SHAN LIN

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RESEARCH INTERESTS

My research interests lie in the integration of artificial intelligence, robotic perception, motion planning, control, and manipulation, with a primary focus on addressing challenges in unstructured, dynamic, and deformable environments to create lifesaving robotic technologies for healthcare applications.

Research Themes

- Autonomous Robotic Surgery
- Computer- and Robot-Assisted Surgery
- Artificial Intelligence
- Robotic Perception
- Surgical Scene Reconstruction and Tracking
- Medical Image Analysis
- Robotic Manipulation

EDUCATION

Ph.D. in Electrical Engineering *Advisor: Blake Hannaford*
University of Washington, Seattle, WA, USA 2017 – 2021
- Dissertation: Vision-based Surgical Instrument Segmentation and Endoscopic Sinus Surgery Skill Assessment.

M.S. in Electrical Engineering *Advisor: Robert J. Webster III*
Vanderbilt University, Nashville, TN, USA 2015 – 2017
- Thesis: Monitoring of Thermal Processes for Medical Applications Using Infrared Thermography.

B.E. in Electronic and Information Engineering
Xiamen University, Xiamen, China 2011 – 2015
- Thesis: The Analysis of Semiconductor Laser Self-mixing Interference Technology and Its Applications.

PROFESSIONAL POSITIONS

Arizona State University *Tempe, AZ, USA*
- Assistant Professor, Tenure-Track, School of Electrical, Computer and Energy Engineering 2025 –

University of California, San Diego *La Jolla, CA, USA*
• Postdoctoral Fellow, Electrical and Computer Engineering 2021 – 2024

University of Washington *Seattle, WA, USA*
• Research Associate, UW BioRobotics Lab 2017 – 2021

Harvard Medical School *Boston, MA, USA*
• Research Intern, Center for Advanced Medical Computing and Analysis 2020

Vanderbilt University *Nashville, TN, USA*
• Research Assistant, Medical Engineering and Discovery Lab 2016 – 2017

AWARDS

• Best Student Paper Award, International Symposium on Medical Robotics (ISMR) 2024.

• Pioneers of Medical Robotics Award, Data vs. Model in Medical Robotics Workshop at International Conference on Intelligent Robots and Systems (IROS) 2023. Award description: An award as part of the workshop to select two stellar doctoral/post-doctoral candidates in the field of medical robotics.

• Rising Star in EECS, Oct. 2022. Description: As part of the international workshop for doctoral/post-doctoral candidates with historically underrepresented genders who are interested in pursuing academic careers.

PUBLICATIONS

* Equal contribution

JOURNALS

J6. Efficient Data-Driven Joint-Level Calibration of Cable-Driven Surgical Robots
H. Peng, A. Lewis, Y.H. Su, **S. Lin**, D.T. Chiang, W. Jiang, H. Lai, B. Hannaford
npj Robotics, 2(1), 1-16, 2024 [paper]

J5. Reducing Annotating Load: Active Learning with Synthetic Images in Surgical Instrument Segmentation
H. Peng, **S. Lin**, D. King, Y.H. Su, R.A. Bly, K.S. Moe, and B. Hannaford
Medical Image Analysis, 97, p.103246, 2024 [paper]

J4. ORRN: An ODE-based Recursive Registration Network for Deformable Respiratory Motion Estimation With Lung 4DCT Images
X. Liang, **S. Lin**, F. Liu, D. Schreiber, and M.C. Yip
IEEE Transactions on Biomedical Engineering, pp. 1-12, 2023 [paper][github]

J3. Contour Primitive of Interest Extraction Network Based on Dual-Metric One-Shot Learning for Vision Measurement

F. Qin, **S. Lin**, and D. Xu
IEEE Transactions on Industrial Informatics, 19(4), pp.5839-5848, 2022 [paper]

J2. Multi-frame Feature Aggregation for Real-time Instrument Segmentation in Endoscopic Video
S. Lin, F. Qin, H. Peng, R.A. Bly, K.S. Moe, and B. Hannaford
IEEE Robotics and Automation Letters, 6(4), pp.6773-6780, 2021 [paper]

J1. Towards Better Surgical Instrument Segmentation in Endoscopic Vision: Multi-angle Feature Aggregation and Contour Supervision
F. Qin, **S. Lin**, Y. Li, R.A. Bly, K.S. Moe, and B. Hannaford
IEEE Robotics and Automation Letters, 5(4), pp.6639-6646, 2020 [paper]

