

William and Gloria Jackson Professor of Computer Systems

FY2021 Annual Report

Timothy C. Havens

1. Introduction

This was my eighth year as the William and Gloria Jackson Professor of Computer Systems. Overall, this has been an exciting year for me. This year I was promoted to the rank of Full Professor, which is such an honor for me. I also continued as Associate Dean for Research in the College of Computing and as Director of the Institute of Computing and Cybersystems.

2. Activities

I continued as Director of the Institute of Computing and Cybersystems (ICC) at Michigan Tech. The ICC is a research institute that has over 60 faculty members from nearly every academic unit at MTU. The institute continues to set record expenditures each year; our FY2021 research expenditures were greater than \$2.7 million. The ICC is now considered the research arm of the newly formed College of Computing at Michigan Tech, providing faculty and students the opportunity to work across organizational boundaries to create an environment that reflects contemporary technological innovation. This collaboration allows for a convergence in communication, control, and computing that mirrors today's industry and society. New this year, we formed the Joint Center for Biocomputing and Digital Health, which is a joint center with the MTU Health Research Institute. This new center is the first joint center on campus at MTU and brings together researchers across campus to investigate problems in bioinformatics, biomechanics, health informatics, etc. The ICC also worked on a growth plan for the future, enabled by key hires of an Assistant Director for Research Development and a Research Scientist position. These hires were then enabled by a \$250,000 gift from Kanwal and Ben Rekhi. Figure 1 shows expenditures and new awards data for FY16-FY21, along with a modeled growth over the next five years.

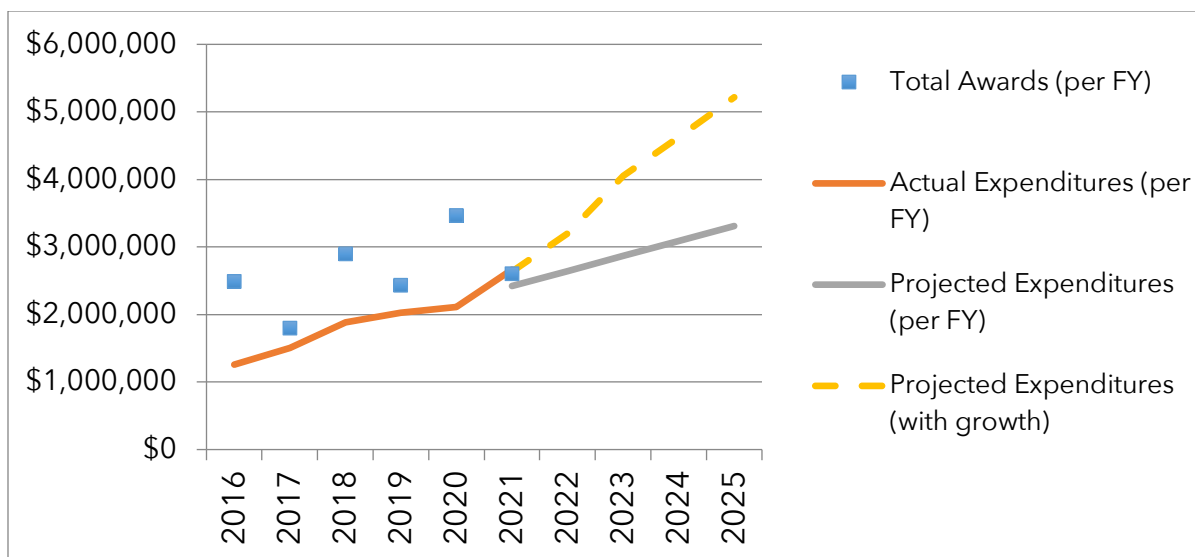


Figure 1. Actual ICC expenditures and new awards from FY16-21, plus modeled expenditures growth FY21-FY25.

I was honored to continue as Associate Dean for Research in the College of Computing. In this role, I have focused heavily on research support and development for new faculty. We have made several hires of new faculty in the last two years and work closely with them to identify opportunities for funding, help them navigate the MTU research landscape, get them integrated within the MTU research community, and help them cross the proposal finish line on time. One program that we led in FY21 was a COVID-19 Research Seed Grant competition. Five grants were awarded, including one funded by a gift by Paul Williams to support research in robotics and AI. These seed grants have already led to successful external funding and to increased visibility of our researchers. Overall, the research in the college continues to grow, with significant growth in expenditures since the formation of the College in FY19—see Figure 2.

