Jiaoyang Li

Curriculum Vitae

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Current Appointment

2022-present Assistant Professor, **Robotics Institute, Carnegie Mellon University (CMU)**, USA.

Education

2017-2022 Ph.D. in Computer Science, **University of Southern California (USC)**, USA

2013-2017 B.Eng. in Automation, **Tsinghua University**, China

Research Experience

2017-2022 Research Assistant, **University of Southern California**, USA.
- Advisor: Sven Koenig, Department of Computer Science.

02/2020 Visiting Researcher (11 months), **Monash University**, Australia.
- Host: Daniel Harabor and Peter J. Stuckey, Faculty of Information Technology.

05/2019 Research Intern (14 weeks), **Amazon Robotics**, USA.
- Mentor: Andrew Tinka; Supervisor: Joseph W. Durham.

12/2018, 11/2019 Visiting Student (twice, 5 weeks in total), **Ben-Gurion University**, Israel.
- Advisor: Ariel Felner, Department of Software and Information Systems Engineering.

08/2016 Visiting Student (5 weeks), **University of California, Berkeley**, USA.
- Advisor: Zuojun (Max) Shen, Department of Industrial Engineering and Operations Research.

06/2016 Visiting Student (6 weeks), **University of Southern California**, USA.
- Advisor: Sven Koenig, Department of Computer Science.

Honors and Awards

2023 Winner team (advisor) of the League of Robot Runners, a competition focusing on the coordination of moving robots, *sponsored by Amazon Robotics*.

2023 Best Paper Award Finalist, *IEEE International Symposium on Multi-Robot & Multi-Agent Systems*.

2023 Distinguished PC Member, *International Joint Conference on Artificial Intelligence*.

2023 Best Dissertation Award, *International Conference on Automated Planning and Scheduling*.

2023 Best Student Paper Award Honorable Mention, *International Conference on Automated Planning and Scheduling*.

2023 William F. Ballhaus, Jr. Prize for Best Dissertation, *USC Viterbi School of Engineering*.

2023 Victor Lesser Distinguished Dissertation Award, *International Foundation for Autonomous Agents and Multiagent Systems*.

2023 AAAI New Faculty Highlights, *AAAI Conference on Artificial Intelligence*.

2021 Selected Participant for Rising Stars: An Academic Career Workshop in EECS, *MIT*.

2021 Best System Demonstration Award, *International Conference on Automated Planning and Scheduling*.

2021 WiSE Merit Award for Doctoral Students (4 recipients in Viterbi School of Engineering), *USC*.

2021 Best Research Assistant Award (2 recipients in Computer Science Department), *USC*.

2020 Winner team (team leader) of both rounds of the Flatland Challenge, a competition on multi-agent reinforcement learning on trains with >700 participants and >2000 submissions over 4 months; An updated version of our software won again in the extended Flatland competition in 2021, *Annual Conference on Neural Information Processing Systems*.

2020 Outstanding Student Paper Award, *International Conference on Automated Planning and Scheduling*.

2020 WiSE Qualcomm Top-Off Fellowship (8 recipients in Viterbi School of Engineering), *USC*.

2018 Technology Commercialization Award, *USC*.
2017 Viterbi/Graduate School Fellowship, *USC*.
2017 Excellent Graduate Award of Beijing, *Beijing Municipal Education Commission*.
2017 Excellent Graduate Award of Department of Automation, *Tsinghua*.
2015 Fellowship of Spark Talents Program (50 recipients in Tsinghua), *Tsinghua*.
2015 "12.9" Scholarship (1 recipient in Department of Automation), *Tsinghua*.
2015 Weimin Zheng Scholarship (2 recipients in Department of Automation), *Tsinghua*.

Publications

Stars (*) next to names in the author lists indicate equal contribution.

Conferences

2024 [C61] **Guidance Graph Optimization for Lifelong Multi-Agent Path Finding**.
Yulun Zhang, He Jiang, Varun Bhatt, Stefanos Nikolaidis and **Jiaoyang Li**.
International Joint Conference on Artificial Intelligence (**IJCAI**), (in print), 2024.

[C60] **Scalable Mechanism Design for Multi-Agent Path Finding**.
Paul Friedrich, Yulun Zhang, Michael Curry, Ludwig Dierks, Stephen McAleer, **Jiaoyang Li**, Tuomas Sandholm and Sven Seuken.
International Joint Conference on Artificial Intelligence (**IJCAI**), (in print), 2024.

[C59] **Scaling Lifelong Multi-Agent Path Finding to More Realistic Settings: Research Challenges and Opportunities**.
He Jiang, Yulun Zhang, Rishi Veerapaneni and **Jiaoyang Li**.
Symposium on Combinatorial Search (**SoCS**), (in print), 2024.

[C58] **Unconstraining Multi-Robot Manipulation: Enabling Arbitrary Constraints in ECBS with Bounded Sub-Optimality**.
Yorai Shaoul, Rishi Veerapaneni, Maxim Likhachev and **Jiaoyang Li**.
Symposium on Combinatorial Search (**SoCS**), (in print), 2024.

[C57] **ITA-ECBS: A Bounded-Suboptimal Algorithm for The Combined Target-Assignment and Path-Finding Problem**.
Yimin Tang, Sven Koenig and **Jiaoyang Li**.
Symposium on Combinatorial Search (**SoCS**), (in print), 2024.

[C56] **MAPF in 3D Warehouses: Dataset and Analysis**.
Qian Wang, Rishi Veerapaneni, Yu Wu, **Jiaoyang Li** and Maxim Likhachev.
International Conference on Automated Planning and Scheduling (**ICAPS**), (in print), 2024.
Acceptance rate: $82/379 = 21.6\%$.

