Wei Guo

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Citizen of China, Permanent Resident of the United States

Expertise Summary

My research interests lie in *deep learning*, *data mining*, and their applications to real-world problems. I have one year experience in applying **semantic segmentation** to detect boundaries of interest in images captured under widely varying illumination conditions in manufacturing systems. My doctoral dissertation mainly focus on exploring the use of **topological data analysis** in *computer vision, image/geometry processing and complex networks*. In addition, I have extensive experience in solving optimization problems from various domains, such as flight trajectory optimization and revenue management. I expect to start working from **April, 2020**.

Computer Skills

Programming Languages: Python, C/C++, R, Matlab, Fortran, AMPL
Software & Tools: Keras, TensorFlow, CVX, SNOPT
Operating Systems: Unix/Linux, Windows

Education

University of Washington, Seattle, WA
Ph.D., Industrial and Systems Engineering *Dec '19*
Dissertation: Feature Extraction Using Topological Data Analysis for Machine Learning and Network Science Applications
Adviser: Prof. Ashis G. Banerjee

University of Minnesota, Twin Cities, Minneapolis, MN
M.S., Industrial and Systems Engineering *Apr '14*
Thesis: Comparative Analysis of Markup and Markdown Pricing Policies in Revenue Management Problems
Adviser: Prof. Zizhuo Wang
M.S., Aerospace Engineering and Mechanics *Dec '10*
Thesis: Optimal Unmanned Aerial Vehicle Flights for Seeability and Endurance in Winds
Adviser: Prof. Yiyuan J. Zhao

Harbin Institute of Technology, Harbin, China
M.S., Control Science and Engineering *Jul '08*
B.S., Control Science and Engineering *Jul '06*

Publications

- **W. Guo**, R. Chen, Y.-C. Chen, and A. G. Banerjee. Community Tree Persistence: A Topological Method for Community Structure Analysis in Dynamic Networks. In preparation for submission to *Proceedings of National Academy of Science*, 2019.
- E. U. Samani, **W. Guo**, and A. G. Banerjee. Deep Learning-Based Semantic Segmentation of Microscale Objects. In *Proceedings of International Conference on Manipulation, Automation and Robotics at Small Scales (MARSS)*, Helsinki, Finland, 2019.
- **W. Guo**, K. Manohar, S. L. Brunton, and A. G. Banerjee. Sparse-TDA: Sparse Realization of Topological Data Analysis for Multi-Way Classification. *IEEE Transactions on Knowledge and Data Engineering*, 30(7): 1403-1408, 2018.
- R. Chen, Y.-C. Chen, **W. Guo**, and A. G. Banerjee. A Note on Community Trees in Networks. *31st Conference on Neural Information Processing Systems (NIPS) workshop on Synergies in Geometric Data Analysis, arXiv preprint arXiv:1710.03924*, 2017.
- **W. Guo** and A. G. Banerjee. Identification of Key Features Using Topological Data Analysis for Accurate Prediction of Manufacturing System Outputs. *Journal of Manufacturing Systems*, Special Issue on *High Performance Computing and Data Analytics for Cyber-Manufacturing*, 43(2): 225-234, 2017.
- **W. Guo** and A. G. Banerjee. Toward Automated Prediction of Manufacturing Productivity Based on Feature Selection Using Topological Data Analysis. In *Proceedings of IEEE International Symposium on Assembly and Manufacturing (ISAM)*, Ft. Worth, TX, 2016.

- **W. Guo**, Y. J. Zhao, and B. Capozzi. Optimal Unmanned Aerial Vehicle Flights for Seeability and Endurance in Winds. *Journal of Aircraft*, 48(1): 305-314, 2011.

Honors & Awards

- **NSF Doctoral Consortium Travel Award**, IEEE CASE & ISAM, 2016
- **Long March Fellowship** from the First Academy of China Aerospace Science & Industry Corp. (CASIC), 2003

Research Experience

- **Research Assistant**: Boeing Advanced Research Center, University of Washington, Seattle, WA
  - **Fiber Placement Tow End Detection using Machine Learning (US Patent Application)**
    - Developed a computer vision algorithm to increase the detection accuracy of tow ends significantly during automated fiber placement *Mar '18 - Dec '20*
  - **Application of TDA in Machine Learning and Complex Networks**
    - Developed and implemented algorithms that efficiently build and update *community tree*, a newly proposed framework based on *clique percolation method* that reflects topological changes of community structures in dynamic networks *Mar '17 - Dec '20*
    - Presented a new method, referred as *Sparse-TDA method*, that combines *persistence image*-based TDA method with *QR pivoting*-based sparse sampling algorithm to transform topological features into image pixels and identify discriminative pixel samples in the presence of noisy and redundant information; demonstrated its advantage over a state-of-the-art kernel TDA method and L_1-regularized feature selection methods in terms of classification accuracy and training time on three challenging data sets pertaining to 3D meshes of synthetic and real human postures and textured images *May '16 - Jan '17*
    - Applied *TDA Mapper algorithm* on two benchmark data sets for chemical process yield prediction and semiconductor wafer fault detection; yielded topological networks that capture the intrinsic clusters and connections among the clusters present in the data sets and identified key process variables that best differentiate the subgroups of interest through statistical tests *Jan '16 - Apr '16*
- **Research Assistant**: Department of Aerospace Engineering and Mechanics, University of Minnesota, Minneapolis, MN
  - **Trajectory Optimization of Aerial Vehicles in Winds/Obstacle Fields**
    - Generated optimal trajectories of aerial vehicles in obstacle fields, and improved navigation algorithm from piecewise optimization to global optimization *Sep '11 - Dec '11*
    - Identified trajectory patterns of periodic unmanned aerial vehicle flights with various constraints in different winds by numerical solutions, and established power-seeability trade-offs in 3D flights *Sep '09 - Dec '10*

Grant Writing Experience

- Contributed in writing proposal for NSF Career Award on Real-Time Manipulation of Optically Actuated Mobile Microrobots for Multicellular Studies (not awarded)
- Played major role in writing full proposal after competitive pre-proposal screening for DARPA Young Faculty Award on Real-time Adaptive Control of Complex Networks Using Persistent Homology (not awarded)

Teaching Experience

- **Teaching Assistant**: Department of Industrial and Systems Engineering (Au '14, Wi '18) and Department of Electrical Engineering (Au '15), University of Washington, Seattle, WA
- **Teaching Assistant**: Department of Aerospace Engineering and Mechanics (Fa '08 - Fa '11), University of Minnesota, Minneapolis, MN