Annual Report FY20
INSTITUTE OF COMPUTING AND CYBERSYSTEMS

Center for Cyber-Physical Systems
Center for Scalable Architectures and Systems
Center for Cybersecurity
Center for Human-Centered Computing
Center for Data Sciences
The mission of the ACIA is to create a scholarly environment for teaching and research in computing, information, and automation that is a reflection of contemporary technological innovation in industry and society at large.
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The mission of the ICC is to promote research and learning experiences in the areas of mobile computing, cybersecurity, cyber-physical systems, cyber-human systems, and computer systems for the benefit of Michigan Tech and society at large.

FY20 Executive Summary

University Centers and Institutes

ICC Organization

7K.H. & LRQHRIPRUHK DQSHVHDU & EWLQJ LQ DQSHVHDU
& FRPSULWHVVHUHVHDFK & HODGHUVDPROJWHK HVLQJ
& HQWQHUQDQG, QVWLWHVHDWLOHRQWLQJ
DUHQLQWHDQG, QVWLWHVHDWLOHRQWLQJ

ICC Membership

JURXS7RQHFXUDJH WKH VHFRQWLQJ
HQQHDYRUVW KHQLY VHULVLSURQGLQHWRQWLQJ
LQFQGXLQJLQFUUVH*WHQXWLRQVWRQWLQJ
RYHUKHSHDFHVWROPLHVLQJ
SURSRVENDORSSURWUXQLWHDQGVVWLQJ
WRKHRIFRIWHK H9L FH3UHV GLQHWRQWLQJ
8QLY HVULW VSSRUW KHQLY HVULW

The Michigan Tech Strategic Plan

The work of the ICC embodies in particular Goal 3 of the University's strategic plan, "Research, scholarship, entrepreneurship, innovation, and creative work that promotes a sustainable, just, and prosperous world."

Further, President Rick Koubek's "Tech Forward" vision, which aims to position Michigan Tech as an internationally recognized academic thought leader in the Fourth Industrial Revolution, is fully embraced by the ICC and its membership. In fact, the 2014 proposal to create the ICC articulates as its vision the need to prepare for and respond to such a revolution.

Active Awards and Expenditures

ICC active grants and contracts number 46, with awards totaling $9.9M, an increase of 11% over FY19 year-end numbers. FY20 research expenditures exceed $2.1 million.

Proposal Activity

In FY20, ICC researchers submitted 25 proposals totaling $9.4 million. 22 proposals were new projects. 28% of all FY20 proposals were awarded.

Scholarship and Service

From the Editor

This report highlights the activities of the Institute of Cybersystems and Cybersecurity (ICC) for the period July 1, 2019, to June 30, 2020. The data and information in this report were gathered from a number of sources. Every effort has been made to ensure the accuracy of this document. This report was prepared by Karen S. Johnson, for the period July 1, 2019, to June 30, 2020. As of Sept. 25, 2020.

University Centers and Institutes

7K.H. & LRQHRIPRUHK DQSHVHDU & EWLQJ LQ DQSHVHDU
& FRPSULWHVVHUHYHDFK & HODGHUVDPROJWHK HVLQJ
& HQWQHUQDQG, QVWLWHVHDWLOHRQWLQJ
DUHQLQWHDQG, QVWLWHVHDWLOHRQWLQJ

JURXS7RQHFXUDJH WKH VHFRQWLQJ
HQQHDYRUVW KHQLY VHULVLSURQGLQHWRQWLQJ
LQFQGXLQJLQFUUVH*WHQXWLRQVWRQWLQJ
RYHUKHSHDFHVWROPLHVLQJ
SURSRVENDORSSURWUXQLWHDQGVVWLQJ
WRKHRIFRIWHK H9L FH3UHV GLQHWRQWLQJ
8QLY HVULW VSSRUWEKHQLYHVULW

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ICC by the Numbers

46 Active Grants
$9.9M

$2.1M Research Expenditures

30 New in FY20 Grants
$3.5M

<table>
<thead>
<tr>
<th>Research Activities</th>
<th>FY16 Results</th>
<th>FY17 Results</th>
<th>FY18 Results</th>
<th>FY19 Results</th>
<th>FY20 Goal</th>
<th>FY20 Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Research Awards</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.8M</td>
<td>3.5M</td>
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<tr>
<td>Research Expenditures</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.6M</td>
<td>2.1M</td>
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<tr>
<td>No. of New Research Awards</td>
<td>17</td>
<td>21</td>
<td>10</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Proposals Submitted</td>
<td>21</td>
<td>47</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FY20 ICC Awards And Expenditures

