

# Dong-Ki Kim

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## Education

### Massachusetts Institute of Technology

Ph.D. in Autonomous Systems

Cambridge, MA

Jan. 2020 – Present

- Thesis Committee: Professors Jonathan P. How, Jakob N. Foerster, Pulkit Agrawal
- Major: Artificial Intelligence and Machine Learning
- Minor: Robot Autonomy
- GPA: 5.0 / 5.0

### Massachusetts Institute of Technology

S.M. in Aeronautics and Astronautics

Cambridge, MA

Graduated Jan. 2020

- Thesis: “Learning to Teach and Meta-Learning for Sample-Efficient Multiagent Reinforcement Learning”
- Advisor: Professor Jonathan P. How
- Focus: Reinforcement Learning
- GPA: 5.0 / 5.0

### Cornell University

B.S. in Electrical and Computer Engineering

Ithaca, NY

Graduated Jan. 2016

- Advisor: Professor Tsuhan Chen
- Focus: Computer Vision & Robotics
- Highest Honors: *Summa Cum Laude*

## Experience

### Laboratory for Information and Decision Systems, MIT

Graduate Researcher, Advisor: Professor Jonathan P. How

Cambridge, MA

Sep. 2017 - Present

- Developed new optimization objective that maximizes each agent’s average reward by directly accounting for impact of its behavior on limiting set of policies that other agents will converge to [1]. [\[Video\]](#)
- Derived new meta-multiagent policy gradient theorem that directly models learning processes of all agents within meta-learning optimization, which enables fast adaptation to new fellow agents across spectrum of mixed incentive, competitive, and cooperative multiagent settings [6, 18]. [\[Video\]](#)
- Developed hierarchical reinforcement learning framework that considers both temporal abstraction and context-specific representation abstraction to effectively reduce the size of the search over policy space in option learning [3]. [\[Video\]](#)
- Contributed to learning robust policy that enables high demonstration-efficiency learning by leveraging properties from robust tube model predictive controller and imitation learning [4]. [\[Video\]](#)
- Developed safe reinforcement learning framework by learning neural network-based meta-optimizer with projection onto polytope for optimizing objective while satisfying constraints [7, 17].
- Developed peer-to-peer teaching frameworks for enabling agents to learn to teach or share knowledge in cooperative multiagent reinforcement learning settings [8, 9, 10, 19, 20].
- Built attention-based hierarchical reinforcement learning framework that identifies useful latent features across multiple sensory inputs and accelerates in transfer learning tasks [11, 15, 21].

### Air Lab, CMU-Robotics Institute

Research Intern, Advisor: Professor Sebastian Scherer

Pittsburgh, PA

Aug. 2016 - Jul. 2017

- Developed deep multimodal network that improves segmentation robustness to appearance variations (e.g., Summer vs Winter) by combining image and LiDAR sensor data [12, 22].
- Built ROS-based system that estimates terrain roughness from 3D LiDAR sensor data in real-time. [\[Video\]](#)

### Robot Intelligence through Perception Lab, TTIC

Research Intern, Advisor: Professor Matthew R. Walter

Chicago, IL

Jan. 2016 - Jul. 2016

- Developed cross-view localization system that estimates vehicle’s pose on georeferenced satellite map given sequence of ground-level images [13]. [\[Video\]](#)
- Improved LSD-SLAM’s pose estimation by incorporating ORB-SLAM’s pose-graph keyframe constraints.

### Advanced Multimedia Processing Lab, Cornell University

Undergraduate Researcher, Advisor: Professor Tsuhan Chen

Ithaca, NY

May. 2014 - Jan. 2016

- Developed indoor localization algorithm based on floor plan and camera [14]. [\[Video\]](#)
- Built vision-based system that enables drone to navigate indoors autonomously and find specific target [23]. [\[Video\]](#)

## Honor & Award

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### Spotlight presentation at ICLR-22 Workshop

Mar. 2022

- Gamification and Multiagent Solutions Workshop

### Outstanding Student Paper Award Honorable Mention at AAAI-19

Jan. 2019

### Kwanjeong Education Foundation Scholarship

Sep. 2017 - May. 2021

- Received \$30,000/year for 4 years for graduate studies

### Merrill Presidential Scholar

Sep. 2015

- Nominated for Cornell University's prestigious award given to top 1% graduating undergraduate seniors

## Publication

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**Google Scholar statistics:** Total of 360 citations with h-index of 9 and i10-index of 9 as of Jun. 29, 2022.

