

Liming Wu

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RESEARCH INTERESTS

My PhD research focuses on three-dimensional fluorescence microscopy image synthesis and analysis using machine learning. I am particularly interested in image/video processing, computer vision and deep learning-based methods.

EDUCATION

Purdue University, West Lafayette, IN 08/2019 - present
Ph.D. in Engineering, Major: Electrical & Computer Engineering
Thesis: *Three-Dimensional Fluorescence Microscopy Image Synthesis and Analysis Using Machine Learning*
Advisor: Prof. Edward J. Delp
GPA: **3.75/4.0**

Purdue University Northwest, Hammond, IN 08/2017 - 05/2019
M.S. in Engineering, Major: Electrical & Computer Engineering
Thesis: *Biomedical Image Classification, Localization and Segmentation using Deep Convolutional Neural Networks*
Advisor: Prof. Bin Chen
GPA: **3.96/4.0**

Anhui University of Technology, Ma'anshan, Anhui, China 08/2013 - 06/2017
Bachelor of Computer Science & Technology
Senior Design: *Design of a Virtual Reality Interface for Auto Manufacturing Technician Training*
Advisor: Prof. Chenn Q. Zhou
GPA: **3.6/4.0**

WORK EXPERIENCES

Software Engineer at Google, Mountain View, CA 11/2022 - present
– Camera image processing & Machine learning

Summer R&D Intern at Qualcomm, San Diego, CA 05/2022 - 08/2022
– 3D depth sensing

Summer R&D Intern at Qualcomm, San Diego, CA 05/2021 - 08/2021
– 3D depth sensing
– My implementation outperforms OpenCV's library by a large margin in speed

Research Assistant, ECE Department, Purdue University 01/2020 - 11/2022
– Research assistant at the Video and Image Processing Laboratory ([VIPER](#)) advised by Prof. Edward J. Delp on project Analysis of Microscopy Image Sequences Collected in Living Animals

Teaching Assistant, ECE Department, Purdue University 08/2019 - 12/2019
– Worked with Prof. David Inouye for graduate-level course: Artificial Intelligence (ECE570). Grade the homework and quiz, answer students' questions and help them with their homework

Teaching Assistant, ECE Department, Purdue University Northwest 09/2018 - 05/2019
– Work with Prof. Bin Chen for undergraduate-level course: Programming for Engineers (ECE152). Make up homework, guide the lab and answer students' questions
– Lab Assistant for Object Oriented Programming (ECE251). Guide the lab and help students complete the lab homework

Summer R&D Intern at PhysIQ, Naperville, IL, USA
– Photoplethysmogram signal analysis of medical device

06/2018 - 09/2018

Research Assistant, Purdue University Northwest

06/2017 - 06/2018

- Advised by Dr. Bin Chen and Dr. Chenn Zhou at the Center for Innovation through Visualization and Simulation (CIVS).
- Completed project “Predictive Maintenance for USS Reheat Furnace Fans in Hot Strip Mill” and “Design of a Virtual Reality Interface for Auto Manufacturing Technician Training”

PUBLICATIONS

L. Wu, A. Chen, P. Salama, K. W. Dunn, Seth Winfree and E. J. Delp, “A Quantitative Metric of Confidence For Segmentation of Nuclei in Large Spatially Variable Image Volumes,” *To be submitted*.

L. Wu, A. Chen, P. Salama, K. W. Dunn and E. J. Delp, Three-Dimensional Nuclei Synthesis For Fluorescence Microscopy Image Analysis, *Submitted to International Symposium on Biomedical Imaging*.