<table>
<thead>
<tr>
<th></th>
<th>FY16</th>
<th>FY17</th>
<th>FY18</th>
<th>FY19</th>
<th>FY20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awards</td>
<td>$2,493,459</td>
<td>$1,798,494</td>
<td>$2,897,137</td>
<td>$2,431,192</td>
<td>$3,467,792</td>
</tr>
<tr>
<td>Expenditures</td>
<td>$1,257,693</td>
<td>$1,508,400</td>
<td>$1,879,387</td>
<td>$2,025,936</td>
<td>$2,108,726</td>
</tr>
</tbody>
</table>
ICC OBJECTIVE 1: BRING FACULTY AND STUDENTS TOGETHER TO DISCOVER INNOVATIVE AND NEW KNOWLEDGE IN THE FIELD OF COMPUTING.
Active Grants and Contracts

Active ICC grants and contracts number 46, with total awards of $9,873,964

PI: GLEN ARCHER, AFFILIATED, ECE
Title: Collaborative Research: ACI-CDS&E: Highly Parallel Algorithms and Architectures for Convex Optimization for Realtime Embedded Systems (CORES) 6SRQVRU16)
$PRXQW_’XUDWLQR_<HDUV
PI: JEREMY BOS, DATAS, ECE
Title: Robust Terrain Identification and Path Planning for Autonomous Ground Vehicles in Unstructured Environments (Request for continuation in Year 2) & R3,V'DUUHO5RELQHWWH0(0 6SRQVRU8QLYR10,86'2' $PRXQW_’XUDWLQR_<HDUV
Title: Imaging Theory and Mitigation in Extreme Turbulence-Induced Anisoplanatism 6SRQVRU86'2' $PRXQW_’XUDWLQR_<HDUV
PI: YU CAI, CEC, CYBERS, CMH
Title: GenCyber Teacher Camp at Michigan Tech & R3,V%&R&K&HQ&6&'EHU66&' (& & 6L79PDQ:DIQHU&' 6SRQVRU86'2' $PRXQW_’XUDWLQR_<HDUV
Title: Interactive GenCyber Learning Experience for High School Students Through Storytelling + Teaching + Gaming + Doing &R3,V%&R&K&HQ&6&'EHU66&' (& & 6X:+HPEURII&'EHU66R7 6SRQVRU86'2' $PRXQW_’XUDWLQR_<HDUV
Title: The Development and Assessment of Advanced Cybersecurity Curriculum & R3,V,HGPRQ+XQ)ZH&'(& 6SRQVRU86'2' $PRXQW_’XUDWLQR_<HDUV
PI: BO CHEN-CS, CYBERS, CEC, CS
Title: SaTC: CORE: Small: Collaborative: Hardware-Assisted Plausibly Deniable System for Mobile Devices 6SRQVRU16)
$PRXQW_’XUDWLQR_<HDUV
Title: EAGER: Enabling Secure Data Recovery for Mobile Devices against Malicious Attacks 6SRQVRU16)
$PRXQW_’XUDWLQR_<HDUV
Title: SHF: Small: Spectral Reduction of Large Graphs and Circuit Networks 6SRQVRU16)
$PRXQW_’XUDWLQR_<HDUV
Title: SHF: Small: Scalable Spectral Sparsification of Graph Laplacians and Integrated Circuits 6SRQVRU16)
$PRXQW_’XUDWLQR_<HDUV
Title: CAREER: Leveraging Heterogeneous Manycore Systems for Scalable Modeling Simulation and Verification of Nanoscale Integrated Circuits 6SRQVRU16)
$PRXQW_’XUDWLQR_<HDUV
PI: TIMOTHY HAVENS, DATAS, ECE
Title: NPT-03|04: Localization Tracking and Classification of On-Ice Underwater Noise Sources Using Machine Learning & R3,V$QGUHZ%DUQDUG*/0(0 6SRQVRU86'2' $PRXQW_’XUDWLQR_<HDUV
Title: Duty Cycle Aggregation and Warranty Mitigation using Customer Usage Data 6SRQVRU16)
$PRXQW_’XUDWLQR_<HDUV
Title: Algorithms for Look-Down Infrared Target Exploitation 6SRQVRU6LJQDWXUH5HVHDUFK,-Q86' $PRXQW_’XUDWLQR_<HDUV
PI: GUY HEMBROFF, CYBERS, CMH
Title: Cybersecurity Course for Career Technical Education (CTE) Program 6SRQVRU& & .6' $PRXQW_’XUDWLQR_<HDUV
Title: Senior Design: Research and Development of an Automated Risk Tiered Asset Inventory System & R3,5LFN%HUNH13&0 6SRQVRU0QXQRQHCG&'WU $PRXQW_’XUDWLQR_<HDUV
PI: JEAN MAYO, CYBERS, CEC, CS
Title: DARPA XAI 6SRQVRU)$,CVW+0&86'2' $PRXQW_’XUDWLQR_<HDUV
Title: Machine Vision Trailering 6SRQVRU)$,CVW+0&86'2' $PRXQW_’XUDWLQR_<HDUV
Title: Machine Learning for Human-Based Visual Detection Metrics 6SRQVRU6LJQDWXUH5HVHDUFK $PRXQW_’XUDWLQR_<HDUV
PI: SAEID NOOSHABADI, AFFILIATED, ECE
Title: Machine Vision Trailering 6SRQVRU)$,CVW+0&86'2' $PRXQW_’XUDWLQR_<HDUV

