# Baichuan Jiang

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## SUMMARY

I am currently a PhD candidate in Computer Science at Johns Hopkins University. My research interests include AI-assisted medical imaging (particularly ultrasound & photoacoustic imaging), and robotic/image-guided medical procedures. I am advised by Dr. Emad M. Boctor at MUSiiC Research Lab and co-advised by Dr. Mathias Unberath and Dr. Russell H. Taylor, in the Laboratory for Computational Sensing and Robotics (LCSR).

## EDUCATION

**Ph. D.** **Johns Hopkins University,** Baltimore, MD Jun. 2018 – Current

- Computer Science, GPA (3.88/4.0)
- Dissertation: Automation methods for interventional and diagnostic wearable ultrasound
- Thesis Advisors: Dr. Emad M. Boctor (Primary), Dr. Russell H. Taylor, Dr. Mathias Unberath

**M.S.E.** **Johns Hopkins University,** Baltimore, MD Sep. 2016 – May 2018

- Robotics, track: Medical robotics and Computer Integrated Surgical System, GPA (3.86/4.0)
- Featured courses: Robot Kinematics and Algorithms, Computer Vision, Computer-Integrated Surgery

**B.E.** **Tianjin University,** Tianjin, China Sep. 2012 – Jul. 2016

- Mechanical Engineering, GPA: 3.72/4.0 (11th/152)
- First Class Bomesc Scholarship (2014)
- Fund recipient for Thesis Abroad program at Harvard Medical School. (2015)

## AWARDS AND RECOGNITIONS

Johns Hopkins ACCM Research Day 1st Place Award Dec. 2023

MICCAI 2022 – ASMUS Workshop Best Demo Award Sep. 2022

IPCAI 2022 – Intuitive Surgical Bench-to-Bedside Award: Runner-up Jun. 2022

MICCAI 2021 – ASMUS Workshop NVidia Special Award Sep. 2021

## WORK & TEACHING EXPERIENCE

**Engineering Intern** (part-time), Clear Guide Medical Inc. Jun. 2021 – Dec. 2021

- Developed multi-platform (software simulation and robotic simulation) validation for wearable scanner[9].
- Developed software visualization tools for ultrasound guided spine intervention[9].
- Conducted full user study for evaluating the developed augmented reality user interfaces[3].

**AI-Based Medical Image Analysis Intern**, Philips Jun. 2019 – Aug. 2019 & Jun. 2020 – Aug. 2020

- Designed and implemented vessel segmentation method for peripheral vascular disease ultrasound exams with spatial and temporal gating mechanisms[10].
- Developed fast image mask annotation tools that enables labeling 5000+ image in an hour.

**Teaching Assistant**, Computer Integrated Surgery I&II (Prof. Russell H. Taylor) Feb. 2019 – May. 2020

- Help managing course contents/assignments/grading, lead TA sessions, hold office hours.

## RESEARCH EXPERIENCE

**Wearable Ultrasound-based Lumbar Puncture Image Guidance** Sep. 2021 – Current

- PI: Dr. Emad M. Boctor, Dr. Peter Kazanzides (JHU)
- Established angle-based volume reconstruction algorithm for better vertebrae definition[7].
- Developed 3D vertebrae estimation algorithm for segmenting the bone surface from ultrasound images[5].
- Integrated two alternative augmented reality-based user interfaces for needle insertion guidance[3].

**Photoacoustic imaging-based Automatic Fetal Brain Hypoxia Identification** Sep. 2021 – Sep.2023

- PI: Dr. Emad M. Boctor, Dr. Jeeun Kang (JHU)
- Developed superior sagittal sinus localization-based algorithm for identification of the brain hypoxia from in vivo piglet experiment dataset using photoacoustic imaging[Paper pending].

**MRI-based Ultrasound Simulation for Wearable Device Placement Analysis** Sep. 2020 – Sep. 2021

- PI: Dr. Emad M. Boctor, Dr. Mathias Unberath (JHU)
- Established IRB protocol for clinical fetal ultrasound and MRI image data collection.
- Initial investigation on fetal MRI tissue labeling and ultrasound simulation[Paper pending].

**Fetal Standard Plane Extraction from Volumetric Ultrasound Data** Sep. 2019 – May. 2020

- PI: Dr. Emad M. Boctor, Dr. Mathias Unberath, Dr. Russell H. Taylor (JHU)
- Designed a deep Q-network based algorithm to extract planes of interest from a volumetric ultrasound image with sequential iterative decision making. Achieved average localization error of 5.51 mm and 2.26 deg on test volume with varying initializations[11].

