

# HYUNWOO RYU

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## RESEARCH INTEREST

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### Physics-inspired Geometric Deep Learning for Robotics

$SE(3)$ -Equivariant Robotic Manipulation      Diffusion Models for Robotics      Neural Fields for Robotics

## EDUCATION

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**Ph.D. in EECS**, Massachusetts Institute of Technology (Advisor: Prof. Vincent Sitzmann)      Sept. 2024 - TBD

**M.S. in Artificial Intelligence**, Yonsei University (Advisor: Prof. Jongeun Choi)      Mar. 2022 - Feb. 2024

**B.S. in Mechanical Engineering**, Yonsei University      Mar. 2015 - Feb. 2022

- 2-year absence due to military service (Aug. 2016 - May 2018).

## PUBLICATION

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### Conference Papers

- **Hyunwoo Ryu**, Jiwoo Kim, Junwoo Chang, Hyunseok An, Joohwan Seo, Taehan Kim, Yubin Kim, Chaewon Hwang, Jongeun Choi, Roberto Horowitz, “[Diffusion-EDFs: Bi-equivariant Denoising Generative Modeling on  \$SE\(3\)\$  for Visual Robotic Manipulation](#)” (CVPR 2024, **Highlight**)
- **Hyunwoo Ryu**, Hong-in Lee, Jeong-hoon Lee, Jongeun Choi, “[Equivariant Descriptor Fields:  \$SE\(3\)\$ -Equivariant Energy-Based Models for End-to-End Visual Robotic Manipulation Learning](#)” (ICLR 2023)

### Workshop Papers      (\* indicates equal contribution)

- Junwoo Chang\*, **Hyunwoo Ryu\***, Jiwoo Kim, Soochul Yoo, Joohwan Seo, Nikhil Potu Surya Prakash, Jongeun Choi, Roberto Horowitz, “[Denoising Heat-inspired Diffusion with Insulators for Collision Free Motion Planning](#)” (NeurIPS 2023 Workshop on Diffusion Models)
- Jiwoo Kim\*, **Hyunwoo Ryu\***, Jongeun Choi, Joohwan Seo, Nikhil Potu Surya Prakash, Ruolin Li, Roberto Horowitz, “[Robotic Manipulation Learning with Equivariant Descriptor Fields: Generative modeling, Bi-equivariance, Steerability, and Locality](#)” (RSS 2023 Workshop on Symmetries in Robot Learning, **Oral (Video), Best Paper**)

## ACHIEVEMENT

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**Best Technical Demonstration Award**      Oct. 2023  
The 5th Yonsei University Mechanical Engineering Graduate Student Academic Conference

**Best Paper Award**      July 2023  
Robotics: Science and Systems (RSS) Workshop on Symmetries in Robot Learning

**Advanced Quantum Computing Certificate**      Dec. 2020  
IBM Quantum Challenge 2020

**3rd Prize & Technical Report S-Rank (top 4 out of 68 universities worldwide)**      May 2019  
International Conference on Robotics and Automation (ICRA) Robomaster AI Challenge 2019

## ACADEMIC SERVICE

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### Conference and Journal Reviewer

ICLR(2024), NeurIPS (2024), RA-L(2024), RO-MAN(2024), ICRA (2024), IROS (2024)

## PROJECT EXPERIENCE

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### Technical Demonstration of Diffusion-EDFs ([Project Website](#))

Aug. 2023 - Oct. 2023

*Team Leader*

- Demonstrated real robot manipulation with *Diffusion-EDFs*.
- Won Best Technical Demonstration Award at Yonsei University M.E. Graduate Students' Conference.

### Undergraduate Capstone Project

Mar. 2021 - June 2021

*Visual-SLAM Engineer*

- Developed tracking and monitoring system for individuals with fever using quadcopter drones.
- Developed visual-SLAM (simultaneous localization and mapping) and aerial motion planning pipelines.
- Developed computer-vision based target individual localization and filtering algorithm.

### IEEE ICRA Robomaster AI Challenge 2019 ([Video](#))

Sep. 2018 - May 2019

*System Architect, ROS Engineer, Motion Planning Engineer*

- Designed overall system architecture with Robot Operating System (ROS), integrating computer-vision based perception system and reinforcement learning based intelligent decision-making system.
- Developed motion planning algorithms and navigation pipeline for our omnidirectional mobile robots.
- Successfully deployed simulation-trained reinforcement learning (RL) agents to our real robots.
- [S-rank](#) in technical reports (top 4 out of 68 universities worldwide); [3rd Prize](#) in main competition.

## RESEARCH EXPERIENCE

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### Machine Learning and Control Systems (MLCS) Lab, Yonsei University

Jan. 2022 - Feb. 2024

Advisor: Prof. Jongeun Choi

- $SE(3)$ -equivariant robotic manipulation learning
- Diffusion models for robot learning

### Undergraduate Thesis

Aug. 2021 - Dec. 2021

Advisor: Prof. Jongeun Choi

- Title: *Learning Discrete State Abstraction for Task Planning with Contrastive Predictive Coding*

## TEACHING EXPERIENCE

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### MEU2105-01 Mechanical Engineering Laboratory I

*Head Teaching Assistant (TA)*

- Served as head teaching assistant (TA), leading 7 other fellow TAs.
- Designed hardware experiments and programming sessions for analog and digital measurement class.

## ADDITIONAL EXPERIENCE

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### CogSci:IN (Yonsei University Students' Academic Club for Cognitive Science)

Aug. 2019 - Feb. 2021

- Served as president in 2020.
- Gave two public presentations on sustained attention (2019) and on spiking neural networks (2020) at Synapse: National Symposium on Brain and Cognitive Science for College Students in South Korea.

### SCC (Yonsei University Students' Academic Club for Physics)

Sep. 2019 - Aug. 2020

- Gave public presentation on ML + Physics (Speech title: "Boltzmann Machines: The Intersection of Statistical Physics and Artificial Intelligence")

### Military Service

Aug. 2016 - May. 2018

- Republic of Korea Army, 702nd Commando Regiment.

## SKILL

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<b>Machine Learning</b>	Geometric/Equivariant Deep Learning, Graph Neural Networks, Computer Vision
<b>Robotics</b>	Robotic Manipulation, Motion Planning, Visual-SLAM, Reinforcement Learning
<b>Programming</b>	PyTorch, Tensorflow, ROS, Qiskit, Python, C++, Shell, Linux
<b>Mathematics</b>	Riemannian Geometry, Lie Group & Lie Algebra, Representation Theory
<b>Interdisciplinary</b>	Theoretical Physics, Neuroscience, Quantum Computing