Active

**ICC OBJECTIVE 2:** FOSTER INTERDISCIPLINARY COLLABORATIONS AND ENABLE FACULTY TO DEVELOP MULTI-DISCIPLINARY PROPOSALS AND CONDUCT IMPACTFUL RESEARCH WHICH OTHERWISE MAY NOT BE POSSIBLE.

**PI: SONER ONDER, SAS, CS**
Title: SHF: Medium: Collaborative Research: Statically Controlled Asynchronous Lane Execution (SCALE)
Sponsor: NSF
Amount | Duration: $246,329 | 4 Years

**PI: ELENA SEMOUCHKINA, CPS, ECE**
Title: Developing Anisichkina Media for Transformation Optics by Using Dielectric Photonic Crystals
Sponsor: NSF
Amount | Duration: $230,744 | 3 Years

**PI: BENJAMIN ONG, DATAS, MATH**
Title: Sphinx: Combining Data and Instruction Level Parallelism through Demand Driven Execution of Imperative Programs
Sponsor: NSF
Amount | Duration: $15,876 | 5 Years

**PI: KEVIN TREWARTHA, HCC, CLS**
Title: Motor Learning as a Sensitive Behavioral Marker of Mild Cognitive Impairment and Early Alzheimer’s Disease
Sponsor: US DHHS
Amount | Duration: $455,884 | 3 Years

**PI: JIE SHI, HCC, CS**
Title: Improving Reliability of In-Memory Storage
Sponsor: NSF
Amount | Duration: $200,636 | 4 Years

**PI: SUMIT PAUDYAL, AFFILIATED, ECE**
Title: Packetized Energy Management: Coordinating Transmissions and Distribution
Sponsor: NSF
Amount | Duration: $390,876 | 5 Years

**PI: SHIFAN TANG, CPS, CMH**
Title: Building Big Data Computing Capabilities toward Advancing Research and Education
Sponsor: Michigan Tech
Amount | Duration: $50,000 | 1 Year

**PI: PIYUSH VORA, AFFILIATED, ECE**
Title: Packetized Energy Management: Coordinating Transmissions and Distribution
Sponsor: Protect Our Power
Amount | Duration: $25,000 | 0.5 Years

**PI: KEITH VERTANEN, HCC, CS**
Title: Improving Mobile Device Input for Users who are Blind or Low Vision
Sponsor: NSF
Amount | Duration: $225,663 | 3 Years

**PI: ZHENLIN WANG, SAS, CS**
Title: CSR: Small: Effective Sampling-Based Miss Ratio Curves: Theory and Practice
Sponsor: NSF
Amount | Duration: $200,636 | 4 Years

**PI: JIANHUI YUE, SAS, CS**
Title: SHF: SMALL: Collaborative Research: Improving Reliability of In-Memory Storage
Sponsor: NSF
Amount | Duration: $200,636 | 4 Years
ICC OBJECTIVE 3: FOSTER INTERDISCIPLINARY COLLABORATIONS AND ENABLE FACULTY TO DEVELOP MULTI-DISCIPLINARY PROPOSALS AND CONDUCT IMPACTFUL RESEARCH WHICH OTHERWISE MAY NOT BE POSSIBLE.