A. Chen, **L. Wu**, S. Winfree, K. Dunn, P. Salama, and E. J. Delp, “3D Ground Truth Annotations of Nuclei in 3D Microscopy Volumes,” *bioRxiv*, September 2022. DOI: [10.1101/2022.09.26.509542](https://doi.org/10.1101/2022.09.26.509542)

L. Wu, A. Chen, P. Salama, K. W. Dunn, E. J. Delp, “3D CentroidNet: Nuclei Centroid Detection With Vector Flow Voting,” *Proceedings of the IEEE International Conference on Image Processing (ICIP)*, October 2022, Bordeaux, France. DOI: [10.1101/2022.07.21.500996](https://doi.org/10.1101/2022.07.21.500996)

L. Wu, A. Chen, P. Salama, K. W. Dunn, E. J. Delp, “NISNet3D: Three-Dimensional Nuclei Synthesis and Instance Segmentation in Fluorescence Microscopy Images,” *BioRxiv*, June 2022. DOI: [10.1101/2022.06.10.495713](https://doi.org/10.1101/2022.06.10.495713)

L. Wu, A. Chen, P. Salama, K. W. Dunn, E. J. Delp, “An Ensemble Learning and Slice Fusion Strategy for Three-Dimensional Nuclei Instance Segmentation,” *Proceedings of the Computer Vision for Microscopy Image Analysis (CVMI) Workshop at Computer Vision and Pattern Recognition (CVPR)*, June 2022, New Orleans, LA. DOI: [10.1101/2022.04.28.489938](https://doi.org/10.1101/2022.04.28.489938)

S. Han, A. Chen, S. Lee, C. Fu, C. Yang, **L. Wu**, P. Salama, K. W. Dunn, E. J. Delp, “DINAVID: A Distributed and Networked Image Analysis System for Volumetric Image Data,” *Biorxiv*. DOI: [10.1101/2022.05.11.491511](https://doi.org/10.1101/2022.05.11.491511)

L. Wu, S. Han, A. Chen, P. Salama, K. W. Dunn, E. J. Delp, “RCNN-SliceNet: A Slice and Cluster Approach for Nuclei Centroid Detection in Three Dimensional Fluorescence Microscopy Images,” *Proceedings of the Computer Vision for Microscopy Image Analysis (CVMI) Workshop at Computer Vision and Pattern Recognition (CVPR)*, June 2021 (Best Paper Award Runner-up). DOI: [10.1109/CVPRW53098.2021.00416](https://doi.org/10.1109/CVPRW53098.2021.00416)

A. Chen, **L. Wu**, S. Han, P. Salama, K. W. Dunn, E. J. Delp, “Three Dimensional Non-ellipsoidal Synthetic Nuclei Volume Generation,” *Proceedings of the IEEE International Symposium on Biomedical Imaging (ISBI)*, April 2021, Nice, France. DOI: [10.1109/ISBI48211.2021.9434149](https://doi.org/10.1109/ISBI48211.2021.9434149)

L. Wu, “Biomedical Image Segmentation and Object Detection Using Deep Convolutional Neural Networks,” M.S. thesis at Purdue University, May 2019. DOI: [10.25394/PGS.8051702.v1](https://doi.org/10.25394/PGS.8051702.v1)

B. Chen, **L. Wu**, B. Zhang, S. Liu, and H. Guo, “Automated Fetal Brain Segmentation Using Deep Convolutional Neural Network,” *Proceedings of the 27th Annual Meeting of ISMRM*, August 2019.

B. Chen, **L. Wu**, A. K. Silaen, and C. Zhou, “Industrial Fan Predictive Maintenance Using Deep Recurrent Neural Network”, *SteelSIM2019*.

RESEARCH PROJECTS

Analysis of Microscopy Image Sequences Collected in Living Animals

01/2020 - 11/2022

- Proposed 3DSpCycleGAN for true 3D microscopy volume synthesis
- Proposed NISNet3D for 3D nuclei instance segmentation using vector gradient volume. NISNet3D was trained with synthetic microscopy volumes generated using SpCycleGAN and lightly trained with real microscopy volumes annotated using ITK-SNAP

- Proposed an ensemble learning and slice fusion strategy using Mask R-CNN detectors for 3D nuclei instance segmentation
- Proposed 3D CentroidNet for estimating nuclei centroids using vector flow voting mechanism
- Developed 3D U-Net and Faster R-CNN based models for nuclei counting, nuclei instance segmentation and nuclei detection in 3D fluorescence microscopy images
- Involved in developing the Distributed and Networked Analysis of Volumetric Image Data ([DINAVID](#)) system that integrates our proposed methods and other image processing tools

