Lingzhi Kong

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Research Interests

- AI in Science
- AI in Biomedicine
- Explainable AI
- Scientist-AI interaction

Education

Northeastern University **Sep. 2019 – present**
Master of Science in Robotics - Computer Science *Boston, MA*

Northeastern University **Sep. 2015 – Jan. 2018**
Master of Engineering in Control Engineering *Shenyang, China*

Inner Mongolia University of Technology **Sep. 2010 – July 2014**
Bachelor of Engineering in Power Engineering *Huhhot, China*

Relevant Coursework

- Machine Learning
- Reinforcement Learning
- Algorithms
- Optimization Theory
- Matrix Analysis
- System Identification
- Mobile Robotics

Works in progress

- Linfeng Zhao, **Lingzhi Kong**, Robin Walters, Lawson L.S. Wong. Toward Understanding Compositional Generalization in Object-Oriented Environments. *In submission*
- **Lingzhi Kong**, Linfeng Zhao, Robin Walters, Lawson L.S. Wong. Implicit Equivariant Planning Networks. *In progress*

Experience

Generalizable Robotics and Artificial Intelligence Lab, Northeastern Univeristy **Sep. 2020 – present**
Research Assistant *Boston, MA*

- Conducted research on Compositional Generalization in Object-oriented World Models.
- Conducted research on Differentiable Equivariant Planning Networks.

Khoury College of Computer Sciences, Northeastern Univeristy **Sep. 2020 – Dec. 2020**
Teaching Assistant, Course title: CS 5180 Reinforcement Learning and Decision Making *Boston, MA*

- Held office hours to answer questions for students' homework.
- Provided guidance for students' course projects in terms of implementation and project choice.

Shenyang Institute of Automation, Chinese Academy of Sciences **May 2016 – May 2017**
Software Intern *Shenyang, China*

- Developed the prototype of a surgical robot for bone surgery.

Research Projects

Differentiable Equivariant Planning Networks **Oct. 2021 – present**

This work proposed differentiable equivariant planning networks, which enables an artificial agent to learn to plan and at the same time, exploits group symmetries such as rotations, reflections, and permutations. This is important for data that has symmetries, such as navigation, graph, molecules, etc. Our networks outperformed previous methods in a 2D navigation environment in terms of both data efficiency and accuracy.

- Formulated our framework by introducing group symmetries based on existing works.
- Implemented the models guided by the formulation and applied them to 2D navigation environments.
- Conducted several baseline experiments to compare with our models and demonstrated our models outperformed baseline algorithms.

Compositional Generalization in Object-Oriented Environments **Jan. 2021 – present**

This work formalized the compositional generalization problem using group theory and homomorphism. Motivated by the formulation, we proposed a framework, which aimed to learn objects representations and their relations, and then algebraically compose those components to understand infinite scenes with novel combinations of objects.

- Participated in formulating the problem using group theory and homomorphism.
- Implemented the models guided by our formulation.
- Implemented the environments for our experiments.
- Conducted several baseline experiments to compare with our models.

Teaching an Artificial Agent to Play CarRacing Game | *deep RL, Data Aggregation* **Oct. 2019 – Dec. 2019**

This project addressed decision making problems in autonomous driving by applying deep reinforcement learning and imitation learning algorithm in a simulated car racing environment.

- Implemented Dataset Aggregation (DAGGER) algorithm and applied it to OpenAI gym car racing environment.
- Demonstrated DAGGER is able to solve the CarRacing game using expert demonstrations.
- Demonstrated the efficacy of Proximal Policy Optimization in sequential decision-making problem.

Image-Guided Surgical Robot for Bone Surgery | *Surgical Robot* **May 2016 – May 2017**

This work aimed to develop an image-guided surgical robotic system for bone resection. The system consists of a computer with imaging software, and a UR5 robot arm mounted with a surgical tool. The surgeon could plan a surgery path in imaging software, and then the robot would follow the path to perform the surgery.

- Developed the prototype of a surgical robot for bone surgery.
- Implemented the algorithms for 3D surgical path generation.
- Implemented the visualization module of the robot position and orientation using Visualization Toolkit.
- Implemented the registration algorithm to build the relationship between physical world space and image space.
- Integrated imaging software, robot control software, and hardware.
- Conducted the isolated trial experiment of bone resection and repair at a hospital.

Technical and Personal Skills

Programming: *Proficient in* Python, MATLAB, Pytorch, Numpy; *some experience in* C++, ROS, Mongodb.
Tools and operating system: *Proficient in* Latex, Git, Linux.
Language: English (*Professional working proficiency*); Chinese (*native*); Mongolian (*daily conversation*).

Awards & activities

2017 Graduate Project Scholarship, Shenyang Institute of Automation, Chinese Academy of Sciences
2017 Title of Outstanding Student, Shenyang Institute of Automation, Chinese Academy of Sciences
2016 Championship of Student Basketball Match, Shenyang Institute of Automation, Chinese Academy of Sciences
2016 The 1st Prize Scholarship, Graduate School of Northeastern University, China
2013 Title of Outstanding Leader of the Student Union, Inner Mongolia University of Technology
2013 Cycling in Qinghai-Tibet Line, Yumazhe Cycling Association, Huhhot
2012 The 2nd Place of College Student Basketball Match, Inner Mongolia University of Technology
2012 Title of Excellent Team, Educational Assistance Activities in Countryside
2011 National Encouragement Scholarship, Inner Mongolia University of Technology