

ZIHING DUAN

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EDUCATION

Zhejiang University

Hangzhou, China

B.E. in Control Science and Engineering

Sep 2016 – Jun 2020

- GPA: 3.74/4.00 (top 15%); admitted on basis of performance on national college admissions exam (top 0.1%)
- Double Major: Computer Science and Technology, Chu-Kochen Honors College
- Selected award: Research and Innovation Scholarship (Ranking of research and innovation: 5/77)

PUBLICATIONS

1. Boxing Wang, Chunlin Zhou, **Ziheng Duan**, Qichao Zhu, Jun Wu, Rong Xiong, “Untethered Quadrupedal Hopping and Bounding on a Trampoline,” Published 2019-10-24, *Frontiers of Mechanical Engineering*.
2. Yueyang Wang, **Ziheng Duan**, Binbing Liao, Fei Wu, Yueting Zhuang, “Heterogeneous Attributed Network Embedding with Graph Convolutional Networks,” Published 2019-07-17, *AAAI-2019*.

PAPER IN PROGRESS

1. **Ziheng Duan***, Haoyan Xu*, Yida Huang*, Jie Feng, Pengyu Song, “Multivariate Time Series Forecasting Based on Causal Inference with Transfer Entropy and Graph Neural Network,” In submission, NIPS-2020.
2. Haoyan Xu, Runjian Chen, Yunsheng Bai, Jie Feng, **Ziheng Duan**, Ke Luo, Yizhou Sun, Wei Wang, “Hierarchical and Fast Graph Similarity Computation via Graph Coarsening and Deep Graph Learning,” In submission, NIPS-2020.
3. **Ziheng Duan***, Haoyan Xu*, Jie Feng*, Runjian Chen, Yida Huang, Yueyang Wang, “Graph Partitioning and Graph Neural Network based Hierarchical Graph Matching for Graph Similarity Computation,” In submission, CIKM-2020.
4. **Ziheng Duan**, Daniel Montes, Yangsibo Huang, Dufan Wu, Javier M. Romero, Ramon Gilberto Gonzalez, Quanzheng Li, “Deep Learning-Based Detection and Localization of Cerebral Aneurysms in Computed Tomography Angiography,” In progress.

REMOTE RESEARCH EXPERIENCE

School of Electrical and Computer Engineering, Purdue University

IN, USA

Research Assistant to Prof. [Xiaoqian Wang](#)

Mar 2020 – Present

Triplet Loss Multi-task Framework for Multivariate Time Series Forecasting (Ongoing Project)

- Optimized multivariate time series forecasting problem from both long-term (raw data) and short-term (first order difference) perspectives.
- Modified the loss function to achieve multi-task learning.

Multivariate Time Series Forecasting based on Heterogeneous Network Embedding (Ongoing Project)

- Used heterogeneous graph neural network to deal with different potential relationships among multivariate time series variables.
- Used causality graph and correlation graph to capture different static relationships among variables
- Introduced dynamic graph to capture the dynamic relationship among variables.

Causality Graph Pooling for Multivariate Time Series Classification (Ongoing Project)

- Converted multivariate time series slices to graphs.
- Used graph pooling based classification method to solve the multivariate time series classification problem.

Multivariate Time Series Forecasting with Transfer Entropy Graph

- Proposed the end-to-end deep learning framework that considers multivariate time series as a graph structure with causality. The causality among time series is used as priori information to guide the forecasting task, and graph neural network is utilized to process this graph structure.
- Used transfer entropy to extract the causality among time series and construct the TE graph. A CNN structure is used to comprehensively extract the features of time series, which are used as node features in the TE graph.
- Conducted extensive experiments on MTS benchmark datasets and the results from the experiment have proved that TEGNN out-performs the state-of-the-art models.

School of Big Data and Software, Chongqing University

Chongqing, China

Research Assistant to Prof. [Yueyang Wang](#)

Mar 2020 – Present

Movie Recommendation System based on Graph Deep Learning (Ongoing Project)

- Proposed a movie recommendation system based on heterogeneous attributed network (HANRec).
- Used the first-order and second-order neighbors of the node to capture the structural and feature information.
- Designed an attention network for neighbors that have a closer relationship with nodes.
- Conducted experiments on the movie ratings dataset MovieLens. HANRec successfully modeled user preferences and predicted movies that users might like.

Graph Partitioning and Graph Neural Network based Hierarchical Graph Matching for Graph Similarity Computation

- Proposed the graph partitioning based framework to address the challenging problem of similarity computation between large graphs. This framework achieves a good trade-off between accuracy and efficiency.
- Proposed a novel model that extract and aggregate local information effectively to conduct subgraph-level comparison. This can resolve the challenges of under representation ability or high time complexity of many graph deep learning based similarity computation models.
- Conducted extensive experiments on a popular graph similarity/distance metric, GED, based on datasets of different size. Results from these experiments and theoretical analysis demonstrate the effectiveness and efficiency of PSimGNN model in graph similarity computation tasks.

School of Computer Science, University of California, Los Angeles

CA, USA

Research Assistant to Dr. [Yunsheng Bai](#)

Mar 2020 – June 2020

Hierarchical Large-scale Graph Similarity Computation via Graph Coarsening and Matching

- Proposed the first framework, which hierarchically encodes and coarsens graphs and then deploys matching mechanism on the coarsened graph pairs, to address the challenging problem of similarity computation between large graphs.
- Proposed a novel pooling layer “ADAPTIVE POOLING”. The generation of centroids in this layer is based on the input graph, which leads to better performance while maintaining permutation invariance.
- Showed significant improvement in time complexity as compared to matching models and outperformed matching models, thus far better than embedding models.
- Conducted extensive experiments on real graph datasets and synthetic datasets consisted of large graphs to demonstrate the scalability, effectiveness and efficiency of our proposed framework.

