation, Federal Railroad Administration, and Korea Automobile Testing & Research Institute (KATRI) on in-vehicle sound technology. The results of his research, conducted in the Mind Music Machine (Tri-M) Lab, could help drivers pay better attention, regulate their emotions while driving, and drive their cars in a more eco-friendly manner with both manual and automatic vehicles.

Another research area that Jeon focuses on is music-based interactive robotic orchestration for children with Autistic Spectrum Disorder (ASD). A National Institutes of Health grant through George Washington University has allowed Jeon and his students to develop a facial detection system and sonification robots.

Jeon's outreach efforts are also notable. In a project with a local elementary school, he used theatre to introduce children to robotics and computing. His graduate students assisted in directing a play which starred children from Dollar Bay Elementary School's after-school program and six robots from the Mind Music Machine Lab. The program helped the young students gain exposure to technology and the arts.

Add all of that to a recently published handbook, a Best Paper Award from 5th International Conference on Arts and Technology (ArtsIT2016), and a feature ACM Magazine, Interactions and Jeon proves to be an outstanding member of the ICC who embodies the mission and spirit of the institute.

"Zhaohui Wang" continued from page 13

Mentoring and SOAR

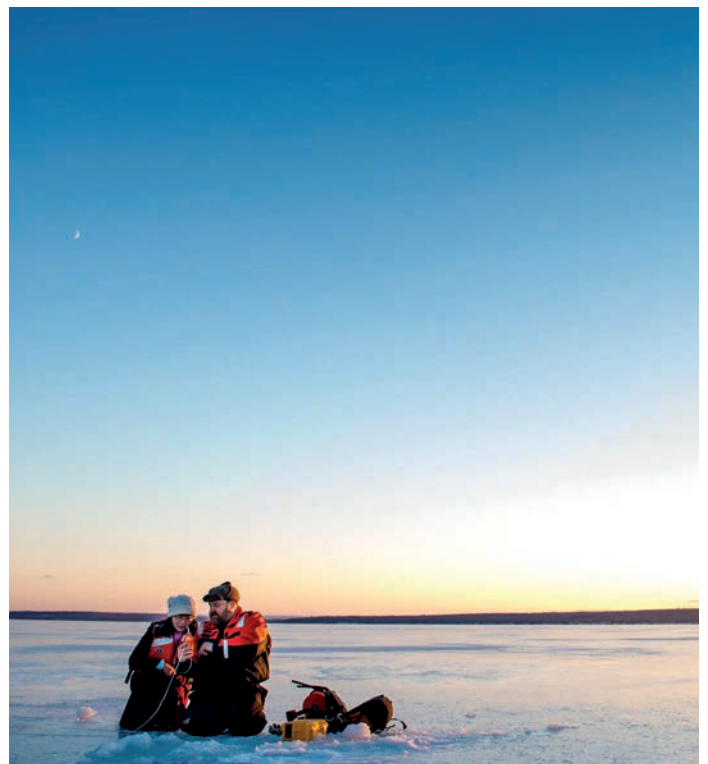
Wang points out that building communication networks comes down to connecting people. As an extension of that, teaching and outreach are a natural part of Wang's work and vital to propagating not just sound waves but future research.

Wang already works with students at local festivals and summer youth programs. Wang will also mentor local students through the Student Organization for Aquatic Robotics (SOAR) at Dollar Bay High School and the undergraduates who work in her lab.

"We want to encourage more female students and, especially in our area, economically disadvantaged students to pursue STEM fields," Wang says. "And for our undergraduate students, we want them to get their feet wet, so they can pursue industry work or continue on to graduate school."

Of course, in Wang's underwater acoustics lab, students really do have a good chance of getting wet feet.

Source: Michigan Tech News



Financial Reporting

ICC Year Two (July 2016 - June 2017) Performance

Research Activities	Year 2 Goals	Year 2 Results
New Research Awards	1.9M	2.195M
Research Expenditures	1.7M	\$1.5M
Number of New Research Awards Received	7	15
Number of Proposals Submitted	37	56
External Visibility	Year 2 Goals	Year 2 Results
Conferences/Workshops Organized	5	8
DLS Talks Organized	10	6 DLS + 9 Seminars
Demos Organized	3	3
Publications	110	118 (as recorded in Digital Measures)
Leadership Roles in Technical Committees, Journal Editors and Conference Chairs	10	24
Keynote Talks	1	1
Invited Talks	4	9
Students Supported	18	27 (16 full-time)

ICC 5-Year Plan

Research Activities	Year 1	Year 2	Year 3	Year 4	Year 5	Total
New Research Awards	1.6M	1.9M	2.2M	2.5M	2.8M	11.0M
Research Expenditures	1.6M	1.7M	1.9M	2.2M	2.6M	10.0M
Number of New Research Awards Received	6	7	8	9	10	40
Number of Proposals Submitted	35	37	40	43	47	202
External Visibility	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Conferences/Workshops Organized	4	5	6	7	8	30
DLS Talks Organized	8	10	12	14	16	60
Demos Organized	2	3	4	5	6	20
Publications	100	110	120	130	140	600
Leadership Roles in Technical Committees, Journal Editors and Conference Chairs	6	10	12	15	20	52
Keynote Talks	1	1	1	1	1	5
Invited Talks	4	4	4	5	5	22
Students Supported	15	18	21	24	27	105

Student Spotlight:

S. Maryam (Shabnam) FakhrHosseini



A large percentage of traffic fatalities are caused each year by aggressive driving. S. Maryam (Shabnam) FakhrHosseini is trying to change that. She is collecting data to measure and model the emotions of drivers in order to help her understand the effectiveness of her methods of mitigating the negative effects of

emotion on driving performance. She is experimenting with using music to do that. She will report her findings in her dissertation defense this summer entitled, "Designing an In-Vehicle Auditory Display for Angry Drivers: Perspective on Assessing Emotion".

