Rui Wang

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EDUCATION

Rutgers University (GPA: 3.94/4.00) New Brunswick, NJ, USA
Ph.D., Computer Science | Advisor: Kostas E. Bekris *Sept 2017 – Nov 2022*
Dissertation: Complete and Efficient Prehensile Rearrangement in Confined Spaces under Kinematic Constraints

Columbia University (GPA: 3.77/4.00) New York City, NY, USA
M.S., Mechanical Engineering | Mentor: Peter K. Allen *Sept 2015 – Dec 2016*

Nanjing University of Aeronautics and Astronautics (GPA: 3.6/5.0) Nanjing, China
B.S., Automotive Engineering *Sept 2011 – Jun 2015*

CAREER INTERESTS

Robot Task and Motion Planning, Vision-based Manipulation, Multi-robot Planning, Planning Under Uncertainty

SKILLS

Programming languages: C++, Python, Matlab
Software Tools and Libraries: ROS, Robot simulation (PyBullet, CoppeliaSim, Gazebo), Moveit, OMPL, OpenCV, PyTorch, Gurobi, PyTrees, Flexbe State Machine
Real Robotic Systems: hands-on experience with robotic platforms – (1) Yaskawa Motoman SDA10F, (2) Rethink Robotics Baxter, (3) GoPiGo Intelligent Robot Cars

WORK EXPERIENCE

Apptronik Austin, TX, USA
Senior Robotics Software Engineer, Robot Autonomy *Dec 2024 – present*
- Develop humanoid robot **teleop** controller features for sophisticated tasks using **behavior trees**.

Diligent Robotics Austin, TX, USA
Robotics Software Engineer, Robot Manipulation *Nov 2022 – July 2024*
- Develop **robot manipulation features** for **healthcare robots** deployed in hospitals to assist medical staff.
- Invent **manipulation footprint** that enables robots to select appropriate base positions to perform manipulation.
- Design robot **behavioral planning** in elevator riding tasks via **Flexbe State Machine** and **Behavior Tree**.

Autodesk Robotics Research San Francisco, CA, USA
Research Intern, Motion Planning | Mentor: Sachin Chitta *May 2022 – Sept 2022*
- Build a **C++ interface** that integrates **Open Motion Planning Library** (OMPL) into Autodesk's own robotic system to facilitate the usage of OMPL in the sophisticated robotic system.
- **Extend the OMPL** to be used in **CNC machine tending** tasks at Autodesk.
- Evaluate performance of various motion planners on CNC machine tending in terms of arm motion quality.

RESEARCH EXPERIENCE

Object Rearrangement in Cluttered and Confined Spaces *Mar 2020 – Oct 2022*
Design task and motion planning (TAMP) algorithms for solving object rearrangement in shelves.
- Propose novel **tree search structures** that solve problems **faster** with **higher** success rate and **fewer** actions.
- Develop **motion planning tools** that (1) speed up online motion planning and (2) generate smooth trajectories.
- Develop a real system (perception, algorithms, and execution) via **ROS**, which **fully automates** rearrangement.

Robot Manipulation Learning for Reconstructing Novel Objects *Nov 2020 – Sept 2021*
Develop a system that facilitates online robot learning and reconstructs models of novel objects efficiently.
- Develop a **ROS-based manipulation system** that integrates motion planning, vision and robot control, to facilitate online novel object reconstruction.
- Implement customized motion planners (**lazy-A*** in a precomputed **PRM***) for object tracking during in-hand manipulation.

Multi-object Planning in 2D Constrained Space *Jan 2020 – Dec 2020*
Design a multi-object planning system, which allows non-collision object interaction in a constrained 2D space.
- Introduce the concept of the **region graph**, which decomposes the space into equivalent regions for **multi-object path planning**.
- Propose a novel **dynamic programming** routine that solves **monotone instances** quickly.

Planning Under Uncertainty with Object Pose Hypotheses *Sept 2018 – Mar 2020*

Plan safe arm motion paths for retrieving objects in clutter under object uncertainty.