Fetal Brain Segmentation

01/2019 - 05/2019

- Created labels for 6700 images for coronal, transverse and sagittal MRI scans, respectively
- Designed a U-Net based method with generative adversarial loss for automatic fetal brain segmentation
- Evaluated the performance with multiple state-of-the-art deep learning models

Pneumonia Detection

08/2018 - 01/2019

- Segmented lungs out from the X-Ray images using U-Net
- Classified segmented lungs to three categories: Normal, Pneumonia and not normal using DenseNet121
- Predicted the confidence score and a bounding box for the pneumonia using Faster R-CNN

Automatic Nucleus Detection Using Deep Convolutional Neural Network

08/2018 - 01/2019

- Proposed a deep learning based segmentation method with a fully convolutional neural network U-Net was implemented to distinguish the nuclei and background
- Mask R-CNN algorithm was implemented to perform instance level segmentation

Predictive Maintenance for USS Reheat Furnace Fans in Hot Strip Mill

08/2017 - 08/2018

- Analyzed the temperature, vibration and pressure sensor data with statistical methods (Noise removal, Data interpolation, Cross correlation, events detection)
- Implemented a real-time warning system that base on moving window and threshold
- Predicted the sensor value in the future base on Long Short-Term Memory (LSTM)
- Converted the predicted value to a “Health Index” for maintenance to use
- Building with Python, Matlab and Keras deep learning framework

Design of a VR Interface for Manufacturing Technician Training

08/2016 - 05/2017

- Design of a Virtual Reality (VR) Interface for Auto Manufacturing Technician Training
- Updated the previous computer operation based version with an interactive version by using Virtual Reality technology and HTC Vive device

AWARDS AND HONORS

Best paper award runner-up in Computer Vision for Microscopy Image Analysis, June, 2021 [\[link1\]](#) [\[link2\]](#)

The winner of 3 Minute Thesis (3MT) competition at Purdue University Northwest, April, 2019. [\[link\]](#)

The second price of poster presentation in the day of discovery at Purdue University Northwest, April, 2019

The first prize scholarship at Anhui University of Technology, November, 2016.

National second prize in The RoboCup3D Simulation Group of China Robot and RobCup Competition, November, 2015.

The first prize scholarship at Anhui University of Technology, November, 2015.

The national encouragement scholarship, December, 2015.

Third prize in Oracle Cup National Java Programming Competition Group A of Eastern China, May, 2015.

National first prize in the 15th Ability Storm Cup China Education Robot Competition, November, 2014.

Excellent prize in the 10th SaiWei Cup C language contest, October, 2014.

TALKS

Presented paper “RCNN-SliceNet: A Slice and Cluster Approach for Nuclei Centroid Detection in Three Dimensional Fluorescence Microscopy Images” in the Computer Vision and Pattern Recognition Workshops, June 2021. [\[link\]](#)

Presented “Pneumonia Detection Using Deep Convolutional Neural Networks” in the 3 Minutes Thesis Competition - ECE Department, Purdue University Northwest, April 2019. [\[link\]](#)

Presented “Automated Fetal Brain Segmentation Using Deep Convolutional Neural Networks” poster in Student Research Day - ECE Department, Purdue University Northwest, April 2019.

Presented “Automatic Nucleus Detection Using Deep Convolutional Neural Network” poster in Student Research Day - ECE Department, Purdue University Northwest, March 2018.

Presented “Predictive Maintenance for Reheat Furnace Fans in Hot Strip Mill” poster in Student Research Day - Center for Innovation through Visualization and Simulation (CIVS), Purdue University Northwest, March 2018.

Presented “Design of a Virtual Reality Interface for Auto Manufacturing Technician Training” poster in Student Research Day - Center for Innovation through Visualization and Simulation (CIVS), Purdue University Northwest, March 2017.

PROFESSIONAL SERVICES

Member of IEEE Signal Processing Society

Journal and Conference Paper Reviews

- Journal of Nature Scientific Reports
- IEEE Conference on Computer Vision and Pattern Recognition Workshops
- Annual Conference on Vision and Intelligent Systems

TECHNICAL SKILLS

Proficient: Python, C/C++, Matlab, PyTorch, Linux, Git, Latex

Familiar: Java, R, C#, JavaScript, TensorFlow, Keras