CONFERENCES

C14. CtRNet-X: Camera-to-Robot Pose Estimation in Real-World Conditions Using a Single Camera
J. Lu, Z. Liang, T. Xie, F. Ritcher, **S. Lin**, S. Liu, M.C. Yip
IEEE International Conference on Robotics and Automation (ICRA), 2025 [paper]

C13. BASED: Bundle-Adjusting Surgical Endoscopic Dynamic Video Reconstruction using Neural Radiance Fields
S. Saha, Z. Liang, **S. Lin**, J. Lu, M.C. Yip, and S. Liu
IEEE/CVF Winter Conference on Applications of Computer Vision (WACV), 2025 [paper]

C12. SuPerPM: A Large Deformation-Robust Surgical Perception Framework Based on Deep Point Matching Learned from Physical Constrained Simulation Data
S. Lin, A.J. Miao, A. Alabiad, F. Liu, K. Wang, J. Lu, F. Richter, and M.C. Yip
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2024 [paper]

C11. Coauthor of DROID: A Large-Scale In-The-Wild Robot Manipulation Dataset
Robotics: Science and Systems (RSS), 2024 [paper]

C10. HemoSet: The First Blood Segmentation Dataset for Automation of Hemostasis Management
A.J. Miao, **S. Lin**, J. Lu, F. Richter, B. Ostrander, E. Funk, R. Orosco, and M.C. Yip
International Symposium on Medical Robotics (ISMR), 2024 [paper]
Best Student Paper Award

C9. Tracking Snake-like Robots in the Wild Using Only a Single Camera
J. Lu, F. Richter, **S. Lin**, and M.C. Yip
IEEE International Conference on Robotics and Automation (ICRA), 2024 [paper]

C8. Real-to-Sim Deformable Object Manipulation: Optimizing Physics Models with Residual Mappings for Robotic Surgery
X. Liang, F. Liu, Y. Zhang, Y. Li, **S. Lin**, and M.C. Yip
IEEE International Conference on Robotics and Automation (ICRA), 2024 [paper]

C7. AnyOKP: One-Shot and Instance-Aware Object Keypoint Extraction with Pretrained ViT
F. Qin, T. Hou, **S. Lin**, Kaiyuan Wang, Michael C. Yip, and Shan Yu
IEEE International Conference on Robotics and Automation (ICRA), 2024 [paper][github]

C6. Coauthor of Open X-Embodiment: Robotic Learning Datasets and RT-X Models
IEEE International Conference on Robotics and Automation (ICRA), 2024 [paper]
Best Conference Paper Award

C5. Semantic-SuPer: A Semantic-aware Surgical Perception Framework for Endoscopic Tissue Identification, Reconstruction, and Tracking
S. Lin, A.J. Miao, J. Lu, S. Yu, Z.Y. Chiu, F. Richter, and M.C. Yip
IEEE International Conference on Robotics and Automation (ICRA), pp. 4739-4746, 2023 [paper][github]

C4. Endoscope Localization and Dense Surgical Scene Reconstruction for Stereo Endoscopy by Unsupervised Optical Flow and Kanade-Lucas-Tomasi Tracking
Z. Yang, **S. Lin**, R. Simon, and C.A. Linte
Annual International Conference of the IEEE Engineering in Medicine & Biology Society, pp. 4839-4842, 2022 [paper][github]

C3. LC-GAN: Image-to-Image Translation Based on Generative Adversarial Network for Endoscopic Images
S. Lin, F. Qin, Y. Li, R.A. Bly, K.S. Moe, and B. Hannaford
International Conference on Intelligent Robots and Systems (IROS), pp. 2914-2920, 2020 [paper]

C2. Video-based Automatic and Objective Endoscopic Sinus Surgery Skill Assessment
S. Lin, X. Gu, R.A. Bly, K.S. Moe, and B. Hannaford
SPIE Medical Imaging 2020: Image-Guided Procedures, Robotic Interventions, and Modeling, Vol. 11315, pp. 663-670, 2020 [paper]

C1. Don't Get Burned: Thermal Monitoring of Vessel Sealing Using a Miniature Infrared Camera
S. Lin, L. Fichera, M.J. Fulton, and R.J. Webster III
SPIE Medical Imaging 2017: Image-Guided Procedures, Robotic Interventions, and Modeling, Vol. 10135, pp. 263-269, 2017 [paper]

PRE-PRINTS

P1. TwinTrack: Bridging Vision and Contact Physics for Real-Time Tracking of Unknown Dynamic Objects
W. Yang, Zhixian Xie, Xuechao Zhang, Heni Ben Amor, Shan Lin, Wanxin Jin
arXiv preprint, 2025 [paper]

