# Wei Guo

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### EXPERTISE SUMMARY

- Hands-on experience using deep learning on image segmentation under widely varying illumination conditions in manufacturing systems
- Research experience applying *topological data analysis* (TDA) methods to feature extraction, computer vision and dynamic network problems
- Extensive experience dealing with both structured and unstructured data on large datasets, and using machine learning-based predictive analytics to solve business problems

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### COMPUTER SKILLS

**Programming Languages**: Python, C/C++, R, SQL, Matlab, AMPL
**Software & Tools**: Spark, Hive, Keras, Pandas, Scikit-Learn, NLTK, OpenCV, CVX

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### 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*

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### RELEVANT PROJECTS

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

- Won **best presentation award** (presented by Dr. Agnes Blom-Schieber) in data analytics track at *2019 Boeing Tech Excellence Conference* as main contributor
- 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%

**Customer Churn Prediction for Streaming Service using PySpark** [Post] [Github]

- Built an end-to-end machine learning pipeline with engineered user behavioral features using random forest classifier to identify customers at risk of churning
- Trained and evaluated large-scale model from 26M+ of log data on AWS EMR (f1 score: 0.91)

**Content-Based Article Recommender for IBM Waston Studio** [Github]

- Applied non-negative matrix factorization to a matrix of TF-IDF features obtained from combined raw documents to find latent topics
- Calculated article similarities and made recommendations for new and existing users

**Real-Time Disaster Response with Figure Eight** [Github]

- Built an ETL pipeline to store categorized emergency messages in a SQLite database
- Created a machine learning pipeline for a web application using TF-IDF transformer and multiclass logistic regression to classify incoming messages (average f1 score: 0.94)

| PROFESSIONAL EXPERIENCE | **University of Washington**, Seattle, WA |
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**University of Washington**, Seattle, WA
**_Research Assistant_**, Boeing Advanced Research Center (BARC)          _Jan '16 - Dec '19_

- **Community Detection in Large-Scale Dynamic Networks Using TDA**          [Github]
  - Developed a unified framework for detecting communities and tracking major structural changes during network evolution based on a newly proposed _community tree_ representation
  - Designed and implemented algorithms to build and update community trees efficiently

- **Sparse Realization of TDA for Multi-Way Classification**          [Github]
  - Presented a new method, a.k.a. _Sparse-TDA_, that incorporates sparse sampling to extract discriminative features in the presence of noisy and redundant information
  - Demonstrated its advantage over a state-of-the-art kernel TDA method (comparable accuracy / up to 98% training time reduction) and $L_1$-regularized feature selection methods (2%-8% accuracy increase / up to 73% training time reduction) on 3D meshes of synthetic and real human postures and textured images

- **Application of TDA in Manufacturing for Feature Selection**
  - Applied _TDA Mapper algorithm_ on benchmark data sets for chemical yield prediction and semiconductor fault detection
  - Yielded topological networks to facilitate a better understanding of casual relationships between process variables and outputs through direct visualization

**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

**COURSEWORK**

- **Deep Learning**: Deep Learning (Coursera specialization certificate)
- **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

**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.