

Research Interests

My research interests lie in the area of machine learning with an emphasis on data/information fusion, deep learning, computer vision, and image processing. To date, my contributions include:

- **Deep learning:** Neuronal representation of aggregation operators and decision level fusion of deep neural network (DNN) architectures for object detection and land-cover classification;
- **Aggregation:** New mathematical and algorithmic extensions of the fuzzy integral for uncertain (e.g., missing) data, computationally efficient approximations of aggregation operators, data-driven compression of fusion and its learning for homogeneous and heterogeneous data, efficient evolutionary algorithm for the fuzzy integral;
- **Computer vision:** Deep morphological hit-or-miss transform neural network, semantic segmentation for off-road trail detection in autonomous driving, and object recognition;
- **Hyperspectral image processing:** Dimensionality reduction using visual clustering, contiguous band grouping, and feature level fusion for classification task in remote sensing.

Education

Mississippi State University

Mississippi, USA

Ph.D. in Electrical and Computer Engineering

August 2018

- GPA: 4.0/4.0
- Dissertation: Efficient Data Driven Multi Source Fusion
- Advisors: Derek T. Anderson, Ph.D. and John E. Ball, Ph.D.

Bangladesh University of Engineering and Technology

Dhaka, Bangladesh

B.Sc. in Electrical and Electronic Engineering

June 2005

- GPA: 3.78/4.0
- Advisor: A. B. M. Harun-Ur-Rashid, Ph.D.

Professional Experience

Research Assistant Professor, **EECS, University of Missouri**

March 2019 - present

Postdoctoral Associate, **Center for Advanced Vehicular Systems**

August 2018 - March 2019

Graduate Research Assistant, **Center for Advanced Vehicular Systems**

Spring 2018 - Summer 2018

Instructor, **Mississippi State University (MSU)**

Summer 2017 - Spring 2018

Graduate Research Assistant, **MSU**

Fall 2015 - Spring 2017

Graduate Research Assistant, **Distributed Analytics and Security Institute**

Fall 2014 - Summer 2015

Graduate Teaching Assistant, **MSU**

Fall 2013 - Summer 2014

Manager in Radio Network Planning (RNP), **Robi Axiata Limited, Bangladesh**

November 2010 - July 2013

Senior Engineer, RNP, **Robi Axiata Limited**

July 2009 - October 2010

Engineer, RNP, **Robi Axiata Limited**

September 2005 - June 2009

Grant Writing

Harnessing Technology to Save Soil. Agriculture and Food Research Initiative (AFRI). National Institute of Food and Agriculture. Submitted.

- PI: Peter C. Sharf; Co-PIs: John A. Lory, Richard M. Cruse, Derek. T. Anderson, Guilherme DeSouza
- Contributed to brainstorming and writing the proposal.

Explainable Artificial Intelligence (XAI) for Multi-Modal, Data-Driven Agriculture. Submitted as a Missouri multi-campus Tier 2 proposal. Made to the final round, ultimately not funded.

- Role: Collaborator. Assisted with organizing meetings, brainstorming, writing, and editing the proposal and associated budget.

Book Chapter

- [1] D. T. Anderson, G. J. Scott, **M. Islam**, B. Murray, and R. Marcum, “Fuzzy choquet integration of deep convolutional neural networks for remote sensing,” in *Computational Intelligence for Pattern Recognition*, Springer, 2018, pp. 1–28.

Journal Articles

- [1] **M. Islam**, B. Murray, A. Buck, D. T. Anderson, G. Scott, M. Popescu, and J. Keller, “Deep morphological hit-or-miss transform neural network,” *IEEE Transactions on Neural Networks and Learning Systems*, under review.
- [2] S. K. Kakula, A. J. Pinar, **M. Islam**, D. T. Anderson, and T. Havens, “Visualization and learning of the choquet integral with limited training data,” *IEEE Transactions on Fuzzy Systems*, under review.
- [3] **M. Islam**, D. T. Anderson, T. C. Havens, and J. E. Ball, “A generalized fuzzy extension principle and its application to information fusion,” *IEEE Transactions on Fuzzy Systems*, under review.
- [4] B. Murray, **M. Islam**, A. J. Pinar, D. T. Anderson, G. Scott, T. C. Havens, and J. M. Keller, “Explainable AI for the choquet integral,” *IEEE Transactions on Emerging Topics in Computational Intelligence*, under review.
- [5] **M. Islam**, D. T. Anderson, A. J. Pinar, T. C. Havens, G. Scott, and J. M. Keller, “Enabling explainable fusion in deep learning with fuzzy integral neural networks,” *Special Issue on Deep Fuzzy Models, IEEE Transactions on Fuzzy Systems*, 2019, issn: 1063-6706. doi: 10.1109/TFUZZ.2019.2917124.
- [6] S. Sharma, J. E. Ball, B. Tang, D. W. Carruth, M. Doude, and **M. Islam**, “Semantic segmentation with transfer learning for off-road autonomous driving,” *Sensors*, vol. 19, no. 11, p. 2577, 2019.
- [7] **M. Islam**, D. T. Anderson, J. E. Ball, and N. H. Younan, “Fusion of heterogeneous bands and kernels in hyperspectral image processing,” *Journal of Applied Remote Sensing*, vol. 13, no. 2, 2019.
- [8] **M. Islam**, D. T. Anderson, F. Petry, and P. Elmore, “An efficient evolutionary algorithm to optimize the Choquet integral,” *International Journal of Intelligent Systems*, 2018. doi: 10.1002/int.22056.
- [9] **M. Islam**, D. T. Anderson, A. J. Pinar, and T. C. Havens, “Data-driven compression and efficient learning of the Choquet integral,” *IEEE Transactions on Fuzzy Systems*, 2017, issn: 1063-6706. doi: 10.1109/TFUZZ.2017.2755002.