P2. SurgXBench: Explainable Vision-Language Model Benchmark for Surgery
J. Cheng, X. Zhao, S. Liu, X. Yu, R. Prakash, P. J. Codd, J. E. Katz, **S. Lin**
arXiv preprint, 2025 [paper]

WORKSHOPS

W3. BAA-NGP: Bundle-Adjusting Accelerated Neural Graphics Primitives
S. Liu*, **S. Lin***, J. Lu, A. Supikov, and M.C. Yip
Workshop on Visual Odometry and Computer Vision Applications Based on Location Clues at CVPR, 2024 [paper][github]

W2. Semantic-SuPer: Employing Semantic Perception for Endoscopic Tissue Identification, Reconstruction, and Tracking
S. Lin, J. Lu, F. Richter, and M.C. Yip
Workshop on Integrated Perception, Planning, and Control for Physically and Contextually-Aware Robot Autonomy at IROS, 2023 [paper]

W1. Automatic Sinus Surgery Skill Assessment Based on Instrument Segmentation and Tracking in Endoscopic Video
S. Lin, F. Qin, R.A. Bly, K.S. Moe, and B. Hannaford
Multiscale Multimodal Medical Imaging at MICCAI, pp. 93-100, 2019 [paper]

THESES

T2. Vision-based Surgical Instrument Segmentation and Endoscopic Sinus Surgery Skill Assessment
S. Lin, Ph.D. Dissertation, University of Washington, 2021 [paper]

T1. Monitoring of Thermal Processes for Medical Applications Using Infrared Thermography
S. Lin, M.S. Thesis, Vanderbilt University, 2017 [paper]

INVITED TALKS

• **IEEE International Conference on Robotics and Automation 2025 1st International Workshop on the Evolving Landscape of Surgical Robotics.** Intelligent, Multimodal Surgical Perception. 05/19/2025, Atlanta, USA.

• **Southwest Robotics Symposium.** ASU Faculty Talks. 10/31/2024, Tempe, USA.

• **International Symposium for Medical Robotics 2024 Workshop on Machine Learning with the da Vinci Research Kit.** Bringing Deep Learning to Surgical Scene Reconstruction and Tracking. 06/03/2024, Atlanta, USA.

• **Arizona State University.** Robust Surgical Perception: Toward Autonomous Robotic Surgery. 03/20/2024, Phoenix, USA.

• **Duke University.** Robust Surgical Perception: Toward Autonomous Robotic Surgery. 03/11/2024, Durham, USA.

• **Worcester Polytechnic Institute.** Robust Surgical Perception: Toward Autonomous Robotic Surgery. 02/23/2024, Worcester, USA.

• **University of Rochester.** Robust Surgical Perception: Toward Autonomous Robotic Surgery. 02/09/2024, Rochester, USA.

• **International Conference on Intelligent Robots and Systems 2023 Workshop on Data vs. Model in Medical Robotics.** Employing Robust, Semantic Perception for Endoscopic Tissue Identification, Tracking, and Reconstruction. 10/05/2023, Detroit, USA.

• **Worcester Polytechnic Institute Robotics Colloquium.** Exploring Robust Real-time Instrument Segmentation for Endoscopic Sinus Surgery. 09/10/2021, virtual.

• **University of California San Diego.** Exploring More Generalizable and Robust Instrument Segmentation for Endoscopic Sinus Surgery. 05/07/2021, virtual.

• **Mount Holyoke College CS Seminar.** Exploring Robust Real-time Instrument Segmentation for Endoscopic Sinus Surgery. 03/05/2020, virtual.

• **Johns Hopkins University LCSR Seminar.** Exploring Robust Real-time Instrument Segmentation for Endoscopic Sinus Surgery. 02/10/2020, virtual.

NEWS COVERAGE

• **ASU Full Circle.** *New Faculty Member, 2024–25*. Oct, 2024.

• **Computer Vision News**. *Pioneers of Medical Robotics from Data vs Model in Medical Robotics Workshop – IROS 2023*. Oct, 2023.