[C55] **Improving Learnt Local MAPF Policies with Heuristic Search**.
Rishi Veerapaneni, Qian Wang, Kevin Ren, Arthur Jakobsson, **Jiaoyang Li** and Maxim Likhachev.
International Conference on Automated Planning and Scheduling (**ICAPS**), (in print), 2024.
Acceptance rate: $82/379 = 21.6\%$.

[C54] **Accelerating Search-Based Planning for Multi-Robot Manipulation by Leveraging Online-Generated Experiences**. Best Student Paper Award.
Yorai Shaoul, Itamar Mishani, Maxim Likhachev and **Jiaoyang Li**.
International Conference on Automated Planning and Scheduling (**ICAPS**), (in print), 2024.
Acceptance rate: $82/379 = 21.6\%$.

[C53] **Efficient Approximate Search for Multi-Objective Multi-Agent Path Finding**.
Fangji Wang, Han Zhang, Sven Koenig and **Jiaoyang Li**.
International Conference on Automated Planning and Scheduling (**ICAPS**), (in print), 2024.
Acceptance rate: $82/379 = 21.6\%$.

[C52] **A Real-Time Rescheduling Algorithm for Multi-robot Plan Execution**.
Ying Feng, Adittyo Paul, Zhe Chen and **Jiaoyang Li**.
International Conference on Automated Planning and Scheduling (**ICAPS**), (in print), 2024.
Acceptance rate: $82/379 = 21.6\%$.

[C51] **Bidirectional Temporal Plan Graph: Enabling Switchable Passing Orders for More Efficient Multi-Agent Path Finding Plan Execution**.
Yifan Su, Rishi Veerapaneni and **Jiaoyang Li**.
AAAI Conference on Artificial Intelligence (**AAAI**), (in print), 2024.
Acceptance rate: $2,342/9,862 = 23.7\%$.

[C50] **Traffic Flow Optimisation for Lifelong Multi-Agent Path Finding**.
Zhe Chen, **Jiaoyang Li**, Daniel Harabor and Peter J. Stuckey.
AAAI Conference on Artificial Intelligence (**AAAI**), (in print), 2024.
Acceptance rate: $2,342/9,862 = 23.7\%$.

2023 [C49] **Arbitrarily Scalable Environment Generators via Neural Cellular Automata**.
Yulun Zhang, Matthew Christopher Fontaine, Varun Bhatt, Stefanos Nikolaidis and **Jiaoyang Li**.
Annual Conference on Neural Information Processing Systems (**NeurIPS**), (in print), 2023.
Acceptance rate: 26.1%.

[C48] **Solving Multi-Agent Target Assignment and Path Finding with a Single Constraint Tree**. Best Paper Award Finalist.
Yimin Tang, Zhongqiang Ren, **Jiaoyang Li** and Katia Sycara.
IEEE International Symposium on Multi-Robot and Multi-Agent Systems (**MRS**), (in print), 2023.
Acceptance rate: $30/85 = 35.3\%$.

[C47] **Multi-Robot Coordination and Layout Design for Automated Warehousing**.
Yulun Zhang, Matthew Fontaine, Varun Bhatt, Stefanos Nikolaidis and **Jiaoyang Li**.
International Joint Conference on Artificial Intelligence (**IJCAI**), pages 5503-5511, 2023.
Acceptance rate: 15%.

[C46] **Binary Branching Multi-Objective Conflict-Based Search for Multi-Agent Path Finding**.
Zhongqiang Ren*, **Jiaoyang Li***, Han Zhang, Sven Koenig, Sivakumar Rathinam and Howie Choset.
International Conference on Automated Planning and Scheduling (**ICAPS**), pages 361-369, 2023.
Acceptance rate: $79/258 = 30.6\%$.

[C45] **Deadline-Aware Multi-Agent Tour Planning**. Best Student Paper Award Honorable Mention.
Taoan Huang, Vikas Shivashankar, Michael Caldara, Joseph W. Durham, **Jiaoyang Li**, Bistra Dilkina and Sven Koenig.
International Conference on Automated Planning and Scheduling (**ICAPS**), 189-197, 2023.
Acceptance rate: $79/258 = 30.6\%$.

[C44] **Beyond Pairwise Reasoning in Multi-Agent Path Finding**.
Bojie Shen, Zhe Chen, **Jiaoyang Li**, Muhammad Aamir Cheema, Daniel Harabor and Peter J. Stuckey.
International Conference on Automated Planning and Scheduling (**ICAPS**), pages 384-392, 2023.
Acceptance rate: $79/258 = 30.6\%$.

[C43] **Cost Splitting for Multi-Objective Conflict-Based Search**.
Cheng Ge*, Han Zhang*, **Jiaoyang Li** and Sven Koenig.
International Conference on Automated Planning and Scheduling (**ICAPS**), pages 128-137, 2023.
Acceptance rate: $79/258 = 30.6\%$.

[C42] **Exact Anytime Multi-Agent Path Finding Using Branch-and-Cut-and-Price and Large Neighborhood Search** (short paper).
Edward Lam, Daniel Harabor, Peter J. Stuckey and **Jiaoyang Li**.
International Conference on Automated Planning and Scheduling (**ICAPS**), pages 254-258, 2023.
Acceptance rate: $79/258 = 30.6\%$.

[C41] **Intersection Coordination with Priority-Based Search for Autonomous Vehicles**.
Jiaoyang Li, The Anh Hoang, Eugene Lin, Hai L. Vu and Sven Koenig.
AAAI Conference on Artificial Intelligence (**AAAI**), pages 11578-11585, 2023.
Acceptance rate: $1,721/8,777 = 19.6\%$.

