

# Shixuan Gu

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## EDUCATION

- **Carnegie Mellon University** Pittsburgh, PA, United States  
*M.S. in Biomedical Engineering and Integrated Study in Computer Science* 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

I'm interested in geometric deep learning, especially the interdisciplinary field of 3D computer vision and medical image analysis. Currently, my research focuses on investigating geometric deep learning to tackle problems in biomedical applications, such as electron microscopy imaging (Connectomics) and CT imaging. I'm also interested in medical robotics and physics.

## PUBLICATIONS

- **RibSeg v2: Benchmark of Rib Segmentation, Labeling, and Anatomical Centerline Extraction**  
Jiancheng Yang\*, **Shixuan Gu\***, Liang Jin\*, Kaiming Kuang, Donglai Wei, Hanspeter Pfister, Bingbing Ni, and Ming Li.  
IEEE Transactions on Medical Imaging (IEEE TMI), 2022, (in revision)
- **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, (manuscript)
- **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)
- **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 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 O<sub>2</sub> concentrator for ICU ventilation.
  - Designed and built a clinical ventilation sensor for breathing data collection and interaction with online database.
  - Developed a deep learning-based alarming system for lung-related disease and built an online database for breathing data.

- **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**).

## PROJECTS

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- **Simulated evaluation of automatic control methods for vehicles:** implemented control methods, including PID, MPC, FLC, and evaluated their performance for intelligent vehicles through simulations on CyberTors.
- **Batch QR code scanning for mobile devices:** built a complimentary system to enable batch QR code scanning on mobile devices, with 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

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- **[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

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