Conference Articles

- [1] B. Murray, **M. Islam**, A. Buck, D. T. Anderson, and J. M. Keller, “You only morph once (YOMO),” in *Automatic Target Recognition, SPIE Defense + Commercial Sensing*, under review.
- [2] C. Veal, A. Yang, A. Hurt, B. Murray, **M. Islam**, D. T. Anderson, G. J. Scott, T. C. Havens, J. M. Keller, and B. Tang, “Linear order statistic neuron,” in *2019 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, Jun. 2019.

- [3] B. Murray, **M. Islam**, A. J. Pinar, D. T. Anderson, G. J. Scott, T. C. Havens, F. Petry, and P. Elmore, "Transfer learning for the choquet integral," in *2019 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, Jun. 2019.
- [4] W. Meadows, C. Hudson, C. Goodin, L. Dabirru, B. Powell, M. Doude, D. Carruth, **M. Islam**, J. Ball, and B. Tang, "Multi-lidar placement, calibration, co-registration, and processing on a subaru forrester for off-road autonomous vehicles operations," in *Autonomous Systems: Sensors, Vehicles, Security, and the Internet of Everything*, International Society for Optics and Photonics, 2019.
- [5] B. Murray, **M. Islam**, A. J. Pinar, T. C. Havens, D. T. Anderson, and G. Scott, "Explainable AI for understanding decisions and data-driven optimization of the Choquet integral," in *2018 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, Jul. 2018.
- [6] **M. Islam**, D. T. Anderson, X. Du, T. C. Havens, and C. Wagner, "Efficient binary fuzzy measure representation and Choquet integral learning," in *2018 17th International Conference on Information Processing and Management of Uncertainty in Knowledge-Based Systems*, Springer, Jun. 2018.
- [7] M. Davis, L. Cagle, C. Morgan, C. Hudson, B. Shell, D. Gardner, **M. Islam**, C. L. Bethel, J. E. Ball, J. R. Gafford, D. T. Anderson, Y. Liu, and A. LeClair, "Hydra: a modular, universal multi-sensor data collection system," in *Autonomous Systems: Sensors, Vehicles, Security, and the Internet of Everything*, International Society for Optics and Photonics, 2018.
- [8] **M. Islam**, D. T. Anderson, F. Petry, D. Smith, and P. Elmore, "The fuzzy integral for missing data," in *2017 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, 2017, pp. 1–8.
- [9] A. J. Pinar, T. C. Havens, **M. Islam**, and D. T. Anderson, "Visualization and learning of the Choquet integral with limited training data," in *2017 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, 2017, pp. 1–6.
- [10] D. T. Anderson, **M. Islam**, R. King, N. H. Younan, J. R. Fairley, S. Howington, F. Petry, P. Elmore, and A. Zare, "Binary fuzzy measures and Choquet integration for multi-source fusion," in *2017 International Conference on Military Technologies (ICMT)*, 2017, pp. 676–681.
- [11] **M. Islam**, D. T. Anderson, J. E. Ball, and N. H. Younan, "Fusion of diverse features and kernels using lp-norm based multiple kernel learning in hyperspectral image processing," in *2016 8th Workshop on Hyperspectral Image and Signal Processing: Evolution in Remote Sensing (WHISPERS)*, 2016, pp. 1–5.
- [12] **M. Islam**, D. T. Anderson, J. E. Ball, and N. H. Younan, "Clodd based band group selection," in *2016 IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, Jul. 2016, pp. 36–39.
- [13] **M. Islam**, D. T. Anderson, and T. C. Havens, "Multi-criteria based learning of the choquet integral using goal programming," in *2015 Annual Conference of the North American Fuzzy Information Processing Society (NAFIPS) held jointly with 2015 5th World Conference on Soft Computing (WConSC)*, 2015, pp. 1–6.