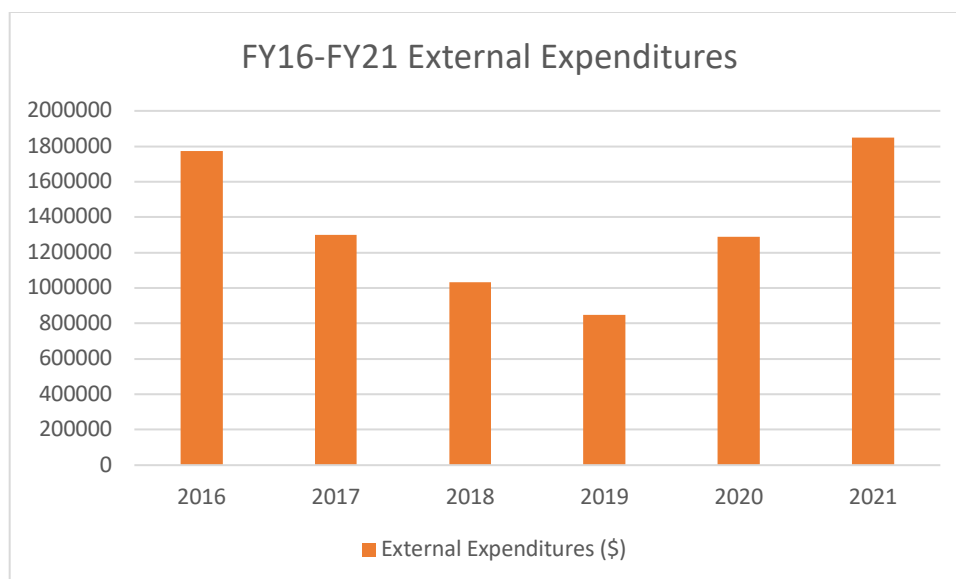


Figure 2. College of Computing externally-funded expenditures, FY16-FY21. College of Computing was formed in FY19.

New Research Grants and Contracts

- SCC-CIVIC-PG Track B: Helping Rural Counties to Enhance Flooding and Coastal Disaster Resilience and Adaptation (\$4,080/\$49,999), NSF, 2021, Co-PI (PI: Thomas Oommen)
- Redesign and Implementation of USDS-Proxy Language (\$17,231/\$76,610), ARiA, 2020, Co-PI (PI: Charles Wallace)
- Modeling and Algorithm Development for Adaptive Adversarial AI for Complex Autonomy (\$428,707), US Army ERDC, 2020-2022, PI
- DURIP: Acoustic Sensing System and High-Throughput Computing for Environment and Threat Monitoring in Naval Environments Using Machine Learning (\$243,169), Office of Naval Research, 2020-2021, PI

- Machine Learning and Artificial Intelligence Using Acoustic Sensors in Connected Vehicles and Roadside Units (\$149,518), Ford Motor Company, 2020-2021, PI
- Defending the Nation's Digital Frontier: Cybersecurity Training for Tomorrow's Officers (\$66,377/\$248,517), Office of Naval Research, 2020-2021, Co-PI (PI: Andrew Barnard)
- Duty Cycle Aggregation, Warranty Mitigation, and Fleet Prognostics using Customer Usage Data (Part II) (\$199,847), Ford Motor Company, 2020-2022, PI
- Algorithms for Look-Down Infrared Target Exploitation – Phase II (\$399,994), NGA, 2020-2022, PI
- Machine Learning for Human-Based Visual Detection Metrics (\$120,000), Signature Research Inc., 2020-2021, PI

3. Publications and Conferences

Journal Articles

- S. Yazdanparast, T.C. Havens, and M. Jamalabdollahi (June, 2021). Soft overlapping community detection in large-scale networks via fast fuzzy modularity maximization. *IEEE Trans. Fuzzy Systems*, 29(6), 1533-1543.
- S. Kabir, C. Wagner, T.C. Havens, and D.T. Anderson (Nov, 2020). A similarity measure based on bidirectional subsethood for intervals. *IEEE Trans. Fuzzy Systems*, 28(11), 2890-2904.
- M.A. Islam, D.T. Anderson, A. Pinar, T.C. Havens, G. Scott, and J.M. Keller (July, 2020). Enabling explainable fusion in deep learning with fuzzy integral neural networks. *IEEE Trans. Fuzzy Systems*, 28(7), 1291-1300.

Conference Papers

- N. Hamilton, A. Webb, Z. Dekraker, B. Hendrickson, M. Blanck, E. Nelson, W. Roemer, and T.C. Havens (Apr, 2021). Augmentation methods for object detection in overhead imagery. *SPIE DSS*, 11729, 1172901.
- A.J. Pinar, A.J. Webb, J.L. Brown, T.C. Havens, B. Alvey, G.N. DeSouza, D.T. Anderson, and S.R. Price (Apr, 2021). Effects of perturbed depth sensors in autonomous ground vehicles. *SPIE DSS*, 11746, 117461F.
- S.K. Kakula, A.J. Pinar, T.C. Havens, and D.T. Anderson (Dec, 2020). Visualization and analysis tools for explainable Choquet integral regression. *IEEE Symp. Ser. Comp. Intell.*
- S.K. Kakula, A.J. Pinar, D.T. Anderson, and T.C. Havens (Oct., 2020). Online learning of the fuzzy Choquet integral. *IEEE Int. Conf. Systems, Man, and Cybernetics*.

- S.K. Kakula, A.J. Pinar, T.C. Havens, and D.T. Anderson (July, 2020). Extended linear order statistic (ELOS) aggregation and regression. *IEEE Int. Conf. Fuzzy Systems*.
- A. Wilbik, T.C. Havens, and T. Wilkin (July, 2020). On a paradox of extended linguistic summaries. *IEEE Int. Conf. Fuzzy Systems*.
- S.K. Kakula, A.J. Pinar, T.C. Havens, and D.T. Anderson (July, 2020). Choquet integral ridge regression. *IEEE Int. Conf. Fuzzy Systems*.

4. Funds Usage

The funds from this endowment were used to build up resources to investigate autonomy and sensing. These resources led to successful proposals including two projects funded by Ford Motor Company, a significant effort funded by US Army ERDC, and new NSF-funded project to develop tools to increase flood resilience of rural areas.

5. Concluding Remarks

Mr. and Mrs. Jackson's gift has made so much possible for my students and me. And their enormous support to MTU, in so many ways, has positively impacted an uncountable number of students, faculty, and staff. A huge thank you to them.