### Preprint

- [1] **Influencing Long-Term Behavior in Multiagent Reinforcement Learning**  
**Dong-Ki Kim**, Matthew Riemer, Miao Liu, Jakob N Foerster, Michael Everett, Chuangchuang Sun, Gerald Tesauero, Jonathan P. How  
*International Conference on Learning Representations (ICLR) Workshop*, 2022 [[Spotlight](#)] [[Paper](#)] [[Video](#)]
- [2] **City-wide Street-to-Satellite Image Geolocalization of a Mobile Ground Agent**  
Lena M. Downes, **Dong-Ki Kim**, Ted J. Steiner, Jonathan P. How  
*International Conference on Robotics and Automation (ICRA) (Under Review)*, 2022 [[Paper](#)] [[Video](#)]

### Conference Proceeding

- [3] **Context-Specific Representation Abstraction for Deep Option Learning**  
Marwa Abdulhai, **Dong-Ki Kim**, Matthew Riemer, Miao Liu, Gerald Tesauero, Jonathan P. How  
*Association for the Advancement of Artificial Intelligence (AAAI)*, 2022 [[Paper](#)] [[Code](#)] [[Video](#)]
- [4] **Demonstration-Efficient Guided Policy Search via Imitation of Robust Tube MPC**  
Andrea Tagliabue, **Dong-Ki Kim**, Michael Everett, Jonathan P. How  
*International Conference on Robotics and Automation (ICRA)*, 2022 [[Paper](#)] [[Video](#)]
- [5] **ROMAX: Certifiably Robust Deep Multiagent Reinforcement Learning via Convex Relaxation**  
Chuangchuang Sun, **Dong-Ki Kim**, Jonathan P. How  
*International Conference on Robotics and Automation (ICRA)*, 2022 [[Paper](#)]
- [6] **A Policy Gradient Algorithm for Learning to Learn in Multiagent Reinforcement Learning**  
**Dong-Ki Kim**, Miao Liu, Matthew Riemer, Chuangchuang Sun, Marwa Abdulhai, Golnaz Habibi, Sebastian Lopez-Cot, Gerald Tesauero, Jonathan P. How  
*International Conference on Machine Learning (ICML)*, 2021 [[Paper](#)] [[Code](#)] [[Video](#)]
- [7] **FISAR: Forward Invariant Safe Reinforcement Learning with a Deep Neural Network-Based Optimizer**  
Chuangchuang Sun, **Dong-Ki Kim**, Jonathan P. How  
*International Conference on Robotics and Automation (ICRA)*, 2021 [[Paper](#)]
- [8] **Learning Hierarchical Teaching Policies for Cooperative Agents**  
**Dong-Ki Kim**, Miao Liu, Shayegan Omidshafiei, Sebastian Lopez-Cot, Matthew Riemer, Golnaz Habibi, Gerald Tesauero, Sami Mourad, Murray Campbell, Jonathan P. How  
*International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, 2020 [[Paper](#)] [[WIRED News](#)]
- [9] **Policy Distillation and Value Matching in Multiagent Reinforcement Learning**  
Samir Wadhwan, **Dong-Ki Kim**, Shayegan Omidshafiei, Jonathan P. How  
*International Conference on Intelligent Robots and Systems (IROS)*, 2019 [[Paper](#)] [[Video](#)]
- [10] **Learning to Teach in Cooperative Multiagent Reinforcement Learning**  
Shayegan Omidshafiei, **Dong-Ki Kim**, Miao Liu, Gerald Tesauero, Matthew Riemer, Christopher Amato, Murray Campbell, Jonathan P. How  
*Association for the Advancement of Artificial Intelligence (AAAI)*, 2019 [[Outstanding Student Paper Honorable Mention](#)] [[Paper](#)] [[MIT News](#)]
- [11] **Crossmodal Attentive Skill Learner**  
Shayegan Omidshafiei, **Dong-Ki Kim**, Jazon Pazis, Jonathan P. How  
*International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, 2018 [[Paper](#)] [[Video](#)] [[Code](#)]

- [12] **Season-Invariant Semantic Segmentation with A Deep Multimodal Network**  
**Dong-Ki Kim**, Daniel Maturana, Masashi Uenoyama, Sebastian Scherer  
*Field and Service Robotics (FSR)*, 2017 [Paper]
- [13] **Satellite Image-based Localization via Learned Embeddings**  
**Dong-Ki Kim**, Matthew R. Walter  
*International Conference on Robotics and Automation (ICRA)*, 2017 [Paper] [Video] [NVIDIA News]
- [14] **You Are Here: Mimicking the Human Thinking Process in Reading Floor-Plans**  
 Hang Chu, **Dong-Ki Kim**, Tsuhan Chen  
*International Conference on Computer Vision (ICCV)*, 2015 [Paper] [Video]