2022 [C40] **Multi-Goal Multi-Agent Pickup and Delivery**.
Qinghong Xu, **Jiaoyang Li**, Sven Koenig and Hang Ma.
IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS**), pages 9964-9971, 2022.

[C39] **A MIP-Based Approach for Multi-Robot Geometric Task-and-Motion Planning**.
Hejia Zhang, Shao-Hung Chan, Jie Zhong, **Jiaoyang Li**, Sven Koenig and Stefanos Nikolaidis.
IEEE International Conference on Automation Science and Engineering (**CASE**), pages 2102-2109, 2022.

[C38] **Which MAPF Model Works Best for Automated Warehousing?**
Sumanth Varambally, **Jiaoyang Li** and Sven Koenig.
Symposium on Combinatorial Search (**SoCS**), pages 190-198, 2022.
Acceptance rate: $31/79 = 39.2\%$.

[C37] **Learning a Priority Ordering for Prioritized Planning in Multi-Agent Path Finding**.
Shuyang Zhang, **Jiaoyang Li**, Taoan Huang, Sven Koenig and Bistra Dilkina.
Symposium on Combinatorial Search (**SoCS**), pages 208-216, 2022.
Acceptance rate: $31/79 = 39.2\%$.

[C36] **Multi-Train Path Finding Revisited**.
Zhe Chen, **Jiaoyang Li**, Daniel Harabor, Peter Stuckey and Sven Koenig.
Symposium on Combinatorial Search (**SoCS**), pages 38-46, 2022.
Acceptance rate: $31/79 = 39.2\%$.

[C35] **Mutex Propagation in Multi-Agent Path Finding for Large Agents** (short paper).
Han Zhang, Yutong Li, **Jiaoyang Li**, T. K. Satish Kumar and Sven Koenig.
Symposium on Combinatorial Search (**SoCS**), pages 249-253, 2022.
Acceptance rate: $31/79 = 39.2\%$.

[C34] **Optimal and Bounded-Suboptimal Multi-Goal Task Assignment and Path Finding**.
Xinyi Zhong, **Jiaoyang Li**, Sven Koenig and Hang Ma.
IEEE International Conference on Robotics and Automation (**ICRA**), pages 10731-10737, 2022.

[C33] **Multi-Agent Path Finding for Precedence-Constrained Goal Sequences**.
Han Zhang*, Jingkai Chen*, **Jiaoyang Li**, Brian C. Williams and Sven Koenig.
International Joint Conference on Autonomous Agents and Multiagent Systems (**AAMAS**), pages 1464-1472, 2022.
Acceptance rate: $166/629 = 26.4\%$.

[C32] **MAPF-LNS2: Fast Repairing for Multi-Agent Path Finding via Large Neighborhood Search**.
Jiaoyang Li, Zhe Chen, Daniel Harabor, Peter J. Stuckey and Sven Koenig.
AAAI Conference on Artificial Intelligence (**AAAI**), pages 10256-10265, 2022.
Acceptance rate: $1,349/9,251 = 14.9\%$.

[C31] **Anytime Multi-Agent Path Finding via Machine Learning-Guided Large Neighborhood Search**.
Taoan Huang, **Jiaoyang Li**, Sven Koenig and Bistra Dilkina.
AAAI Conference on Artificial Intelligence (**AAAI**), pages 9368-9376, 2022.
Acceptance rate: $1,349/9,251 = 14.9\%$.

[C30] **Shard Systems: Scalable, Robust and Persistent Multi-Agent Path Finding with Performance Guarantees**.
Christopher Leet, **Jiaoyang Li** and Sven Koenig.
AAAI Conference on Artificial Intelligence (**AAAI**), pages 9386-9395, 2022.
Acceptance rate: $1,349/9,251 = 14.9\%$.

[C29] **Flex Distribution for Bounded-Suboptimal Multi-Agent Path Finding**.
Shao-Hung Chan, **Jiaoyang Li**, Graeme Gange, Daniel Harabor, Peter J. Stuckey and Sven Koenig.
AAAI Conference on Artificial Intelligence (**AAAI**), pages 9313-9322, 2022.
Acceptance rate: $1,349/9,251 = 14.9\%$.

2021 [C28] **Anytime Multi-Agent Path Finding via Large Neighborhood Search**.
Jiaoyang Li, Zhe Chen, Daniel Harabor, Peter J. Stuckey and Sven Koenig.
International Joint Conference on Artificial Intelligence (**IJCAI**), pages 4127-4135, 2021.
Acceptance rate: $587/4204 = 13.9\%$.

[C27] **Scalable Rail Planning and Replanning: Winning the 2020 Flatland Challenge**. Winner of the Flatland Challenge at NeurIPS'20.
Jiaoyang Li, Zhe Chen, Yi Zheng, Shao-Hung Chan, Daniel Harabor, Peter J. Stuckey, Hang Ma and Sven Koenig.
International Conference on Automated Planning and Scheduling (**ICAPS**), pages 477-485, 2021.

[C26] **Conflict-Based Increasing Cost Search**.
Thayne T. Walker, Nathan R. Sturtevant, Ariel Felner, Han Zhang, **Jiaoyang Li** and T. K. Satish Kumar.
International Conference on Automated Planning and Scheduling (**ICAPS**), pages 385-395, 2021.

[C25] **EECBS: A Bounded-Suboptimal Search for Multi-Agent Path Finding**.
Jiaoyang Li, Wheeler Ruml and Sven Koenig.
AAAI Conference on Artificial Intelligence (**AAAI**), pages 12353-12362, 2021.
Acceptance rate: $1692/7911 = 21.4\%$.

