Ruiqi Zhu

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Education

King's College London **present**
PhD student of Artificial Intelligence | Full Scholarship

Imperial College London
Master of Medical Robotics and Image-guided Intervention | Distinction

University of Birmingham
Bachelor of Mechanical Engineering | First-Class

Key skills: Deep Reinforcement Learning, Robotics
Tools: OpenCV, ROS, Python, C++, Matlab, Tensorflow, Pytorch

Research Experience

1. Machine Learning Based Human-Robot Shared Control for Robotic Surgery

In this project, Deep Reinforcement Learning methods were applied to automate some repetitive manipulations such as approaching targets and grasping targets in the simulated scenario, which mimics the real working scenario of the medical-robot-assisted surgery platform.

2. Sim-to-Real Transfer Learning for Hybrid Human-Robot Control Interfaces Based on Multi-Domain Robotic Surgery Dataset

As an emerging interdisciplinary field, surgical data science has led to significant advances in extracting underlying information from the data recorded. In surgical robotics, the large dataset can accelerate the development of a high level of autonomy in surgical operation and enable surgical skill analysis. Numerous surgical robotic platforms have been introduced for various surgeries, while the data collected has inherent domain gaps. In this case, transfer learning can enable the fusion of surgical data from different robotics platforms to extract the generic models of the surgical task while preserving the inherent features of the specific tasks. In this project, my responsibility is to bridge the gap between datasets from different domains.

3. Supervised Semi-Autonomous Control for Surgical Robot Based on Bayesian Optimization

The recent development of Robot-Assisted Minimally Invasive Surgery (RAMIS) has brought many benefits to ease the performance of complex Minimally Invasive Surgery (MIS) tasks and lead to more clinical outcomes. Compared to direct master-slave manipulation, semi-autonomous control for the surgical robot can enhance the efficiency of the operation, particularly for repetitive tasks. However, operating in a highly dynamic in-vivo environment is complex. Supervisory control functions should be included to ensure flexibility and safety during the autonomous control phase. This project presents a haptic rendering interface to enable supervised semi-autonomous control for a surgical robot.

4. Human-Robot Shared Control for Surgical Robot Based on Sim-to-Real Transfer Via Dynamic Motion Primitive

With the advances in artificial intelligence, human robot shared control will soon become the new standard in robotic surgery, where the surgical robots carry out the sub-tasks autonomously while the surgeon focus on delicate tasks. The human control can be implemented via master-slave mapping, while the automation can be achieved by Learning from Demonstration (LfD). To avoid the expensive data collection on the real surgical robots, the collection was carried out in a simulator. The optimal trajectory

was extracted from the data and then transferred to the real scenario for the automation part. This project introduced the construction of the human-robot shared control framework and the effectiveness of the proposed framework is validated on the da Vinci Research Kit (dVRK).

Work Experience

1. Visiting Research, Tsinghua University Mar 2021 – Aug 2021

During the period, I worked at Machine Intelligent Group at the Institute for Interdisciplinary Information Science of Tsinghua University. My research focused mainly on robotics and the applications of deep reinforcement learning.

2. Coding Mentor (part-time), Richer Education Jun 2020 – present

As a member of the mentors, I gained experience in communicating better with my teammates and colleagues. And as a mentor, I learned to be patient and how to explain my thinking.

3. Robotics Intern, AUTOREMAN team of UOB Aug 2018 – Oct 2018

During this internship, my team and I focused on the achieve Robotic Flexi-Cell Disassembly. The link to the project: https://www.youtube.com/watch?v=pzjYPkNSAWk. With the collaborative disassembly, efficiency can be significantly improved, and therefore the energy and cost can be saved.

Publication

1. Chen, J., Zhang, D., Munawar, A., **Zhu, R.**, Lo, B., Fischer, G., Yang, G., *Supervised Semi-Autonomous Control for Surgical Robot Based on Bayesian Optimization* (IROS). IEEE. 2020.
2. Zhang, D., **Zhu, R.**, Wu, Z., Tsai, Y., Chen, J., Li, W., Li, Q., Xu, Y., Zhang L., Li, Z., Liu, J., Yang, G., Lo, B., *Sim-to-Real Transfer Learning for Hybrid Human-Robot Control Interfaces Based on Multi-Domain Robotic Surgery Dataset* (pending)
3. Zhang, D., Wu, Z., Chen, J., Xiao, B., Munawar, A., **Zhu, R.**, Hong, W., Guo, Y., Fischer, G., Lo, B., Yang, G., *Human-Robot Shared Control for Surgical Robot Based on Sim-to-Real Transfer Via Dynamic Motion Primitive* (pending)

Certificate

Bayesian Methods for Machine Learning, Coursera
Machine Learning, Coursera