PROFESSIONAL SERVICES

Workshop / Symposium Organizer:

• 1st International Workshop on the Evolving Landscape of Surgical Robotics (ELSR), ICRA 2025, Atlanta, USA

• Southwest Robotics Symposium 2024, Arizona State University

Reviewer:

• Robotics: Science and Systems (RSS)

• IEEE International Conference on Robotics and Automation (ICRA)

• IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)

• IEEE International Conference on Soft Robotics (RoboSoft)

• International Symposium on Medical Robotics (ISMR)

• IEEE Robotics and Automation Letters (RA-L)

• IEEE Transactions on Medical Imaging (TMI)

• International Journal of Robotics Research (IJRR)

• Journal of Medical Robotics Research (JMRR)

• IEEE Transactions on Medical Robotics and Bionics (T-MRB)

MENTORSHIP

PhD Student

Arizona State University

- Jiajun Cheng *2025*
  Benchmarking and Developing Vision Language Models for Surgical Data
- Haokai Xu *2025*
  Dynamic and Deformable Scene 3D Reconstruction
- Hiu Ching (Athena) Cheung - Joining in Spring 2026 *2026*
  Physics-based Deformable Object Manipulation

Master's Student

Arizona State University

- Xianwu Zhao *2025*
  Benchmarking Vision Language Models for Surgical Data

Undergraduate Student Mentorship

Arizona State University

- Spencer Romero *2025*
  Multimodal Sensing
- Leonardo Dayal *2025*
  Robot Pose Estimation

Past Mentorship During My Postdoc and PhD:

Master's Student

University of California San Diego

- Pradhit Ongole *2024*
  Deformable Object Manipulation
- Tung-Yen Chiang *2024*
  Lithotripsy Video Event Detection
- Zekai (Lucas) Liang, Now Ph.D. student at UC San Diego, USA *2024*
  Surgical Applications of INR, Robot Pose Tracking
- Sharvari Deshmukh *2024*
  Lithotripsy Video Event Detection
- Kaiyuan Wang, Now Ph.D. Student at USC, USA *2023-2024*
  Uncertainty Analysis of 3D Surgical Perception
- Saksham Jindal *2023*
  Robotics applications of INR
- Stephen Jarrell, Now Machine Learning Engineer at Google *2023*
  Surgical Applications of INR
- Rohitkumar Murali Arasanipalai *2022*
  Differentiable Rendering of Surgical Scenes
- Chong He, Now Ph.D. Student at Simon Fraser University, Canada *2021-2022*
  Surgical Video Event Detection

- Xiao Liang, Now Ph.D. student at UC San Diego, USA *2021-2022*
  4D-CT Lung Motion Tracking

Undergraduate Student

University of California San Diego

- Yijie He *2024*
  Lithotripsy Video Event Detection
- Charvi Shukla *2024*
  LLMs for Medical Treatment Planning
- Vandita Jain *2024*
  Physical Simulation-Assisted 3D Surgical Perception
- Albert Miao, Now Ph.D. Student at University of Cambridge, UK *2021-2023*
  Semantic Information-Assisted 3D Surgical Perception
- Ali Alabiad *2023*
  Physical Simulation-Assisted 3D Surgical Perception
- Huaner Wang *2023*
  Vision-based Surgical Instrument Tracking
- Shunkai Yu, Now Software Engineer at Qualcomm *2021-2022*
  Semantic Segmentation of Endoscopic Videos

University of Washington

- Xinyu Gu *2020*
  Surgical Skill Assessment

TEACHING

Arizona State University, Tempe, USA

School of Electrical, Computer and Energy Engineering

- EEE 203 Signals and Systems *01/2025 – 05/2025*

Past Teaching During My PhD

University of Washington, Seattle, USA

Course Developer and Instructor *Electrical & Computer Engineering Department*

- EE 200A ECE Lecture Series on Image Processing *06/2020 – 08/2020*

Course Developer *Global Innovation Exchange*

- Robotics I: Navigation and Mobility *12/2019 – 03/2020*

Teaching Assistant *Electrical & Computer Engineering Department*

- EE 557 Dynamics of Controlled Systems *09/2019 – 12/2019*
- EE 447 Control System Analysis *09/2018 – 12/2018,03/2019 – 06/2019, 03/2020 – 06/2020*
- EE 341 Discrete Time Linear Systems *01/2018 – 03/2018, 06/2018 – 08/2018,01/2019 – 03/2019*
- EE 235 Continuous Time Linear Systems *09/2020 – 12/2020*
- EE 233 Circuit Theory *06/2019 – 08/2019*

- EE 215 Fundamentals of Electrical Engineering *03/2018 – 06/2018*

Vanderbilt University, Nashville, USA

Teaching Assistant *Computer Science Department*

- CS2212 Discrete Structure *01/2017 – 04/2017*