## Journal Article

- [15] **Crossmodal Attentive Skill Learner: Learning in Atari and Beyond with Audio-Video Inputs**  
**Dong-Ki Kim**, Shayegan Omidshafiei, Jazon Pazis, Jonathan P. How  
*Journal of Autonomous Agents and Multiagent Systems (JAAMAS)*, 2020 [Paper]

## Book Chapter

- [16] **Multiagent Reinforcement Learning**  
 Jonathan P. How, **Dong-Ki Kim**, Samir Wadhwanja  
*Encyclopedia of Systems and Control*, 2nd Ed. [Chapter]

## Workshop and Symposium Paper

- [17] **Set-Invariant Constrained Reinforcement Learning with a Meta-Optimizer**  
 Chuangchuang Sun, **Dong-Ki Kim**, Jonathan P. How  
*International Conference on Machine Learning (ICML) Workshop*, 2020 [Paper]
- [18] **A Policy Gradient Theorem for Learning to Learn in Multiagent Reinforcement Learning**  
**Dong-Ki Kim**, Miao Liu, Matthew Riemer, Golnaz Habibi, Sebastian Lopez-Cot, Samir Wadhwanja, Gerald Tesauro, Jonathan P. How  
*Association for the Advancement of Artificial Intelligence (AAAI) Spring Symposium*, 2020 [Paper]
- [19] **Heterogeneous Knowledge Transfer via Hierarchical Teaching in Cooperative Multiagent Reinforcement Learning**  
**Dong-Ki Kim**, Miao Liu, Shayegan Omidshafiei, Sebastian Lopez-Cot, Matthew Riemer, Gerald Tesauro, Murray Campbell, Golnaz Habibi, Jonathan P. How  
*Association for the Advancement of Artificial Intelligence (AAAI) Workshop*, 2019
- [20] **Learning to Teach in Cooperative Multiagent Reinforcement Learning**  
 Shayegan Omidshafiei, **Dong-Ki Kim**, Miao Liu, Gerald Tesauro, Matthew Riemer, Christopher Amato, Murray Campbell, Jonathan P. How  
*International Conference on Machine Learning (ICML) Workshop*, 2018
- [21] **Crossmodal Attentive Skill Learner**  
 Shayegan Omidshafiei, **Dong-Ki Kim**, Jazon Pazis, Jonathan P. How  
*Neural Information Processing Systems (NeurIPS) Symposium*, 2017
- [22] **Online Semantic Mapping for Autonomous Navigation and Scouting**  
 Daniel Maturana, Sankalp Arora, Po-Wei Chou, **Dong-Ki Kim**, Masashi Uenoyama, Sebastian Scherer  
*Robotics: Science and Systems (RSS) Workshop*, 2017 [Paper]

## Technical Report

- [23] **Deep Neural Network for Real-Time Autonomous Indoor Navigation**  
**Dong-Ki Kim**, Tsuhan Chen  
*arXiv preprint arXiv:1511.04668*, 2015 [Paper] [Video]

## Skill

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**Tools/Library/Software:** PyTorch, TensorFlow, Theano, Caffe, Keras, OpenCV, ROS, Point Cloud Library

**Programming Language:** Python, C/C++, Matlab

## Invited Talk

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### Mila

Jun. 2022

- Talk title: Effective Learning in Non-Stationary Multiagent Environments

### Mila

Jul. 2021

- Talk title: Learning to Learn in Multiagent Reinforcement Learning to Address Non-Stationarity

### IBM Research-Zurich

Jul. 2019

- Talk title: Learning to teach for collective intelligence

### Northeastern University

Feb. 2019

- Talk title: Learning to Teach in Cooperative Multiagent Reinforcement Learning

## Academic Service

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### Reviewer of Conference and Journal

- **Machine learning:** ICML, NeurIPS, ICLR, AAMAS, AAAI, IEEE TNNLS
- **Robotics:** ICRA, IROS, RA-L

## Student Mentoring

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### MIT

- **Lucy Halperin:** Currently a Ph.D. student in Aero/Astro
- **Ammar Fayad:** Currently a B.S. student in EECS
- **Marwa Abdulhai:** B.S. and M.Eng in EECS (currently a Ph.D. student at UC Berkeley EECS)
- **Sebastian Lopez-Cot:** B.S. and M.Eng in EECS (currently a self driving engineer at Aurora)

## Reference

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### Professor Jonathan P. How

- **Affiliation:** Laboratory for Information and Decision Systems, MIT
- **Title:** Richard Cockburn Maclaurin Professor
- **Email:** jhow@mit.edu

### Dr. Shayegan Omidshafiei

- **Affiliation:** Google Research
- **Title:** Senior Research Scientist
- **Email:** somidshafiei@google.com