- Propose a **perception** pipeline (**VGG16** for object recognition and segmentation; model matching for object pose estimation) to first obtain discrete distributions of object poses.
- Propose a **planning** pipeline to **generate safe paths** to approach the target object without collisions.

Hands-on Experience on a Robot Car *May 2016 – Dec 2016*

Design algorithms on a real robot car called GoPiGo with ultrasonic sensors, RGB-D cameras and encoders.

- Implement **path planning** algorithms (**Bug algorithms**, **Dijkstra**, **A***, **RRT**) for vehicle navigation tasks.
- Implement **vision** algorithms (**color tracking** and **SLAM particle filter**).

PUBLICATIONS

- Yinglong Miao, **Rui Wang**, Kostas E. Bekris, "*Safe, Occlusion-Aware Manipulation for Online Object Reconstruction in Confined Spaces*", In International Symposium on Robotics Research (**ISRR**), Geneva, Switzerland, 2022.
- **Rui Wang**, Kai Gao, Jingjin Yu, Kostas E. Bekris, "*Lazy Rearrangement Planning in Confined Spaces*", In International Conference on Automated Planning and Scheduling (**ICAPS**), Singapore (virtual), 2022. ***Student Outstanding Scholarship***.
- **Rui Wang**, Yinglong Miao, Kostas E. Bekris, "*Efficient and High-quality Prehensile Rearrangement in Cluttered and Confined Spaces*", In IEEE International Conference on Robotics and Automation (**ICRA**), Philadelphia, USA, 2022.
- Shiyang Lu, **Rui Wang**, Yinglong Miao, Chaitanya Mitash, Kostas E. Bekris, "*Online Object Model Reconstruction and Reuse for Lifelong Improvement of Robot Manipulation*", In IEEE International Conference on Robotics and Automation (**ICRA**), Philadelphia, USA, 2022. ***Outstanding Manipulation Paper Finalist***.
- Ewerton Vieira, Daniel Nakhimovich, Kai Gao, **Rui Wang**, Jingjin Yu, Kostas E. Bekris, "*Persistent Homology for Effective Non-Prehensile Manipulation*", In IEEE International Conference on Robotics and Automation (**ICRA**), Philadelphia, USA, 2022.
- **Rui Wang**, Daniel Nakhimovich, Fred S. Roberts, Kostas E. Bekris. (2021) *Chapter 5 Robotics as an Enabler of Resiliency to Disasters: Promises and Pitfalls*. In: Roberts F.S., Sheremet I.A. (eds) **Resilience in the Digital Age**. Lecture Notes in Computer Science, vol 12660. **Springer**, Cham. ***Book Chapter***
- **Rui Wang**, Kai Gao, Daniel Nakhimovich, Jingjin Yu, Kostas E. Bekris, "*Uniform Object Rearrangement: From Complete Monotone Primitives to Efficient Non-monotone Informed Search*", In IEEE International Conference on Robotics and Automation (**ICRA**), Xi'an, China, 2021.
- **Rui Wang**, Chaitanya Mitash, Shiyang Lu, Daniel Boehm, Kostas E. Bekris, "*Safe and Effective Picking Paths in Clutter given Discrete Distributions of Object Poses*", In IEEE/RSJ International Conference on Intelligent Robot and Systems (**IROS**), Las Vegas, USA, 2020.

TEACHING EXPERIENCE

- **Course Instructor:** Introduction to Artificial Intelligence, *Summer 2019, 2020*, Rutgers University, ***receiving very good reviews from students***
  - Give lectures on a variety of topics related to artificial intelligence.
  - Design homework and assignments, as well as grading rubrics.
  - Manage and lead a group of teaching assistants for setting up the recitations, office hours and grading.
- **Teaching Assistant:** Introduction to Computational Robotics, *Fall 2018*, Rutgers University
  Computational Aspects of Robotics, *Fall 2016*, Columbia University