

# Ran Hao

Robotics Researcher, Engineer

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RANHAOHR

## Research Interests

I'm currently a research assistant in Medical Robotics and Computer Integrated Surgery (MERCIS) Laboratory, Case Western Reserve University. My research interests include Medical Robotics, Planning and Control For Robot-Assisted Interventions, Image Guided Interventions and Planning, Haptics.

## Education

- 2018–Present **Case Western Reserve University**  
*Ph.D. Candidate in Electrical Engineering*  
Advisor: M. Cenk Cavusoglu.
- Aug 2017 **Case Western Reserve University**  
*M.S. in Electrical Engineering*  
Thesis: Vision-based Surgical Tool Pose Estimation for Da Vinci Robotic System  
Advisor: M. Cenk Cavusoglu.
- July 2015 **Beihang University**  
*B.Eng. in Quality and Reliability Engineering*  
Thesis: Design and Verification of a Mutl-Dimentional Tilt-Rotor Quadrotor.

## Research Experience

- 2018–Present **MRI-Actuated Robotic Cardiac Catheter Interaction Control**  
*Case Western Reserve University*  
Advisor: M. Cenk Cavusoglu  
Publications: J. Dyn. Sys., Meas., Control.'21 [1] [2], ICRA'20 [3], IROS'20 [4], ICRA'23 [5] [6] (in progress).
- 2021–2022 **Homology-Class Guided Belief Space Planning**  
*Case Western Reserve University*  
Advisor: M. Cenk Cavusoglu  
Publications: IROS'22 [7] .
- Summer 2019 **Summer Research Intern**  
*Path Robotics, Columbus, OH*  
Designed a constraint optimal motion planning algorithm for welding robots.
- 2017-2018 **Distributed Real-time Systems**  
*Vanderbilt University*  
Advisor: Taylor Johnson.
- 2016–2017 **Visual-Based Surgical Robot Tool Tracking for Da Vinci Robotic Surgery System**  
*Case Western Reserve University*  
Advisor: M. Cenk Cavusoglu  
Publications: IROS'18 [8], ICRA'18 [9].

- 2016–2017 **Hand-Eye Calibration of Da Vinci Robotic Surgery System**  
*Case Western Reserve University*  
Advisor: M. Cenk Cavusoglu  
Publications: T-ASE'20 [10].
- 2013–2014 **Multi-object Optimization based on Pigeon Inspired Optimization Algorithm**  
*Beihang University*  
Advisor: Haibin Duan  
Publications: CGNCC'14 [11].

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## Publications

- [1] **R. Hao**, E. E. Tuna, and M. C. Çavuşoğlu, "Contact stability and contact safety of a magnetic resonance imaging-guided robotic catheter under heart surface motion," *ASME Journal of Dynamic Systems, Measurement, and Control*, 2021.
- [2] **R. Hao** and M. C. Cavusoglu, "A probabilistic approach for contact stability and contact safety analysis of robotic intracardiac catheter," *ASME Journal of Dynamic Systems, Measurement, and Control*, 2021.
- [3] **R. Hao**, T. Greigarn, and M. C. Çavuşoğlu, "Contact stability analysis of magnetically-actuated robotic catheter under surface motion," in *2020 IEEE International Conference on Robotics and Automation (ICRA)*. IEEE, 2020, pp. 4455–4462.
- [4] **R. Hao**, N. L. Poirot, and M. C. Cavusoglu, "Analysis of contact stability and contact safety of a robotic intravascular cardiac catheter under blood flow disturbances," in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2020.
- [5] **R. Hao**, Y. Itsarachaiyot, and M. C. Cavusoglu, "Bayesian optimization based preprocedural planning for robotic left atrial appendage occlusion," in *The IEEE/RSJ International Conference on Intelligent Robots and Systems (ICRA) (In progress)*, 2023.
- [6] Y. Itsarachaiyot, **R. Hao**, and M. C. Cavusoglu, "Analytical computation of the contact force jacobian for mri-actuated robotic catheter," in *The IEEE/RSJ International Conference on Intelligent Robots and Systems (ICRA) (In progress)*, 2023.
- [7] **R. Hao** and M. C. Cavusoglu, "Homology-class guided rapidly-exploring random tree for belief space planning," in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) (Accepted)*, 2022.
- [8] **R. Hao**, O. Özgüner, and M. C. Çavuşoğlu, "Vision-based surgical tool pose estimation for the da vinci robotic surgical system," in *2018 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. IEEE, 2018, pp. 1298–1305.
- [9] O. Özgüner, **R. Hao**, R. C. Jackson, T. Shkurti, W. Newman, and M. C. Cavusoglu, "Three-dimensional surgical needle localization and tracking using stereo endoscopic image streams," in *2018 IEEE international conference on robotics and automation (ICRA)*. IEEE, 2018, pp. 6617–6624.
- [10] O. Özgüner, T. Shkurti, S. Huang, **R. Hao**, R. C. Jackson, W. S. Newman, and M. C. Çavuşoğlu, "Camera-robot calibration for the da vinci robotic surgery system," *IEEE Transactions on Automation Science and Engineering*, 2020.

- [11] **R. Hao**, D. Luo, and H. Duan, "Multiple uavs mission assignment based on modified pigeon-inspired optimization algorithm," in *Proceedings of 2014 IEEE Chinese Guidance, Navigation and Control Conference (Best Paper Finalist)*.

## Professional Experience

Reviews IEEE International Conference on Robotics and Automation (ICRA)  
IEEE International Conference on Intelligent Robots and Systems (IROS)  
IEEE/ASME Transactions on Mechatronics  
IEEE Transactions on Robotics

## Teaching Assistance

Spring 2020 EECS499 Algorithmic Robotics (*Curriculum Designer*)  
Fall 2019 EECS489 Robotics I  
Spring 2019 EECS305 Control Engineering  
Fall 2018/  
2020 EECS484 Computational Intelligence I

## Students Mentored

Grace Shum, High school student, Summer 2022

## Skills

C++/C, Robot Operating System (ROS), MATLAB, Python, OpenCV, OpenGL

## References

### **M. Cenk Cavusoglu**

*Nord Professor of Engineering in Dept. of Electrical, Computer, and Systems Engineering*

Case Western Reserve University

E-mail: mcc14@case.edu.

### **Michael Fu**

*Assistant Professor of Engineering in Dept. of Electrical, Computer, and Systems Engineering*

Case Western Reserve University

E-mail: mjf24@case.edu.

### **Wyatt Newman**

*Professor of Engineering in Dept. of Electrical, Computer, and Systems Engineering*

Case Western Reserve University

E-mail: wsn@case.edu .

### **Orhan Ozguner**

*Assistant Professor of Engineering in Dept. of Computer and Data Sciences*

Case Western Reserve University

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