Poster Presentation

- [1] **M. Islam**, D. T. Anderson, A. Pinar, T. Havens, G. Scott, and J. Keller, "The choquet integral neuron, its pytorch implementation, and application to decision fusion," 2019, IEEE International Conference on Fuzzy Systems (FUZZ-IEEE).
- [2] B. Ruprecht, C. Veal, B. Murray, **M. Islam**, D. Anderson, F. Petry, J. Keller, G. Scott, and C. Davis, "Fuzzy logic-based fusion of deep learners in remote sensing," 2019, IEEE International Conference on Fuzzy Systems (FUZZ-IEEE).

Teaching Experience

Instructor, **Mississippi State University**

- Electromagnetics I (junior-level course), Spring 2018
- Electromagnetics II (junior-level course), Summer-I and Fall, 2017

Graduate Teaching Assistant, **Mississippi State University**

- Grading and lecture support for Intermediate Electronic Circuit, Summer-I and II, 2014
- Supervised Advanced Electronic Circuit lab, Spring 2014
- Grading and lecture support for Intermediate Electronic Circuit and Advanced Electronic Circuit, Fall 2013

Honors and Awards

- Bagley College Travel Award to attend the *IEEE International Conf. on Fuzzy Systems*, Naples, Italy 2017
- MSU Travel Assistance Grant to attend the *8th Workshop on Hyperspectral Image and Signal Proc.*, CA 2016
- Bagley College Travel Award to attend the *8th Workshop on Hyperspectral Image and Signal Proc.*, CA 2016
- Dean's List, Bangladesh University of Engineering and Technology 2003 - 2005

Professional Services

Session Chair

- Special Session on Fuzzy Algorithms, IEEE International Conference on Fuzzy Systems, New Orleans June 23- 26, 2019

Organizing Conference

2019

- Assisted General and Program Chairs of the 2019 FUZZ-IEEE Conference at JW Marriot in New Orleans. Examples include organizing and leading conference workers, coordinating and assisting speakers, helping co-run poster session, helping with technical as much as program side

Manager, Sensor Analysis and Intelligence Laboratory, MSU and MINDFUL, MU

2016 - present

- Assisted in organizing and running the lab
- Mentored undergraduate and graduate students of the lab
- Managed and bootstrapped project codes

Journal Reviewer

- IEEE Transaction on Fuzzy Systems 2016 - present
- Journal of Applied Remote Sensing 2017 - present
- International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems 2019
- Electronics 2019
- Artificial Intelligence Review (AIRE) 2018
- Journal of Ambient Intelligence and Humanized Computing 2018
- ISPRS International Journal of Geo-Information 2018
- IEEE Transactions on Geoscience and Remote Sensing 2017

Conference Reviewer

- IEEE International Conference on Fuzzy Systems 2016 - present
- IEEE Congress on Evolutionary Computation 2016 - present
- Signal Processing in Medicine 2017 - 2018

Member

- IEEE
- IEEE Computational Intelligence Society
- IEEE Signal Processing Society
- IEEE Big Data Community

Research Projects

Data Driven Agriculture (DDAg) Initiative, MU

2019 - present

- Data Driven Agriculture (DDAg) is an initiative taken by the MU informatics institute in an aim to foster innovation in sensors and novel platforms, explainable artificial intelligence, and data translation for implementation in agriculture (<http://ddag.missouri.edu>).
- Organizing a two day event at MU Campus with cross-campus researchers to brainstorm and share new research ideas and new funding opportunities.
- Writing grant proposals to seek internal and external funding.

Center for Advanced Vehicular Systems, MSU

Off-Road Autonomous Driving

January 2018 - March 2019

- Led the perception group of this project. Directed two Ph.D., one Masters, and one undergraduate student. The perception group focused on academic research and industrial applications. Topics explored include sensor fusion, deep neural network based object detection, semantic segmentation of point cloud, off-road trail detection, localization, occupancy grid, and free space mapping.

Hyperspectral Image Processing, MSU

2015 - 2016

- Proposed a visual clustering based method for contiguous and non-contiguous band grouping in hyperspectral image processing
- Implemented the proposed algorithm using OpenMP and MPI protocols for high performance computation (HPC)

Fusion of Heterogeneous Big Data, MSU

2014 - 2015

- Worked on a scalable feature level fusion technique using *multi kernel learning* (MKL) by Low Rank Approximation and Linearization in kernel space
- Developed a flexible goal programming framework that allows for constrained optimization of the Choquet Integral in light of multiple sets of varying priority data and high-level expert knowledge

Technical Skills

- Programming Languages: C/C++, Python, R, and Matlab
- High Performance Computing: MPI, OpenMP
- Deep Learning: Tensorflow, PyTorch
- Robot Operating System (ROS), Windows, Linux