Yi Liu

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Education

University of Delaware — Newark, DE
Ph.D. in Computer Science (GPA 4.0/4.0) — Sept. 2017 – May 2022

Research Area: Computer Vision, Image Processing, Deep Learning, Image Segmentation

University of Maryland — College Park, MD
Master of Engineering (GPA 3.9/4.0) — Jan. 2016 – Aug. 2017

Hunan University — Changsha, China
Bachelor of Engineering — Sept. 2011 – June 2015

Research Experience | *VIMS LAB*

Instance Segmentation on thin and elongated objects — Jan. 2020 – Present

- Explored methods for instance segmentation on thin and elongated objects which is a challenging and not well studied problem in the field
- Developed a program to create a synthetic dataset for thin and elongated objects, which alleviated the problem of lacking of data for this problem
- Proposed a deep learning model which includes an CNN encoder and a LSTM network, and creatively converted an object detection and segmentation problem into predicting a sequence of control points, which is more suitable for tracking and shape analysis in the future

Quantification analysis of microtubule in microscopic images | **github page** — Jan. 2017 – Present

- Collaborated with Delaware Biotechnology Institute and explored methods such as active contour, deep learning based approaches and etc. for automated quantification analysis of filamentous structures in microscopic images
- Developed a pipeline for to collect dataset and collected a microtubule dataset with 50 high resolution microscopic images.
- Proposed a neural network for binary segmentation on filamentous structures which outperforms other existing methods both for actin filaments and microtubules
- Proposed an orientation aware neural network and a terminus pairing algorithm based on geometric properties to segment filaments at instance level, which outperforms other existing methods and is deployed for domain experts

Quantification analysis of actin filaments in microscopic images | **github page** — Jan. 2017 – Present

- Collaborated with Delaware Biotechnology Institute and collected a actin dataset for deep learning based research
- Developed methods to extract fragments in actin filaments network with a human keypoint detection neural network using Pytorch and a fast-marching algorithm, which reduced average analyzing time from 2 hours to minutes
- Performed quantification analysis segmented actins and clustered stromules with a probabilistic framework, and obtained other metrics like curvatures, speed and etc

Tracking Movement of Stromules — Sept. 2019 – Dec. 2019

- Adopted U-Net to segment microtubules and stromules (curved objects) in time-series microscopic images
- Applied active contour to track the deformation and movement of each segmented stronmule over time, and successfully captured the interactions between stromules and microtubules, which was used to done manually
- Clustered stromules with a probabilistic framework, and obtained other metrics like curvatures, speed and etc.

Tracking Spherical Objects' Response to Water Waves in Flumes — May 2018 – Dec. 2018

- Collaborated with Ocean Engineering Lab at the University of Delaware and developed methods for automated quantification analysis of munition mobility experiments in a wave flume based on videos of a bird view camera
- Applied threshold-based methods and morphological operations to detect multiple spherical objects and adopted Kalman-filter to track the objects and successfully obtained their trajectories when objects are occluded

Publications

- **Yi Liu**, Alexander Nedo, Kody Seward, Jeffrey Caplan, Chandra Kambhamettu, *Quantifying Actin Filaments in Microscopic Images using Keypoint Detection Techniques and A Fast Marching Algorithm, ICIP, 2020.*
- **Yi Liu**, Abhishek Kolagunda, Wayne Treible, Alex Nedo, Jeffrey Caplan, Chandra Kambhamettu, *Intersection To Overpass: Instance Segmentation on Filamentous Structures with An Orientation-Aware Neural Network and Terminus Pairing Algorithm*, CVPR Bioimaging Workshop, 2019.
- W. Treible*, P. Saponaro*, **Y. Liu**, A. Das Gupta, V. Veerendraveer, S. Sorensen, C. Kambhamettu., *CATS 2: Color And Thermal Stereo Scenes with Semantic Labels. Vision for All Seasons: Bad Weather and Nighttime (CVPRW)*, 2019.
- **Liu, Y.**, Treible, W., Kolagunda, A., Nedo, A., Saponaro, P., Caplan, J. and Kambhamettu, C., *Densely Connected Stacked U-Network for Filament Segmentation in Microscopy Images*, ECCV Workshops, 2018.

Publications Under Review

- **Yi Liu**, Jeffrey Caplan, Chandra Kambhamettu, *Extracting and clustering of Actin Segments in time-series microscopic images, to be submitted to ICIP 2021.*
- **Yi Liu**, Alexander Nedo, Jeffrey Caplan, Chandra Kambhamettu, *Quantification of filamentous structures in microscopic images, to be submitted to PAMI.*
- **Yi Liu**, Alexander Nedo, Lauren Olson, Jeffrey Caplan, Chandra Kambhamettu, *Instance segmentation on thin and elongated objects with LSTM network, to be submitted to ICCV 2021.*
- Wayne Treible, Alexander Nedo, Kody Seward, **Yi Liu**, Jeffrey Caplan, Chandra Kambhamettu, *Automatic Classification and Quantification of Stromule Dynamics from Microscopy Images, to be submitted*

Industry Experience

Computer Vision Research Intern May 2019 – Sept. 2019
Malong Technologies Shenzhen, China

- Explored methods to detect cloth fibers in microscopic images and observed that existing anchor-based object detection frameworks, such as Faster-RCNN, are not suitable for this task after experiments
- Reconstructed the problem by modeling fibers as sequences of points; implemented methods to convert COCO format binary mask to sequence data and avoided extra expenses on annotation
- Proposed a neural network based on human pose estimation methods to predict the skeleton of fibers, which addresses the heavily overlapping issue and outperformed other existing object detection frameworks for this task

Technical Skills

- **Languages**: Python, Matlab, Java, C++, SQL
- **Frameworks**: Pytorch, Keras, Tensorflow
- **Tools and MISC**: NumPy, OpenCV, OpenGL, MySQL Cplex; Linux, Git, Latex