Shabnam is a student in the Applied Cognitive Science and Human Factors Doctoral Program. She is ICC supported through a grant with Dr. Philart Jeon, Director of the Center for Human-Centered Computing (HCC). She has also contributed to research projects for Hyundai Motors Co. and the National Institutes of Health. She has co-authored over fifteen publications in just four years at Michigan Tech.

Beyond her excellent record of research, Shabnam is an active member in the community. She lead the "Child-Robot Theater Afterschool Program" at Dollar Bay Elementary School. She is also an Undergraduate Mentor, was an instructor in Human-Robot Interaction Study Club, as well as in the Summer Youth Programs, "Women in Engineering" & "Engineering in Scholar".

Shabnam embodies the ICC mission, citing collaboration as an inspiration to pursue human factors research. "In these four years of the PhD program in Michigan Tech I have had wonderful experiences in my personal and academic life. In the Mind Music Machine lab, we always have so many interesting projects and students from different fields. I have had the opportunity to collaborate with engineers, designers, developers, and psychologists, novice or experienced, and led many projects on road users' safety, assistive technology, and human-robot interaction...Collaboration across such disparate fields is really inspiring to me."

Shabnam is actively looking for a position where she can apply her knowledge and experience to improve systems and facilitate human-system interactions.

IRAD and Seed Fund Usage

Each center received a \$15K Start-Up package in addition to receiving 15% of their IRAD funds. Center directors and members decide how to use the funds to promote their center's strategic development and members' growth. Last year, centers used their funds to support students, to provide travel funds to visiting professors and students, support scholarly visits to Michigan Tech, to purchase lab equipment, including two 12-core workstations for the Computer System Lab, and to develop new research projects.

Research Projects in Development

PI: Tim Havens

Title: Big Data Analysis of Driving Data

Plausible Sponsor: Automotive Sector

PI: Timothy Havens, Timothy Schulz

Title: Coherent Sensing from Networks of UAVs

Plausible Sponsor: US Army, US Office of Naval Research

PI: Hyungchul Yoon, Co-PI: Myounghoon Jeon

Title: Collaborative Research: Improving Undergraduate Education in Civil Engineering through Interactive Cyber-Physical System Tools - Bringing Real World Problems to Classrooms

Plausible Sponsor: National Science Foundation (NSF)

PI: Kevin Trewartha, **Co-PI:** Myounghoon Jeon

Title: The Impact of Mild Cognitive Impairment and Alzheimer's Disease on Short- and Long-term Memory Processes Underlying Motor Learning

Plausible Sponsor: Alzheimer's Association Research Grant (AARG)

PI: Kevin Trewartha, **Co-PI:** Myounghoon Jeon, Min Wang

Title: Aging and the Neurocognitive Mechanisms Underlying Corrective Movements for Obstacle Avoidance in Dynamic Environments

Plausible Sponsor: National Institutes of Health (NIH)

PI: Tejin Yoon, **Co-PI:** Shane Mueller, Yeonwoo Rho

Title: Effects of stress and fatigue in men and women across the lifespan

Plausible Sponsor: National Institutes of Health (NIH)

PI: Benjamin Ong

Title: Data Science Enterprise

Plausible Sponsor: National Science Foundation (NSF)

PI: Keith Vertanen **Co-PI:** Scott Kuhl, Myounghoon Jeon

Title: CHS: Small: Efficient Text Entry in Virtual and Augmented Reality

Plausible Sponsor: National Science Foundation (NSF)

2016-2017 Select Publications

Center for Cyber-Physical Systems

Aghdaei, Ali, and Seyed A. Reza Zekavat. "Novel low-latency, high-resolution and low-cost time synchronisation." *IET Wireless Sensor Systems* (2017).

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Hembroff, Guy, and Marcos Almeida Matos. "Bridging the Technology Gap in Health Care: Developing a Model to Better Help Those Who Help Others." *Brazilian Journal of Medicine and Human Health* 4.4 (2016).

He, Shuibing, Yuanhua Yang, Xianbin Xu, and Xiaohua Xu. "MGPA: a multi-granularity space preallocation algorithm for object-based storage devices." *International Journal of Embedded Systems* 8.2-3 (2016): 237-248.

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Wang, Zhaohui, Xiaohua Xu, and Chaofeng Wang. "Multi-flow scheduling in multi-hop underwater acoustic networks." OCEANS 2016-Shanghai. IEEE, 2016.

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ICC Directory

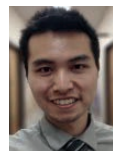
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