

Shixuan Gu

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EDUCATION

- Carnegie Mellon University** Pittsburgh, PA, United States
M.S. in Biomedical Engineering - Research Sep. 2021 - Present
Biomedical Engineering Department Head's Fellowship
- Shanghai Jiao Tong University** Shanghai, China
B.Eng. in Information Engineering and Artificial Intelligence, IEEE Honor Class Sep. 2017 - Jun. 2021
Outstanding Graduate of Shanghai Jiao Tong University

RESEARCH INTERESTS

My research interest lies in geometric deep learning with applications in biomedical image analysis. My latest research focuses on 3D registration and reconstruction in electron microscopy imaging (Connectomics) and CT imaging (rib analysis). I also build robots for competition events and medical usage.

PUBLICATIONS

- RibSeg v2: A Large-scale Benchmark for Rib Labeling and Anatomical Centerline Extraction**
Liang Jin*, **Shixuan Gu***, Donglai Wei, Kaiming Kuang, Hanspeter Pfister, Jiancheng Yang, Ming Li, and Bingbing Ni
IEEE Transactions on Medical Imaging (IEEE TMI), 2022 (under review)
- FreNet Frame: A Skeleton-based Method for Segmentation of Elongated Objects**
Shixuan Gu, Jason Ken Adhinarta, Jiancheng Yang, Hanspeter Pfister, Jeff W. Lichtman, and Donglai Wei
IEEE Transactions on Medical Imaging (IEEE TMI), 2022 (in submission)
- Modeling Neuron Growth Process Using Physics-informed Convolutional Neural Network**
Kuanren Qian, Ashlee Liao, **Shixuan Gu**, Victoria Webster-Wood, Jessica Zhang
Scientific Reports, 2022 (manuscript in preparation)
- Ribbon: Template Alignment-based Rib Anatomical Centerline Extraction from CT Scans**
Shixuan Gu, Jiancheng Yang, Donglai Wei, Hanspeter Pfister, and Bingbing Ni
International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI), 2023 (manuscript in preparation)
- Multi-stage Neurite Tracer Detection for Rat Hippocampal Neuron Morphogenesis Analysis**
Shixuan Gu, Ashlee Liao, Victoria Webster-Wood, Jessica Zhang
(ongoing)
- RibSeg Dataset and Strong Point Cloud Baselines for Rib Segmentation from CT Scans**
Jiancheng Yang*, **Shixuan Gu***, Donglai Wei, Hanspeter Pfister, Bingbing Ni
International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI), 2021
[\[paper\]](#) [\[code\]](#) [\[dataset\]](#) [\[poster\]](#)

RESEARCH EXPERIENCE

Visual Computing Group - Harvard University Cambridge, MA, United States

- DenSpineEM: 3D Dendritic Spine Instance Segmentation from EM Images**
Advisor: Prof. Hanspeter Pfister, Prof. Donglai Wei, Prof. Jeff Lichtman May. 2022 - Present
 - Explored the topic of the human brain and computational neuroscience, and developed 3 dendritic spine segmentation benchmarks, from mouse somatosensory cortex, mouse visual cortex, and human frontal lobe, respectively.
 - Implemented a TEASAR-based baseline method to perform dendritic spine segmentation.
 - Generalized the method to perform intracranial aneurysm segmentation.
- RibSeg v2: Benchmark of Rib Segmentation, Labeling, and Anatomical Centerline Extraction**
Advisor: Prof. Hanspeter Pfister, Prof. Donglai Wei, Prof. Bingbing Ni Jun. 2021 - Jul. 2022
 - Enlarged RibSeg dataset by adding 170 cases with labeled rib segmentation and providing the annotations of anatomical centerlines for the total 660 cases, which is the first large public benchmark for this topic.
 - Proposed a point-based deep learning method for end-to-end rib segmentation, labeling, and centerline extraction, with multiple metrics for comprehensive method evaluation.
 - Explored the key challenges and clinical significance of rib segmentation, labeling, and anatomical centerline extraction, facilitating rib-related studies and bone reading tasks for radiologists.

Biorobotics Lab - Carnegie Mellon University

Pittsburgh, PA, United States

- **Robotic Ventilator: Patient Care Technologies for Permanent Ambulatory Artificial Lung Support**

Advisor: Prof. Howie Choset, Prof. Keith Cook

Sep. 2021 - Present

- Designed and built a portable O₂ concentrator for ICU ventilation.
- Designed and built a clinical ventilation sensor for breathing data collection and interaction with an online database.
- Developed a deep learning-based alarming system for lung-related disease and built an online database for breathing data.

Bingbing Ni's Lab - Shanghai Jiao Tong University

Shanghai, China

- **RibSeg Dataset and Strong Point Cloud Baselines for Rib Segmentation from CT Scans**

Advisor: Prof. Bingbing Ni, Prof. Hanspeter Pfister

Oct. 2020 - Jun. 2021

- Developed RibSeg, the first public large-scale dataset, including 490 CT scans (11,719 individual ribs), for rib segmentation and centerline extraction to enable downstream applications and method comparison.
- Proposed an efficient point cloud-based model to segment ribs, which converts dense CT volume into sparse point clouds via thresholding and random downsampling, and produces high-quality and robust rib segmentation (**Dice 95%**) with significant efficiency (**40× faster than prior arts**).

Intelligent Robot Lab - Shanghai Jiao Tong University

Shanghai, China

- **VEX Robotics Project: VEX U robotics world tournaments**

Advisor: Prof. Chuntao Leng

Sep. 2018 - May. 2020

- Co-founded the SJTU VEX Lab, won the first VEX robotics world championship for STJU.
- Designed and built the ejection structure crossbow, trebuchet, and flywheel for three prototypes, respectively.
- Designed the scoring path and programmed control codes for the automation stage of the competition.

PROJECTS

- **Simulated evaluation of automatic control methods for vehicles:** implemented control methods, including PID, MPC, and FLC, and evaluated their performance for intelligent vehicles through simulations on CyberTorcs.
- **Batch QR code scanning for mobile devices:** built a complimentary system to enable batch QR code scanning on mobile devices, with an online CNN-based method and offline DIP-based method.
- **Machine learning-based vehicle localization and mapping:** developed machine learning-based methods for vehicle localization and mapping under complex environments.

AWARDS

- **[2019] VEX U Skills Challenge World Champion, VEX U Division Champion, and World Finalist**
2019 VEX U Robotics World Championship, Robotics Education & Competition Foundation
- **[2018] Create Award, Robot Skills Finalist, Silver Award**
2018 12th Asia-Pacific Robotics Championship, Asian Robotics League
- **[2018] Nomination for Excellence Award, Amaze Award, Tournament Semifinalists**
2018 China National VEX Robotics Competition
- **[2018] Student Ambassador, Excellent Student Presentation Award**
2018 Student Learning Festival of C9+1 Symposium, The University of Hong Kong
- **[2016] First Prize, Best Con in Shanghai International Young Physicists' Tournament (IYPT Shanghai)**
Shanghai Physical Society, China

MISCELLANEOUS

- **Programming:** Python (PyTorch, scikit-learn, NumPy, Pandas), C++, Javascript, HTML, etc.
- **Robotics:** Proficient in VEX robot design, RobotC, SolidWorks.
- **Tools:** ITK, MySQL, CyberTorcs.
- **Teaching Assistant:** UCLA Extension (Shanghai Pinghe School) - Artificial Intelligence and Data Science (COM SCI - 960.01: Aug'21), Research Methodologies (ENGL 902: Aug'21), Academic Writing (ENGL 901: Aug'21).