

William and Gloria Jackson Associate Professor of Computer Systems

2019 Annual Report

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1. Introduction

This year I was reappointed as the William and Gloria Jackson Associate Professor of Computer Systems after an extensive review by the department chairs in electrical and computer engineering and computer science and the provost. This professorship has meant the world to me over the last six years and was one of the deciding factors on joining Michigan Tech. I am hopeful that I can continue to espouse Mr. and Mrs. Jackson's commitment to innovation, education, and giving as I continue in this role.

2. Activities

In August, I was appointed Director of the Institute of Computing and Cybersystems (ICC) at Michigan Tech. The ICC is a research institute that currently has 50 faculty members from 15 academic units at MTU. Our FY2018 research expenditures were about \$2 million, which places us among the most successful institutes on campus. The ICC is the research arm of the Alliance of Computing, Information and Automation (ACIA) at Michigan Tech. It leads and promotes the ACIA mission—to provide faculty and students the opportunity to work across organizational boundaries to create an environment that is a reflection of contemporary technological innovation. This collaboration allows for a convergence in communication, control and computing that mirrors today's industry and society.

One of the most exciting things happening at MTU right now is the creation of a College of Computing (CC). This new college will be the nexus of computing education and research at MTU, and will significantly raise our visibility nationally and internationally. There are currently only 15 Colleges of Computing (or similar organizations) in the US; hence, this will be a big step, as MTU joins this vanguard. The College will initially house Computer Science, Software Engineering, Computer Networks and Administration, Cybersecurity, Health Informatics, and Mechatronics and Robotics Engineering Technology. The CC will also bridge to other disciplines through the creation of *convergence programs*, which converge multiple disciplines to form new computing-focused degree programs—we will call these X+CS programs. Existing examples include Computer Engineering (ECE+CS) and Data Science (Math+Business+CS and others). I have been part of an executive team helping to define the details of the new College and the ICC is slated to be the research arm, which will allow me to expand my role to enabling growth in research across the whole college and university and to help raise the visibility of the College by telling the world about the fantastic research being done here at Michigan Tech.

This summer I will be in New Orleans as the General Chair of the IEEE International Conference on Fuzzy Systems. I have been publishing in this community for many years now and am very honored that I was selected as the Chair of the flagship conference. It has been a lot of work, but it is great to give back to the community that has supported me.

I took a sabbatical for the 2018-19 academic year to refresh and rejuvenate my research in artificial intelligence and machine learning. I have been working as Chief Scientist at Signature Research, Inc., (SGR) in Calumet. I am helping them build a division in AI for Department of

Defense (DoD) applications. It has been fascinating work, and I have met tons of new contacts through my interactions with SGR and their customers in the DoD community. We already have had success in getting funding for our joint work. We have a project funded by the National Geospatial Intelligence Agency to examine automatic object detection methods in infrared satellite imagery. We have several follow-on projects being reviewed by funding agencies and anticipate a big growth in business in this area over the next year.

3. Publications, Conferences, and Invited Talks

Journal Articles

- C.D. Demars, M.C. Roggemann, A.J. Webb, and T.C. Havens. (Oct, 2018) Target localization and tracking by fusing Doppler differentials from cellular emanations with a multi-spectral video tracker. *Sensors*, 18(11), 3687.
- A.J. Webb, T.C. Havens, and T.J. Schulz (Sept, 2018). Fast image reconstruction in forward looking GPR using dual l1 regularization. *IEEE Trans. Computational Imaging*, 4(3), 470-478.
- M.A. Islam, D.T. Anderson, A.J. Pinar, and T.C. Havens (Aug, 2018). Data-driven compression and efficient learning of the Choquet integral. *IEEE Trans. Fuzzy Systems*, 26(4), 1908-1922.

Conference Papers

- T.C. Havens and D.T. Anderson (June, 2019). Machine learning of Choquet integral regression with respect to a bounded capacity (or non-monotonic fuzzy measure). *IEEE Int. Conf. Fuzzy Systems*.
- C. Veal, A. Yang, A. Hurt, M. Islam, D.T. Anderson, G. Scott, T.C. Havens, J.M. Keller and B. Tang (June, 2019). Linear order statistic neuron. *IEEE Int. Conf. Fuzzy Systems*.
- B. Murray, M. Islam, A.J. Pinar, D.T. Anderson, G. Scott, T.C. Havens, F. Petry and P. Elmore (June, 2019). Transfer learning for the Choquet integral. *IEEE Int. Conf. Fuzzy Systems*.
- S. Kabir, C. Wagner, T.C. Havens and D.T. Anderson (June, 2019). Measuring similarity between discontinuous intervals – challenges and solutions. *IEEE Int. Conf. Fuzzy Systems*.
- I.T. Cummings, T.J. Schulz, J.P. Doane, S.A. Zekavat, and T.C. Havens (Oct, 2018). Information-theoretic optimization of full-duplex communication between digital phased arrays. *Allerton Conf. Comm., Control, and Comp.* 373-377.
- T.C. Havens, A.J. Pinar, D.T. Anderson, and C. Wagner (July, 2018). SPFI: shape-preserving Choquet fuzzy integral for non-normal fuzzy set-valued evidence. *IEEE Int. Conf. Fuzzy Systems*.
- B. Murray, M. Aminul Islam, A.J. Pinar, T.C. Havens, D.T. Anderson, and G. Scott (July, 2018). Explainable AI for understanding decision and data-driven optimization of the Choquet integral. *IEEE Int. Conf. Fuzzy Systems*. [Best Student Paper Award Finalist](#)
- S. Kabir, C. Wagner, T.C. Havens, and D.T. Anderson (July, 2018). A bi-directional subsethood based similarity measure for fuzzy sets. *IEEE Int. Conf. Fuzzy Systems*.
- I.T. Cummings, T.J. Schulz, J.P. Doane, and T.C. Havens (July, 2018). Optimizing the information-theoretic partitioning of simultaneous transmit and receive phased arrays. *IEEE Int. Symp. Antennas and Propagation*.

Invited Talks

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| Explainable deep fusion, Technological University of Eindhoven | (May, 2019) |
| Interpretable deep fusion using non-linear deep learning architectures, Ford M.C. | (March, 2019) |
| Making sense of deep fusion using explainable AI, NGA | (January, 2019) |
| How to win on trivia night: sensor fusion beyond the weighted average, MIT LL | (July, 2018) |

4. Funds Usage

Each year, I use the return on the endowment to fund a graduate student research fellowship. In AY18-19, Sakineh Yazdanparast was the Jackson Fellow. Sakineh just successfully defended her PhD dissertation research and is now Dr. Yazdanparast. Her research has been exemplary and she is a creative and independent student—one of the best! She developed methods to automatically discover communities in graph data—such as social networks—and then extended these algorithms to improve the energy efficiency and performance of localization in wireless sensor networks. This problem is one of the canonical problems of sensor networks and seeks to answer the question, “Where is each sensor located?” Applications include environment monitoring, infrastructure monitoring, and surveillance. She has published her work in top journals and has several articles that are still under review. Sakineh recently took a full-time job at Cisco in Ohio and is enjoying her career very much.

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.