Active Awards by Sponsor

<table>
<thead>
<tr>
<th>Sponsor</th>
<th>Awards</th>
</tr>
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<tbody>
<tr>
<td>NSF</td>
<td>$6,515,564</td>
</tr>
<tr>
<td>US DOD</td>
<td>$2,132,029</td>
</tr>
<tr>
<td>US DHHS</td>
<td>$504,878</td>
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<tr>
<td>FORD MOTOR</td>
<td>$372,567</td>
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<tr>
<td>OTHER</td>
<td>$267,658</td>
</tr>
<tr>
<td>MICHIGAN</td>
<td>$81,268</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$9,873,964</strong></td>
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Active Awards by PI

<table>
<thead>
<tr>
<th>PI</th>
<th>Sponsor</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feng, AFL, ECE</td>
<td>NSF</td>
<td>$1,158,074</td>
</tr>
<tr>
<td>Vertanen, HCC, CS</td>
<td>Other</td>
<td>$1,057,700</td>
</tr>
<tr>
<td>Onder, SAS, CS</td>
<td>Other</td>
<td>$1,052,949</td>
</tr>
<tr>
<td>Cai, CyberS, CMH</td>
<td>Other</td>
<td>$592,255</td>
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<tr>
<td>Ten, CPS, ECE</td>
<td>Other</td>
<td>$373,866</td>
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<tr>
<td>Trewartha, HCC, CLS</td>
<td>Other</td>
<td>$455,884</td>
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<tr>
<td>Archer, AFL, ECE</td>
<td>Other</td>
<td>$349,988</td>
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<td>Mueller, HCC, CLS</td>
<td>US DOD</td>
<td>$643,407</td>
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<tr>
<td>Mu, SAS, CS</td>
<td>NSF</td>
<td>$200,636</td>
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<tr>
<td>Wang-Z, SAS, CS</td>
<td>Other</td>
<td>$390,876</td>
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<tr>
<td>Pastel, HCC, CS</td>
<td>Other</td>
<td>$178,321</td>
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<td>Semouchkina, CPS, ECE</td>
<td>US DOD</td>
<td>$337,217</td>
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<td>Fuhrmann, SAS, ECE</td>
<td>Other</td>
<td>$202,567</td>
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<tr>
<td>Nooshabadi, APL, ECE</td>
<td>Other</td>
<td>$120,000</td>
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<tr>
<td>Zorzi, AP, Chem</td>
<td>Other</td>
<td>$489,782</td>
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<td>Misselhorn, CMH</td>
<td>Other</td>
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<td>Onder, APS, Chem</td>
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<td>Yue, SAS, CS</td>
<td>Other</td>
<td>$200,636</td>
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<tr>
<td>Chen, CyberS, CS</td>
<td>Other</td>
<td>$449,893</td>
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<td>Havens, Data5, ECE</td>
<td>Other</td>
<td>$406,435</td>
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<tr>
<td>Kuo, APS, Chem</td>
<td>Other</td>
<td>$651,821</td>
</tr>
<tr>
<td>Mayo, CyberS, ECE</td>
<td>Other</td>
<td>$130,001</td>
</tr>
</tbody>
</table>
In FY20, ICC researchers submitted 25 proposals totaling $9.4 million. 22 proposals were new projects; 5% were awarded; 9 proposals were pending on June 30, 2020.

**Pending Proposals**

- **Title: FW-HTF-RM**
  - PI: Jung Bae, CPS, ME-EM
  - New Novel Dual-System Approach in Multi-Robot Tasks
  - Sponsor: NSF

- **Title: Collaborative Research: PPoSS: Planning**
  - PI: Bo Chen, CyberS, CEC, CS
  - New Scaling Autonomous Vehicle Systems at the Edge: from On-Board Processing to Cloud Infrastructure
  - Sponsor: NSF

- **Title: REF-PHF-RS: Deep learning applied to electrical activation propagation from a website ECG device to improve cardiac resynchronization therapy for patients with heart failure**
  - PI: Qing Chen, DataS, Biomed Eng
  - New for electrical activation
  - Sponsor: Michigan Tech

- **Title: Dissecting distinct and redundant functions of diverse integrin-talin modules for adhesion heterogeneity and mechanosensation**
  - PI: Timothy Havens, DataS, CC
  - New for adhesion heterogeneity and mechanosensation
  - Sponsor: US DHHS

- **Title: Machine Learning and Artificial Intelligence Using Acoustic Sensors in Connected Vehicles and Roadside Units**
  - PI: Guy Hembroff, CyberS, CMH
  - New for connected vehicles
  - Sponsor: Ford Motor

- **Title: Maintaining Independence in Older Adults by Preventing Future Falls: Development of mHealth Intervention to Address Psychological Fall Factors**
  - PI: Ye Sun, CPS, ME-EM
  - New for maintaining independence
  - Sponsor: BC/BS of MI Foundation