[C24] **Lifelong Multi-Agent Path Finding in Large-Scale Warehouses**.
Jiaoyang Li, Andrew Tinka, Scott Kiesel, Joseph W. Durham, T. K. Satish Kumar and Sven Koenig.
AAAI Conference on Artificial Intelligence (**AAAI**), pages 11272-11281, 2021.
Acceptance rate: $1692/7911 = 21.4\%$.

[C23] **Scalable and Safe Multi-Agent Motion Planning with Nonlinear Dynamics and Bounded Disturbances**.
Jingkai Chen, **Jiaoyang Li**, Chuchu Fan and Brian Williams.
AAAI Conference on Artificial Intelligence (**AAAI**), pages 11237-11245, 2021.
Acceptance rate: $1692/7911 = 21.4\%$.

[C22] **Symmetry Breaking for k-Robust Multi-Agent Path Finding**.
Zhe Chen, Daniel Harabor, **Jiaoyang Li** and Peter J. Stuckey.
AAAI Conference on Artificial Intelligence (**AAAI**), pages 12267-12274, 2021.
Acceptance rate: $1692/7911 = 21.4\%$.

2020 [C21] **Flatland Competition 2020: MAPF and MARL for Efficient Train Coordination on a Grid World**.
Florian Laurent, Manuel Schneider, Christian Scheller, Jeremy Watson, **Jiaoyang Li**, Zhe Chen, Yi Zheng, Shao-Hung Chan, Konstantin Makhnev, Oleg Svidchenko, Vladimir Egorov, Dmitry Ivanov, Aleksei Shpilman, Evgenija Spirovska, Oliver Tanevski, Aleksandar Nikov, Ramon Grunder, David Galevski, Jakov Mitrovski, Guillaume Sartoretti, Zhiyao Luo, Mehul Damani, Nilabha Bhattacharya, Shivam Agarwal, Adrian Egli, Erik Nygren and Sharada Mohanty.
NeurIPS 2020 Competition and Demonstration Track, Proceedings of Machine Learning Research (**PMLR**), volume 133, pages 275-301, 2020.

[C20] **Mutex Propagation for SAT-Based Multi-Agent Path Finding**.
Pavel Surynek, **Jiaoyang Li**, Han Zhang, T. K. Satish Kumar and Sven Koenig.
International Conference on Principles and Practice of Multi-Agent Systems (**PRIMA**), pages 248-258, 2020.
Acceptance rate: $19/50 = 38.0\%$.

[C19] **Multi-Directional Heuristic Search**.
Dor Atzmon, **Jiaoyang Li**, Ariel Felner, Eliran Nachmani, Shahaf Shperberg, Nathan R. Sturtevant and Sven Koenig.
International Joint Conference on Artificial Intelligence (**IJCAI**), pages 4062-4068, 2020.
Acceptance rate: $592/4717 = 12.6\%$.

[C18] **Iterative-Deepening Conflict-Based Search**.
Eli Boyarski, Ariel Felner, Daniel Harabor, Peter J. Stuckey, Liron Cohen, **Jiaoyang Li** and Sven Koenig.
International Joint Conference on Artificial Intelligence (**IJCAI**), pages 4084-4090, 2020.
Acceptance rate: $592/4717 = 12.6\%$.

[C17] **New Techniques for Pairwise Symmetry Breaking in Multi-Agent Path Finding**.
Jiaoyang Li, Graeme Gange, Daniel Harabor, Peter J. Stuckey, Hang Ma and Sven Koenig.
International Conference on Automated Planning and Scheduling (**ICAPS**), pages 193-201, 2020.
Acceptance rate: $69/216 = 31.9\%$.

[C16] **Multi-Agent Pathfinding with Mutex Propagation**. Outstanding Student Paper Award.
Han Zhang, **Jiaoyang Li**, Pavel Surynek, Sven Koenig and T. K. Satish Kumar.
International Conference on Automated Planning and Scheduling (**ICAPS**), pages 323-332, 2020.
Acceptance rate: $69/216 = 31.9\%$.

[C15] **Moving Agents in Formation in Congested Environments**.
Jiaoyang Li, Kexuan Sun, Hang Ma, Ariel Felner, T. K. Satish Kumar and Sven Koenig.
International Joint Conference on Autonomous Agents and Multiagent Systems (**AAMAS**), pages 726-734, 2020.
Acceptance rate: $186/808 = 23.0\%$.

[C14] **Model AI Assignments 2020**.
Todd W.Neller, Stephen Keeley, Michael Guerzhoy, Wolfgang Hoenig, **Jiaoyang Li**, Sven Koenig, Ameet Soni, Krista Thomason, Lisa Zhang, Bibin Sebatian, Cinjon Resnick, Avital Oliver, Surya Bhupatiraju, Kumar Krishna Agrawal, James Allingham, Sejong Yoon, Johnathan Chen, Tom Larsen, Marion Neumann, Narges Norouzi, Ryan Hausen and Matthew Evett.
Symposium on Educational Advances in Artificial Intelligence (**EAAI**), 2020.

2019 [C13] **Scheduling and Airport Taxiway Path Planning under Uncertainty**.
Jiaoyang Li, Han Zhang, Mimi Gong, Zi Liang, Weizi Liu, Zhongyi Tong, Liangchen Yi, Robert Morris, Corina Pasareanu and Sven Koenig.
AIAA Aviation and Aeronautics Forum and Exposition (**AIAA AVIATION Forum**), 2019.