RESEARCH EXPERIENCE

Harvard Medical School

Boston, MA

Research Assistant to Prof. [Quanzheng Li](#)

Aug 2019 – Mar 2020

Deep Learning for Medical Image Analysis

- Proposed an automatic cerebral aneurysm diagnosis system, *DeepBrain*, based on deep learning.
- Used a 3D Faster R-CNN and a U-netlike encoder-decoder structure to detect a candidate’s aneurysm.
- Designed a multi-scale 3D CNN to reduce false positives from 2 per scan to 0.3.

Robotics Laboratory, Zhejiang University

Hangzhou, China

Research Assistant to Prof. [Rong Xiong](#), Head of the Robotics Laboratory

Oct 2018 – July 2019

Trampoline Jumping of Quadruped Robot

- Used a robot without elastic components jumping on a trampoline to solve the control problem. This required appropriate elastic components and elaborate control algorithms.
- Designed a control algorithm to balance the contact force of feet and avoid oscillation during jumping.
- Adjusted the time delay and models of leg stretching to control the jump height effectively.
- Designed different motion control algorithms to make the robot perform translational and rotational movement while hopping or bounding on the trampoline.

Artificial Intelligence Laboratory, Zhejiang University

Hangzhou, China

Research Assistant to Prof. [Fei Wu](#), the Vice-Dean of College of Computer Science

June 2018 – Sept 2018

Deep Learning for Graph Convolutional Network

- Designed a new network embedding method based on the graph convolution network, *HANE*, which uses network heterogeneity and node attributes to generate high quality embedding.
- Used a node aggregation method for heterogeneous networks, which enables nodes to keep their own characteristics while collecting information of neighboring nodes. Compared with GraphSAGE, this method achieves 1 ~ 4 percent point gain in terms of Macro-F1 and 1 ~ 2 percent point gain in terms of Micro-F1.
- Designed an attention mechanism on graph convolutional networks to leverage not only heterogeneity, but also the node attributes. Compared with GraphSAGE, this mechanism achieves 4 ~ 6 percent point gain in terms of Macro-F1 and 3 ~ 5 percent point gain in terms of Micro-F1.

SELECTED PROJECTS

Course Project of Natural Language Processing:

Pointer-Generator Network for Text Summarization [\[code\]](#) [\[report\]](#)

Mar 2019 – June 2019

- Applied pointer-generator network, which facilitates copying words from original texts by pointing to it, thereby improving the accuracy and handles out of vocabulary (OOV) while retaining the ability to generate new words. This network can be thought of as a balance between the extractive method and the abstractive method.
- Applied the coverage model to solve the repetition problem for sequence-to-sequence models (words are often repeated, especially when generating multiple sentences).
- Used Sohu News as a training dataset and tested the model with different news. This demonstrated a good performance in rouge-n evaluation metric.

Course Project of Computer Vision:

CNN for The Recognition of Handwritten Numbers [\[code\]](#) [\[report\]](#)

Jan 2019

- Used MNIST dataset, CNN network, and TensorFlow framework to achieve handwritten digit recognition.
- Used dropout at the fully connected layer to prevent the network over-fitting.
- Adopted the batch gradient descent method to improve the memory utilization and parallelization efficiency of the large matrix multiplication.

Course Project of Math Modeling:

Optimization Model for Riding and Relocating Rules [\[code\]](#) [\[report\]](#)

June 2018

- Used a neural network regression method to analyze and predict the starting capacity of each return point.
- Used the classification method of clustering to divide the return points into different categories.
- Visualized our model with real data from Hangzhou bicycles to verify its effectiveness.

SELECTED AWARDS AND HONORS

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| • Research and Innovation Scholarship, Zhejiang University | 2019 |
| • Merit Student, Zhejiang University | 2019 |
| • Third Class Scholarship for Academic Excellence, Zhejiang University | 2019 |
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| • Third Class Scholarship for Academic Excellence, Zhejiang University | 2018 |
| • Third Prize of Zhejiang Physics Competition | 2017 |
| • Third Class Scholarship for Academic Excellence, Zhejiang University | 2017 |
| • First Prize in Chinese Physics Olympiad (CPhO; Top 0.1% in Shanxi Province, China) | 2015 |
| • Second Prize in Chinese Mathematical Olympiad (CMO) | 2015 |

SKILLS AND OTHER INFORMATION

Skills

- Major Related Skills: Control Theory, Numerical Analysis, Embedded System, Computer Vision, Natural Language Processing, Machine Learning, Medical Image Analysis
- Basic Science Knowledge: Probability, Mathematic Analysis, Linear Algebra, Physics

Programming Language and Tools

- Python, C/C++, MATLAB, Verilog, Assembly
- Pytorch, Tensorflow, LaTeX

Extracurricular Activities

- **Characteristic Town Research Project** Hangzhou, China, 2019
Investigation on the development of towns with Chinese characteristics.
- **“Running Man,” Students Quality Training Project** Hangzhou, China, 2019
Organized students to participate in various sports activities and supplied related knowledge about running, mountaineering, tennis, badminton, etc.

Leadership Activities

- **National Collegiate Honors Council (NCHC) Meeting** Boston, USA. 2018
Attended the honors council on behalf of the Chu-Kochen Honors College and made suggestions for college development.
- **Singapore Exchange and Studying Visiting Project** NUS, Singapore. 2018
Took part in exchange activities in NUS on behalf of the Chu-Kochen Honors College and made suggestions for college development.