**Point-of-Care Ultrasound Probe Guidance for Trauma Care** Nov. 2018 – May. 2019

- PI: Dr. Emad M. Boctor, Dr. Mathias Unberath, Dr. Russell H. Taylor (JHU)
- Established a data collection environment for optically tracked ultrasound scanning with Kinect sensing.
- Obtained IRB human participant data collection protocol, performed first trial on human subject. The same IRB protocol and user study environment can be used for our current novice user training tasks.

**Ultrasound Integration into Surgical Robot Complementary Situational Awareness (CSA)** Feb. 2018 – Sep. 2018

- PI: Dr. Preetham Chalasani, Dr. Russell H. Taylor, Dr. Emad M. Boctor (JHU)
- Enabled teleoperated ultrasound scanning within CSA framework which gives surgeon an integrated information flow. My contributions include ultrasound phantom design, robotic ultrasound hand-eye calibration, automatic phantom lesion segmentation, US-CT registration based on the segmentation results.

**CoSTAR in surgery: A Cross-platform User Interface for Surgical Robot Task Specification** Jan. 2017 – Aug. 2017

- PI: Dr. Christopher Paxton, Dr. Gregory D. Hager (JHU)
- Integrated the CoSTAR system with daVinci research kit (dVRK) to perform behavior-tree based tasks for semi-autonomous suturing[17].
- Implemented Dynamic Movemnt Primitive (DMP)-based action for simulating surgical sub-gestures

**Intra-ocular Snake Robot Vision-based Angular Calibration and 2-DOF Teleoperation** Jan. 2017 – May 2017

- PI: Dr. Ehsan Azimi, Dr. Peter Kazanzides, Dr. Iulian Iordachita (JHU)
- Designed a real-time video processing algorithm for robot tip pose measurement and calibration[15].
- Designed and implemented a 2DOF intraocular snake robot control algorithm for teleoperation[15].

**Needle Deflection Estimation under Optical-EM Tracking in MRI-guided cryoablation** Nov. 2015 – May 2016

- PI: Dr. Jayender Jagadeesan (HMS, BWH)
- Established the angular spring model of the surgical needle configuration to achieve higher end-point position accuracy and integrating the model into the Optical-EM-based navigation system[13,14].
- Designed Kalman filter-based algorithm to fuse optical-EM sensor data to achieve real-time needle deflection compensation via integration of above needle model[16,18].

**©Image-based Surgical Robot Navigation Software System** May 2014 – Jun. 2015

- PI: Dr. Shan Jiang (TJU)
- Implemented the Navigation Module for EM-tracked robotic needle insertion system
- Integrated the navigation/dose planning/segmentation modules into a complete navigation system for image-guided tumor ablation needle insertion.

## PUBLICATIONS

In reverse chronological order, newest first:

1. Wu, Y., Enders, J., Williams, C., **Jiang, B.**, Wiskin, J., Rothberg, M.B., Negussie, A.H., Klock, J., Hazen, L., Xu, S. and Turkbey, B., 2024, April. Realistic digital phantoms for prostate ultrasound and photoacoustic imaging.

In Medical Imaging 2024: Ultrasonic Imaging and Tomography (Vol. 12932, pp. 318-327). SPIE.