[C12] **Multi-Agent Pathfinding: Definitions, Variants, and Benchmarks** (position paper).
Roni Stern, Nathan R. Sturtevant, Ariel Felner, Sven Koenig, Hang Ma, Thayne T. Walker, **Jiaoyang Li**, Dor Atzmon, Liron Cohen, T. K. Satish Kumar, Eli Boyarski and Roman Bartak.
Symposium on Combinatorial Search (**SoCS**), pages 151-159, 2019.
Acceptance rate: $14/31 = 45.2\%$.

[C11] **Improved Heuristics for Conflict-Based Search for Multi-Agent Path Finding**.
Jiaoyang Li, Ariel Felner, Eli Boyarski, Hang Ma and Sven Koenig.
International Joint Conference on Artificial Intelligence (**IJCAI**), pages 442-449, 2019.
Acceptance rate: $850/4752 = 17.9\%$.

[C10] **Using FastMap to Solve Graph Problems in a Euclidean Space** (short paper).
Jiaoyang Li, Ariel Felner, Sven Koenig and T. K. Satish Kumar.
International Conference on Automated Planning and Scheduling (**ICAPS**), pages 273-278, 2019.

[C9] **Disjoint Splitting for Multi-Agent Path Finding with Conflict-Based Search** (short paper).
Jiaoyang Li, Daniel Harabor, Peter J. Stuckey, Ariel Felner, Hang Ma and Sven Koenig.
International Conference on Automated Planning and Scheduling (**ICAPS**), pages 279-283, 2019.

[C8] **Task and Path Planning for Multi-Agent Pickup and Delivery**.
Minghua Liu, Hang Ma, **Jiaoyang Li** and Sven Koenig.
International Joint Conference on Autonomous Agents and Multiagent Systems (**AAMAS**), pages 1152-1160, 2019.
Acceptance rate: $189/781 = 24.2\%$.

[C7] **Multi-Agent Path Finding for Large Agents**.
Jiaoyang Li, Pavel Surynek, Ariel Felner, Hang Ma, T. K. Satish Kumar and Sven Koenig.
AAAI Conference on Artificial Intelligence (**AAAI**), pages 7627-7634, 2019.
Acceptance rate: $1150/7095 = 16.2\%$.

[C6] **Symmetry Breaking Constraints for Grid-Based Multi-Agent Path Finding**.
Jiaoyang Li, Daniel Harabor, Peter J. Stuckey, Hang Ma and Sven Koenig.
AAAI Conference on Artificial Intelligence (**AAAI**), pages 6087-6095, 2019.
Acceptance rate: $1150/7095 = 16.2\%$.

[C5] **Searching with Consistent Prioritization for Multi-Agent Path Finding**.
Hang Ma, Daniel Harabor, Peter J. Stuckey, **Jiaoyang Li** and Sven Koenig.
AAAI Conference on Artificial Intelligence (**AAAI**), pages 7643-7650, 2019.
Acceptance rate: $1150/7095 = 16.2\%$.

2018 [C4] **Adding Heuristics to Conflict-Based Search for Multi-Agent Path Finding** (short paper).
Ariel Felner, **Jiaoyang Li**, Eli Boyarski, Hang Ma, Liron Cohen, T. K. Satish Kumar and Sven Koenig.
International Conference on Automated Planning and Scheduling (**ICAPS**), pages 83-87, 2018.
Acceptance rate: $69/209 = 33.0\%$.

[C3] **Multi-Agent Path Finding with Deadlines**.
Hang Ma, G. Wagner, Ariel Felner, **Jiaoyang Li**, T. K. Satish Kumar and Sven Koenig.
International Joint Conference on Artificial Intelligence (**IJCAI**), pages 417-423, 2018.
Acceptance rate: $710/3470 = 20.5\%$.

2017 [C2] **Lifelong Multi-Agent Path Finding for Online Pickup and Delivery Tasks**.
Hang Ma, **Jiaoyang Li**, T. K. Satish Kumar and Sven Koenig.
International Joint Conference on Autonomous Agents and Multiagent Systems (**AAMAS**), pages 837-845, 2017.
Acceptance rate: $155/595 = 26.1\%$.

[C1] **Planning for Electric Taxi Charging System from the Perspective of Transport Energy Supply Chain: A Data-Driven Approach in Beijing**.
Yinghao Jia, Huimiao Chen, **Jiaoyang Li**, Fang He, Meng Li, Zechun Hu and Zuo-Jun Max Shen.
IEEE Transportation Electrification Conference & EXPO Asia-Pacific (**ITEC-AP**), pages 1-6, 2017.

Journals

2024 [J6] **Multi-Agent Motion Planning with Bézier Curve Optimization under Kinodynamic Constraint**.
Jingtian Yan and **Jiaoyang Li**.
IEEE Robotics and Automation Letters, (in print), 2024.

2023 [J5] **Multi-Robot Geometric Task-and-Motion Planning for Collaborative Manipulation Tasks**.
Hejia Zhang, Shao-Hung Chan, Jie Zhong, **Jiaoyang Li**, Peter Kolapo, Sven Koenig, Zach Agioutantis, Steven Schafrik and Stefanos Nikolaidis.
Autonomous Robots, (in print), 2023.

[J4] **Conflict-Tolerant and Conflict-Free Multi-Agent Meeting**.
Dor Atzmon, Ariel Felner, **Jiaoyang Li**, Shahaf Shperberg, Nathan Sturtevant and Sven Koenig.
Artificial Intelligence, volume 322, page 103950, 2023.