- **Title: SBIR: A New Fabric-based ECG Monitoring System**
  - PI: Ye Sun, CPS, ME-EM
  - New for fabric-based ECG monitoring
  - Sponsor: Intelligent Fusion Technology Inc

- **Title: Augmenting Situational Awareness in Underground Mines**
  - PI: Ye Sun, CPS, ME-EM
  - New for situational awareness
  - Sponsor: NSF
Center for Cyber-Physical Systems

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RESEARCH AREAS
- CYBER-PHYSICAL SYSTEMS
- INTERNET-OF-THINGS
- SMART HOME, BUILDING, COMMUNITY, AND GRID
- SMART TRANSPORTATION
- SMART HEALTH
- UNDERWATER COMMUNICATIONS AND NETWORKS
MEMBER RESEARCHERS

Guy Hembroff | Director, Center for Cybersecurity |
Yu Cai |
Bo Chen |
Steven Goldsmith |
Jean Mayo |
Jeffrey Wall |

RESEARCH AREAS
- BIOMETRICS
- CYBERSECURITY
- INFORMATION SECURITY
- SECURITY IN MOBILE COMPUTING
- TRUSTED SOFTWARE ENGINEERING
- WIRELESS COMMUNICATIONS
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Charles Wallace | Associate Professor, Computer Science | wallace@mtu.edu

RESEARCH AREAS

- MULTIMODAL INTERACTIONS
- HUMAN-AGENT INTERACTIONS
- ASSISTIVE TECHNOLOGIES
- INTELLIGENT HEALTH
- SOFTWARE EDUCATION
- NOVEL INTERFACES
- COMPUTATIONAL MODELING
- EXPLANATION IN SYSTEMS
- COLLABORATION AND TRUST
- DECISION MAKING AND ADAPTIVE LEARNING
Center for Scalable Architectures and Systems

RESEARCH AREAS
• SCALABLE COMPUTER ARCHITECTURE AND SYSTEMS
• HETEROGENEOUS PARALLEL AND DISTRIBUTED COMPUTING FOR INFORMATION PROCESSING
• EMBEDDED SYSTEMS
• DEPENDABLE COMPUTING
• FORMAL METHODS
• FAULT TOLERANT SYSTEMS
• VLSI DESIGN AND CAD
• ARCHITECTURES FOR SECURE SYSTEMS
• VIRTUALIZATION
• SCALABLE ALGORITHMS

MEMBER RESEARCHERS

Soner Onder | Director, Center for Scalable Architectures and Systems | 3URIHVVRU&RPSXWHU6FLHQFH_5IDLDWGH3URIQHFWU5FDODQG6VRQHU&PWXHGX
Ali Ebnenasir | $VVRFLDWH3URIHVVRU&RPSXWHU6FLHQFH_DHEQ
Dan Fuhrmann | &KDLU'HSDUWHQWRIHSSOLHG&RPSXWLQJ_'DYH3URIHVVRULQ&RPSXWHU(QJLQHULQJ)_IXKUPDQQ&PWXHGX
Yakov Nekrich | $VVRFLDWH3URIHVVRU&RPSXWHU6FLHQFH_DNR
Junqiao Qiu | $VVLVWDQW&RPSXWHU6FLHQFH_5IDLDWGH$VVLV&RJQLWLHDFQ/HDFQLQJ6FLHQFH_VMXQTLDRT&PWXHGX
Zhenlin Wang | 3URIHVVRU&RPSXWHU6FLHQFH_J0ZDQJ&PWXHGX
Jianhui Yue | $VVLVWDQW3URIHVVRU&RPSXWHU6FLHQFH_M\XH&PWX

S&$118$/5(3257_
Your gifts support multidisciplinary research and education in the fields 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.

- **GRADUATE FELLOWSHIPS**
- **HONORARIAUMS, TRAVEL FUNDS**
- **UNDERGRADUATE RESEARCH FELLOWSHIPS**
- **SEED GRANTS**
- **VISITING PROFESSORS, RESEARCH SCIENTISTS**
- **OUTREACH SUPPORT**
- **FACILITIES AND EQUIPMENT**
- **HONORARIAUMS, TRAVEL FUNDS**
- **ENDOWED PROFESSORSHIPS**
- **VISITING PROFESSORS, RESEARCH SCIENTISTS**
- **OUTREACH SUPPORT**
- **FACILITIES AND EQUIPMENT**

There is growing interest in ICC members’ research as external stakeholders learn more about what we are building here at Michigan Tech in all things computing.

—Timothy C. Havens, Ph.D.