

Kai Gao

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EDUCATION

Rutgers, the State University of New Jersey

Robotics PhD Candidate

Aug. 2019 – Present

Piscataway, USA

- GPA:3.92/4.0
- Related courses: Computer Vision, Machine Learning

University of Science and Technology of China(USTC)

Bachelor in Mathematics

Aug. 2015 – Jun. 2019

Hefei, China

- Outstanding Graduates(2019)
- Outstanding Student Scholarship (2015-2016) (2017-2018)
- Gold Award of China Undergraduate Mathematical Contest in Modeling in Anhui Province(2017)(1/65 in USTC)
- Related courses: Computer Graphics

WORK EXPERIENCE

Advanced Robotics Intern

Siemens Corporation

May. 2022 – Sep. 2022

Berkeley, USA

- Conducted extensive literature research on object packing problems.
- Developed model-free approaches for efficiently packing irregularly-shaped objects.
- Created a prototype pick-and-pack system with a UR5 robot, integrating the proposed packing strategy and Siemens' advanced grasping technology.
- Created demonstration videos and experimental results of the packing strategy for potential customers to showcase its effectiveness and efficiency.

RESEARCH EXPERIENCE

Object Rearrangement

Research Assistant

Mar. 2020 – Present

Algorithmic Robotics and Control Lab(ARCL), Rutgers University, USA

- Implemented a complete perception-planning-control pipeline utilizing the UR-5e robotic arm.
- Developed efficient algorithms and analyzed structural characteristics with mathematical proofs for various manipulation scenarios.
- Applied deep learning models for perception and employed DQN for push planning tasks.
- Performed extensive experimentation and demonstration utilizing various simulation platforms, including PyBullet, Issac Gym, MuJoCo, and ROS+Gazebo.

Multi-Robot Path Planning

Research Intern

Jul. 2018 – Sep. 2018

Algorithmic Robotics and Control Lab(ARCL), Rutgers University, USA

- Designed fast algorithms to solve multi-robot path planning problems with different objectives.
- Designed an efficient algorithm to solve the perimeter guarding problem.
- Proved some lemmas and theorems on the efficiency of the algorithms.

Image Registration

Research Assistant

Sep. 2017 – Jun. 2019

Graphics&Geometric Computing Laboratory(GCL), USTC, China

- Developed a highly efficient non-rigid image registration algorithm that is able to handle noise and outliers effectively, surpassing the state of the arts.
- Implemented the algorithm with C++ and employed OpenGL for visualization.

PUBLICATIONS

- **K. Gao**, S. W. Feng, B. Huang, and J Yu. “Minimizing Running Buffers for Tabletop Object Rearrangement: Complexity, Fast Algorithms, and Applications.” The International Journal of Robotics Research (IJRR).
- **K. Gao**, and J. Yu. “On the Utility of Buffers in Pick-n-Swap Based Lattice Rearrangement.” 2023 IEEE International Conference on Robotics and Automation (ICRA 2023).
- **K. Gao** and J. Yu. “Toward Efficient Task Planning for Dual-Arm Tabletop Object Rearrangement.” 2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2022).
- **K. Gao**, D. Lau, B. Huang, K. E. Bekris and J. Yu. “Fast High-Quality Tabletop Rearrangement in Bounded Workspace.” 2022 IEEE International Conference on Robotics and Automation (ICRA 2022).
- E. R. Vieira, D. Nakhimovich, **K. Gao**, R. Wang, J. Yu and K. E. Bekris. “Persistent Homology for Effective Non-Prehensile Manipulation” 2022 IEEE International Conference on Robotics and Automation (ICRA 2022).
- R. Wang, **K. Gao**, J. Yu and K. E. Bekris. “Lazy Rearrangement Planning in Confined Spaces.” the 32nd International Conference on Automated Planning and Scheduling (ICAPS 2022).
- **K. Gao** and J. Yu. “Capacitated Vehicle Routing with Target Geometric Constraints.” 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2021).
- **K. Gao**, S. W. Feng, and J Yu. “On Minimizing the Number of Running Buffers for Tabletop Rearrangement.” 2021 Robotics: Science and Systems (RSS 2021).
- R. Wang*, **K. Gao***, D. Nakhimovich*, J. Yu, and K. E. Bekris. “Uniform Object Rearrangement: From Complete Monotone Primitives to Efficient Non-Monotone Informed Search.” 2021 IEEE International Conference on Robotics and Automation (ICRA 2021).
- S. W. Feng, **K. Gao**, J. Gong, and J. Yu. “Sensor Placement for Globally Optimal Coverage of 3D-Embedded Surfaces.” 2021 IEEE International Conference on Robotics and Automation (ICRA 2021).
- S. W. Feng, S. D. Han, **K. Gao**, and J. Yu. “Efficient Algorithms for Optimal Perimeter Guarding.” 2019 Robotics: Science and Systems (RSS 2019).

PAPERS UNDER REVIEW

- **K. Gao**, J. Yu, T. S. Punjabi, and J. Yu. “Effectively Rearranging Heterogeneous Objects on Cluttered Tabletops.” submitted to 2023 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2023).
- Andy Xu*, **K. Gao***, S. W. Feng*, and J. Yu. “Optimal and Stable Multi-Layer Object Rearrangement on a Tabletop.” submitted to 2023 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2023).
- E. R. Vieira, **K. Gao**, D. Nakhimovich, J. Yu and K. E. Bekris. “Effective and Robust Non-Prehensile Manipulation via Persistent Homology Guided Monte-Carlo Tree Search.” submitted to 2023 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2023).
- R. Wang, **K. Gao**, Y. Miao, J. Yu and K. E. Bekris. “Improving Feasibility, Efficiency and Quality for Rearranging Uniform Objects in Confined Spaces.” submitted to IEEE Transactions on Robotics (T-RO).

INVITED TALKS

Fast High-Quality Tabletop Rearrangement in Bounded Workspace.

TRIPODS/DATA-INSPIRE Graduate Student Workshop

March 2022

Virtual

On Minimizing the Number of Running Buffers for Tabletop Rearrangement

TRIPODS (Transdisciplinary Research in Principles of Data Science) Seminar

May 2021

Virtual

SKILLS

Programming Languages : Python, Matlab, C++

Tools : Git, ROS, PyBullet, Gazebo, OpenCV, Gurobi