2022 [J3] **Multi-Agent Path Finding with Mutex Propagation**.
Han Zhang, **Jiaoyang Li**, Pavel Surynek, T. K. Satish Kumar and Sven Koenig.
Artificial Intelligence, volume 311, page 1034766, 2022.

2021 [J2] **Pairwise Symmetry Reasoning for Multi-Agent Path Finding Search**.
Jiaoyang Li, Daniel Harabor, Peter J. Stuckey, Hang Ma, Graeme Gange and Sven Koenig.
Artificial Intelligence, volume 301, page 103574, 2021.

2017 [J1] **Optimal Combinations and Variable Departure Intervals for Micro Bus System**.
Jiaoyang Li, Jianming Hu and Yi Zhang.
Tsinghua Science and Technology, 22(3):282-292, 2017.

Book Chapters

2021 [B1] **Artificial Intelligence and Automation**.
Sven Koenig, Shao-Hung Chan, **Jiaoyang Li** and Yi Zheng.
In Handbook of Automation, Shimon Y. Nof (editor), Springer, 2021.

Demos

2021 [D1] **Scalable Rail Planning and Replanning: Winning the 2020 Flatland Challenge**. Best System Demonstration Award.
Jiaoyang Li, Zhe Chen, Yi Zheng, Shao-Hung Chan, Daniel Harabor, Peter J. Stuckey, Hang Ma and Sven Koenig.
System Demonstrations and Exhibits Program at International Conference on Automated Planning and Scheduling (**ICAPS**), 2021.

Extended Abstracts

Extended abstracts with a conference or workshop version are not listed below.

2024 [E2] **Optimal Task Assignment and Path Planning using Conflict-Based Search with Precedence and Temporal Constraints** (extended abstract).
Yu Quan Chong, **Jiaoyang Li** and Katia Sycara.
International Joint Conference on Autonomous Agents and Multiagent Systems (**AAMAS**), (in print), 2024.

2019 [E1] **A New Constraint Satisfaction Perspective on Multi-Agent Path Finding: Preliminary Results** (extended abstract).
Jiangxing Wang, **Jiaoyang Li**, Hang Ma, Sven Koenig and T. K. Satish Kumar.
International Joint Conference on Autonomous Agents and Multiagent Systems (**AAMAS**), pages 2253-2255, 2019.
Acceptance rate: 407/781=52.1%.

Teaching

Teaching at CMU

Spring 2024 Multi-Robot Planning and Coordination, 16-891 (graduate level)

Fall 2023 Manipulation, Estimation, and Control, 16-642 (graduate level) -revised.

Spring 2023 Multi-Robot Planning and Coordination, 16-891 (graduate level) -new.

Teaching Assistants at USC

Summer 2021 Research Coach at Viterbi Summer Institute (VSI).
- *A program designed to enhance the transition of engineering students from underrepresented backgrounds to USC.*

Spring 2021 Teaching Assistant at Advanced Analysis of Algorithms, CSCI670 (graduate level).

Fall 2019 Teaching Assistant at Introduction to Artificial Intelligence, CSCI360 (undergraduate level). USC

Summer 2019 Lab Assistant at the Third Summer School on Cognitive Robotics.
- *Co-developed a lab project on multi-agent path finding, which was later chosen as a Model AI Assignment 2020 by the Symposium on Educational Advances in Artificial Intelligence.*

Student Supervision and Mentoring

Supervised Ph.D. Students at CMU

2024-present Rishi Veerapaneni (Ph.D. in Robotics), co-advised with Maxim Likhachev
- *Winner team of the League of Robot Runners, a competition sponsored by Amazon Robotics that focuses on the coordination of multiple moving robots, 2023.*
- *Publications: [C51], [C55], [C56], [C58], [C59].*

2023-present Philip Huang (Ph.D. in Robotics)

2023-present Yorai Shaoul (Ph.D. in Robotics), co-advised with Maxim Likhachev
- *His paper [C54] received the Best Student Paper Award from ICAPS 2024.*
- *Publications: [C54], [C58].*

2022-present Yulun Zhang (Ph.D. in Robotics)
- *Received a CMU fellowship on Quality of Life Tech Center Student Research Fund, 2023.*
- *Winner team of the League of Robot Runners, a competition sponsored by Amazon Robotics that focuses on the coordination of multiple moving robots, 2023.*
- *Publications: [C47], [C49], [C59], [C60], [C61].*

Supervised Master's Students at CMU

2023-present He Jiang (Master of Science in Robotics)
- *Winner team (team leader) of the League of Robot Runners, a competition sponsored by Amazon Robotics that focuses on the coordination of multiple moving robots, 2023.*
- *Publications: [C59], [C61].*

2022-present Harvey Mei (Master of Science in Mechanical Engineering - Research)

Mentored Master's Students at CMU

2023-present Jingtian Yan (Master of Science in Electrical & Computer Engineering)
- *Publications: [J6].*

2022-2023 Yimin Tang (Master of Science in Robotics)
- *His paper [C48] was selected as the finalist of the best paper award.*
- *Publications: [C48], [C57].*

Mentored Undergraduate Students at CMU

2023 Fangji Wang (Visiting undergraduate from Mechanical Engineering at Tsinghua University)
- *Publications: [C53].*

2023-present Yifan Su (CS Undergraduate)
- *Publications: [C51].*

2022-2023 Adittyo Paul (CS Undergraduate w/ Concentration in Machine Learning and Minor in Statistics)
- *Publications: [C52].*

2022-2023 Ying Feng (CS Undergraduate w/ Minor in Algorithms and Complexity Theory)
- *Publications: [C52].*