2. Song, H., Moradi, H., **Jiang, B.**, Wu, Y., Taylor, R., Deguet, A., Kang, J.U., Salcudean, S. and Boctor, E.M., 2023. Photoacoustic imaging with photoacoustic markers: an ex vivo demonstration. Authorea Preprints.
3. **Jiang, B.,** Wang, L., Xu, K., Hossbach, M., Demir, A., Rajan, P., Taylor, R.H., Moghekar, A., Foroughi, P., Kazanzides, P. and Boctor, E.M., 2023. Wearable Mechatronic Ultrasound-Integrated AR Navigation System for Lumbar Puncture Guidance. IEEE Transactions on Medical Robotics and Bionics.
4. **Jiang, B.**, Wang, L., Xu, K., Moghekar, A., Kazanzides, P. and Boctor, E.M., 2023, September. Active Needle Tracking with Wearable 2-DOF Ultrasound Scanner for Lumbar Puncture Guidance. In 2023 IEEE International Ultrasonics Symposium (IUS) (pp. 1-3). IEEE.
5. **Jiang, B.**, Xu, K., Moghekar, A., Kazanzides, P. and Boctor, E., 2023, April. Feature-aggregated spatiotemporal spine surface estimation for wearable patch ultrasound volumetric imaging. In Medical Imaging 2023: Ultrasonic Imaging and Tomography (Vol. 12470, pp. 111-117). SPIE.
6. Wu, Y., **Jiang, B.**, Song, H., Xu, K., Moradi, H. and Boctor, E.M., 2022, October. Feasibility of Using Low-Energy Pulsed Laser Diode on Clinical Ultrasound Platforms for Photoacoustic and Transrectal Ultrasound Guided Laparoscopic Prostatectomy. In 2022 IEEE International Ultrasonics Symposium (IUS) (pp. 1-4). IEEE.
7. **Jiang, B.**, Xu, K., Moghekar, A., Kazanzides, P. and Boctor, E.M., 2022, October. Insonification Angle-based Ultrasound Volume Reconstruction for Spine Intervention. In 2022 IEEE International Ultrasonics Symposium (IUS) (pp. 1-4). IEEE.
8. Song, H., Moradi, H., **Jiang, B.**, Xu, K., Wu, Y., Taylor, R.H., Deguet, A., Kang, J.U., Salcudean, S.E. and Boctor, E.M., 2022. Real-time intraoperative surgical guidance system in the da Vinci surgical robot based on transrectal ultrasound/photoacoustic imaging with photoacoustic markers: an ex vivo demonstration. IEEE Robotics and Automation Letters, 8(3), pp.1287-1294.
9. Xu, K., **Jiang, B.**, Moghekar, A., Kazanzides, P. and Boctor, E., 2022. AutoInFocus, a new paradigm for ultrasound-guided spine intervention: a multi-platform validation study. International Journal of Computer Assisted Radiology and Surgery, 17(5), pp.911-920.
10. **Jiang, B.**, Chen, A., Bharat, S. and Zheng, M., 2021. Automatic ultrasound vessel segmentation with deep spatiotemporal context learning. In Simplifying Medical Ultrasound: Second International Workshop, ASMUS 2021, Held in Conjunction with MICCAI 2021, Strasbourg, France, September 27, 2021, Proceedings 2 (pp. 3-13). Springer International Publishing.
11. **Jiang, B**., Xu, K., Taylor, R.H., Graham, E., Unberath, M. and Boctor, E.M., 2020, September. Standard plane extraction from 3D ultrasound with 6-DOF deep reinforcement learning agent. In 2020 IEEE International Ultrasonics Symposium (IUS) (pp. 1-4). IEEE.
12. Gao, W., **Jiang, B.**, Kapur, T. and Jayender, J., 2019. MULTI-MODAL IMAGING FOR SURGERY AND INTERVENTIONS. In The Encyclopedia of MEDICAL ROBOTICS: Volume 3 Image-guided Surgical Procedures and Interventions (pp. 119-153).
13. **Jiang, B.**, Gao, W., Kacher, D., Nevo, E., Fetics, B., Lee, T.C. and Jayender, J., 2018. Kalman filter-based EM-optical sensor fusion for needle deflection estimation. International journal of computer assisted radiology and surgery, 13, pp.573-583.
14. Gao, W., **Jiang, B.**, Kacher, D.F., Fetics, B., Nevo, E., Lee, T.C. and Jayender, J., 2018. Real‐time probe tracking using EM‐optical sensor for MRI‐guided cryoablation. The International Journal of Medical Robotics and Computer Assisted Surgery, 14(1), p.e1871.
15. Azimi, E., **Jiang, B.**, Tang, E., Kazanzides, P. and Iordachita, I., 2017, October. Teleoperative control of intraocular robotic snake: Vision-based angular calibration. In 2017 IEEE SENSORS (pp. 1-3). IEEE.
16. Gao, W., **Jiang, B.**, Kacher, D.F., Fetics, B., Nevo, E., Lee, T.C. and Jayender, J., 2017, March. Real-time MRI-guided needle intervention for cryoablation: a phantom study. In Medical Imaging 2017: Image-Guided Procedures, Robotic Interventions, and Modeling (Vol. 10135, pp. 240-245). SPIE.
17. **Jiang, B.**, Paxton, C., Kazanzides, P. and Hager, G.D., 2017. CoSTAR in Surgery: A Cross-platform User

Interface for Surgical Robot Task Specification.

18. **Jiang, B.**, Gao, W., Kacher, D.F., Lee, T.C. and Jayender, J., 2016. Kalman filter based data fusion for needle deflection estimation using optical-em sensor. In Medical Image Computing and Computer-Assisted Intervention–MICCAI 2016: 19th International Conference, Athens, Greece, October 17-21, 2016, Proceedings, Part I 19 (pp. 457-464). Springer International Publishing.

## ACADEMIC AND RESEARCH SKILLS

Confident: Python, MATLAB, C/C++, ROS, Git, CAD, PyTorch, TensorFlow, Qt, Linux, OpenCV

Having experience: C#, Java, CMake, 3D Slicer SDK, VTK, ITK, R, SQL, Arduino, Ruby, CUDA, Unity