Wei Guo

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Citizen of China, Permanent Resident of the United States

EXPERTISE SUMMARY

- Research experience applying *topological data analysis* (TDA) methods to computer vision and dynamic network problems
- Hands-on experience using deep learning to tackle line segment detection challenges on images captured under widely varying illumination conditions in manufacturing systems
- Comfortable solving trajectory optimization problems with application of unmanned aerial vehicles in winds or obstacle fields

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COMPUTER SKILLS

Programming Languages: Python, C/C++, R, Matlab, Fortran, AMPL
Software & Tools: Keras, TensorFlow, CVX, SNOPT

EDUCATION

University of Washington, Seattle, WA
Ph.D., Industrial and Systems Engineering   *Mar '20*
Dissertation: Feature Extraction Using Topological Data Analysis for Machine Learning and Network Science Applications

University of Minnesota, Twin Cities, Minneapolis, MN
M.S., Industrial and Systems Engineering   *Apr '14*
M.S., Aerospace Engineering and Mechanics   *Dec '10*

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

RELEVANT PROJECT

Deep Learning for Automated In-Process Inspection of Composite Layup (US Patent Application)   [Github]
Supervisors: Dr. Agnes Blom-Schieber (Boeing) and Prof. Ashis G. Banerjee Apr '18 - Dec '19

- Developed semantic segmentation-based methods for visual inspections of tow boundaries that form the edges of the individual composite plies
- Trained a two-stage modified U-Net model to learn binary pixel-level segmentation
- Extracted tow boundaries based on the differences between predicted pixel class probabilities
- Improved tow end detection accuracy from 88% using current software to ∼99%
- Won **best presentation award** (presented by Dr. Agnes Blom-Schieber) in data analytics track at *2019 Boeing Tech Excellence Conference*

PUBLICATIONS

- **W. Guo**, R. Chen, Y.-C. Chen, and A. G. Banerjee. Efficient Community Detection in Large-Scale Dynamic Networks Using Topological Data Analysis. Working paper.
- 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. In *Workshop on Synergies in Geometric Data Analysis at Neural Information Processing Systems (NIPS), 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*, 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

University of Washington, Seattle, WA
Research Assistant, Boeing Advanced Research Center   *Jan '16 - Dec '19*
- 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   [Github]
- Presented a new method, referred as *Sparse-TDA method*, that integrates *QR pivoting*-based sparse sampling algorithm into *persistence image* to transform topological features into image pixels and identify discriminative pixel samples in the presence of noisy and redundant information   [Github]
  - 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 3D meshes of synthetic and real human postures and textured images
- Applied *TDA Mapper algorithm* on benchmark data sets for chemical yield prediction and semiconductor fault detection, and yielded topological networks to facilitate a better understanding of casual relationships between process variables and outputs through direct visualization

University of Minnesota, Minneapolis, MN
Research Assistant, Dept. of Aerospace Engineering and Mechanics   *Sep '09 - Dec '11*
- Generated optimal trajectories of aerial vehicles in *obstacle fields*, and improved navigation algorithm from piecewise optimization to global optimization
- Identified trajectory patterns of periodic unmanned aerial vehicle flights with various constraints in *different winds*, and established power-seeability tradeoffs in 3D flights

COURSEWORK

- **Deep Learning**: Deep Learning Specialization (Coursera)
- **Statistics**: Statistical Inference, Stochastic Modeling of Scientific Data, Nonparametric Regression and Classification, Statistical Computing, Stochastic Programming & Game Theory
- **Operations Research**: Linear Optimization Models in Engineering, Convex Optimization, Stochastic Processes in Engineering, Engineering Simulation, Decision Analysis

TEACHING & LEADERSHIP

University of Washington, Seattle, WA
Teaching Assistant, Dept. of Industrial and Systems Engineering   *Sep '14 - Dec '15*
- Led laboratory sessions and held office hours for courses "Linear Systems Theory", "Design of Experiments" and "Manufacturing Scheduling and Inventory"

University of Minnesota, Minneapolis, MN
Women's Coordinator, Dept. of Aerospace Engineering and Mechanics   *Jan '12 - May '12*
- Organized lunch / dinner and other events for AEM women graduate students

Teaching Assistant, Dept. of Aerospace Engineering and Mechanics   *Sep '08 - Dec '11*
- Duties at various times included teaching recitation classes, holding office hours, writing and grading problem sets and exam questions, helping design student projects and giving solutions for course "Modern Feedback Control" and multiple mechanics courses