M.S. Thesis Committee at CMU

2023 Ziwen Ye (Master of Science in Computer Science-Research)
Evolutionary Topology in Truss Optimization via Dissolvable Beams, Lining Yao

2023 Yimin Tang (Master of Science in Robotics),
Solving Multi-Agent Target Assignment and Path Finding with a Single Constraint Tree, Katia Sycara

Mentored Undergraduate and Master's Students at USC

2021-2022 Sumanth Varambally (Undergraduate Student at Indian Institute of Technology Delhi), *IUSSTF-Viterbi Summer Research Program*.
- *Publications: [C38].*

2021-2022 Shuyang Zhang (Undergraduate Student at USC), *Center for Undergraduate Research in Viterbi Engineering (CURVE) Program*.
- *Her poster was selected as a winner of the CURVE Symposium at USC.*
- *Won a Best Research Award in Computer Science at USC.*
- *Publications: [C37].*

2021 Qinghong Xu (Master's Student at Simon Fraser University).
- *Publications: [C40].*

2020-2021 Xinyi Zhong (Master's Student at Simon Fraser University).
- *Publications: [C34].*

2020-2021 Eugene (Zijun) Lin (Master's Student at USC).
- *Publications: [C41].*

2018 Jiangxing Wang (Master's Student at USC), *Directed Research Project*.
- *Won a Best Research Award in Computer Science at USC.*
- *Publications: [E1].*

Summer 2018 Minghua Liu (Undergraduate Student at Tsinghua University), *USC-Tsinghua Summer Research Program*.
- *Publications: [C8].*

Media Coverage

03/2021 Making the (Virtual) Trains Run On Time: USC Team World Champs in AI Challenge, USC Press

05/2020 Amazon Studies Anti-Collision Method for Robots to Increase Throughput, Supply Chain Dive

05/2020 Amazon's AI Tool Can Plan Collision-Free Paths for 1,000 Warehouse Robots, Venture Beat
- *Also distributed via ACM TechNews.*

Academic Activities

Conference and Workshop Organizing Committee

2024 System Demonstration Track Co-Chair of International Conference on Automated Planning and Scheduling (ICAPS)

2024 Co-chair of International Symposium of Combinatorial Search (SoCS)

2023 Co-organizer of AAAI Fall Symposium on Agent Teaming in Mixed-Motive Situations

2023 Doctoral Consortium Co-Chair of Symposium of Combinatorial Search (SoCS)

2023 Co-chair of AAAI Workshop on Multi-Agent Path Finding (WoMAPF)

2022-2024 3x Co-chair of AAMAS Workshop on Optimization and Learning in Multi-Agent Systems (OptLearnMAS)

2022 Local organizing committee of International Conference on the Integration of Constraint Programming, Artificial Intelligence, and Operations Research (CPAIOR)

2020 Co-chair of IJCAI Workshop on Multi-Agent Path Finding (WoMAPF)

Conference Senior Program Committee and Area Chair

2024 Area Chair of International Conference on Automated Planning and Scheduling (ICAPS)

2021 Senior Program Committee of International Joint Conference on Artificial Intelligence (IJCAI)

Conference and Workshop Program Committee

2024 Student Program at AAAI Conference on Artificial Intelligence (AAAI)

2023, 2024 International Joint Conference on Autonomous Agents and Multiagent Systems (AAMAS)

2023, 2024 Robotics: Science and Systems (RSS)

2021-2024 4x AAAI Conference on Artificial Intelligence (AAAI)

2020-2024 4x International Joint Conference on Artificial Intelligence (IJCAI)

2023 International Symposium on Combinatorial Search (SoCS)

2022, 2023 International Conference on the Integration of Constraint Programming, Artificial Intelligence, and Operations Research (CPAIOR)

2021-2023 3x International Conference on Automated Planning and Scheduling (ICAPS)

2021-2023 3x Special track on Autonomous Robots and Agents at International Conference of the Florida Artificial Intelligence Research Society (FLAIRS)

2021 System demonstrations track at International Conference on Automated Planning and Scheduling (ICAPS)

2019, 2020 International Conference on Autonomic and Autonomous Systems (ICAS)

2019 IJCAI Workshop on Multi-Agent Path Finding (WoMAPF)

Conference and Workshop Reviewer (of Individual Papers)

2021-2024 5x IEEE International Conference on Robotics and Automation (ICRA)

2023 Workshop Proposal for IEEE International Conference on Robotics and Automation (ICRA)

2021 2x IEEE International Symposium on Multi-Robot and Multi-Agent Systems (MRS)

2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)

2021 Undergraduate Consortium at AAAI Conference on Artificial Intelligence (AAAI-UC)

2018-2021 3x AAAI/ACM Conference on Artificial Intelligence, Ethics, and Society (AIES)

2020 Workshop on the Algorithmic Foundations of Robotics (WAFR)

2019 Global Conference on Artificial Intelligence (GCAI)

2019 International Joint Conference on Artificial Intelligence (IJCAI)

2019 International Conference on Automated Planning and Scheduling (ICAPS)

2019 International Joint Conference on Autonomous Agents and Multiagent Systems (AAMAS)

2018, 2019 International Symposium on Combinatorial Search (SoCS)

2018 AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment (AIIDE)

2018 ACM Siggraph Conference on Motion, Interaction and Games (MIG)

2018 IEEE Conference on Computational Intelligence and Games (CIG)

2018 ICAPS Workshop on Planning and Robotics (PlanRob)

Journal Editor

2024-2027 Journal of Artificial Intelligence (AIJ)

Journal Reviewer (of Individual Papers)

2023 Robotics and Autonomous Systems

2021,2023 Journal of Artificial Intelligence Research (JAIR)

2022 Autonomous Agents and Multi-Agent Systems (JAAMAS)

2022 2x IEEE Transactions on Robotics (T-RO)

2021-2024 5x Artificial Intelligence (AIJ)

2019-2022 6x IEEE Robotics and Automation Letters (RA-L)

2020,2021 IEEE Transactions on Automation Science and Engineering (T-ASE)

2020 IEEE Transactions on Control of Network Systems (TCNS)

2020 Journal of Aerospace Information Systems (JAIS)

2020 Aerospace Lab (AL)

2017 Tsinghua Science and Technology (TST)

Talks and Presentations

Invited Talks

03/2024 **Intelligent Planning for Large-Scale Multi-Agent Coordination** (virtual). Autonomy Talks.

02/2024 **Layout Design for Large-Scale Multi-Robot Coordination**. Simon Fraser University.

02/2024 **Layout Design for Large-Scale Multi-Robot Coordination**. CMU RI Seminar.

02/2024 **Intelligent Planning for Large-Scale Multi-Agent Coordination** (virtual). CCFAI talk.

12/2023 **Multi-Robot Coordination and Layout Design for Automated Warehousing**. Amazon Robotics.

07/2023 **Efficient and Effective Techniques for Large-Scale Multi-Agent Path Finding**. Dissertation award talk at the International Conference on Automated Planning and Scheduling (ICAPS).

06/2023 **Efficient and Effective Techniques for Large-Scale Multi-Agent Path Finding**. Dissertation award talk at the International Joint Conference on Autonomous Agents and Multiagent Systems (AAMAS).

05/2023 **Efficient and Effective Techniques for Large-Scale Multi-Agent Path Finding**. Dissertation award talk at the Viterbi School of Engineering at the University of Southern California.

05/2023 **Large-Scale Multi-Agent Path Finding** (virtual). OMRON corporation.

04/2023 **Large-Scale Multi-Agent Path Finding** (virtual). Robotics and Controls Seminar at the University of North Carolina at Charlotte.

02/2023 **Intelligent Planning for Large-Scale Multi-Agent Coordination**. AAAI New Faculty Highlights.

06/2022 **Intelligent Planning for Large-Scale Multi-Agent Coordination** (virtual). ICAPS'22 Workshop on Heuristics and Search for Domain-independent Planning.

10/2019 **Fast and Realistic Multi-Agent Path Finding**. Amazon Research Awards - Robotics Symposium.

Guest Lectures

03/2024 **Large-Scale Multi-Agent Path Finding**. CMU Course on Mobile Robots.

03/2022 **Introduction to Multi-Agent Path Finding** (virtual). MIT Course on Cognitive Robotics.

Conference Tutorials

05/2022 AAMAS tutorial on **Recent Advances in Multi-Agent Path Finding** (with Daniel Harabor, Sven Koenig, and Ariel Felner).

02/2022 AAAI tutorial on **Recent Advances in Multi-Agent Path Finding** (with Daniel Harabor, Sven Koenig, and Ariel Felner).

Paper Presentations at Conferences and Symposiums

02/2023 **Intersection Coordination with Priority-Based Search for Autonomous Vehicles**. AAAI Conference on Artificial Intelligence (AAAI).

02/2022 **MAPF-LNS2: Repairing Multi-Agent Path Finding via Large Neighborhood Search** (virtual). AAAI Conference on Artificial Intelligence (AAAI).

08/2021 **Anytime Multi-Agent Path Finding via Large Neighborhood Search** (virtual). International Joint Conference on Artificial Intelligence (IJCAI).

08/2021 **Scalable Rail Planning and Replanning: Winning the 2020 Flatland Challenge** (virtual). International Conference on Automated Planning and Scheduling (ICAPS).

02/2021 **EECBS: A Bounded-Suboptimal Search on Multi-Agent Path Finding** (virtual). AAAI Conference on Artificial Intelligence (AAAI).

02/2021 **Lifelong Multi-Agent Path Finding in Large-Scale Warehouses** (virtual). AAAI Conference on Artificial Intelligence (AAAI).

12/2020 **Winning the 2020 Flatland Challenge** (virtual). Conference on Neural Information Processing Systems (NeurIPS).

10/2020 **New Techniques for Pairwise Symmetry Breaking in Multi-Agent Path Finding** (virtual). International Conference on Automated Planning and Scheduling (ICAPS).

10/2020 **Pairwise Symmetry Reasoning for Multi-Agent Path Finding** (virtual). Doctoral Consortium at the International Conference on Automated Planning and Scheduling (ICAPS).

05/2020 **Moving Agents in Formation in Congested Environments** (virtual). Symposium on Combinatorial Search (SoCS).

05/2020 **New Techniques for Pairwise Symmetry Breaking in Multi-Agent Path Finding** (virtual). Symposium on Combinatorial Search (SoCS).

05/2020 **Moving Agents in Formation in Congested Environments** (virtual). International Joint Conference on Autonomous Agents and Multiagent Systems (AAMAS).

05/2020 **Lifelong Multi-Agent Path Finding in Large-Scale Warehouses** (virtual). International Joint Conference on Autonomous Agents and Multiagent Systems (AAMAS).

02/2020 **A Project on Multi-Agent Path Finding**. Educational Advances in Artificial Intelligence (EAAI).

08/2019 **Improved Heuristics for Conflict-Based Search for Multi-Agent Path Finding**. International Joint Conference on Artificial Intelligence (IJCAI).

08/2019 **Disjoint Splitting for Multi-Agent Path Finding with Conflict-Based Search**. IJCAI-19 Workshop on Multi-Agent Path Finding (WoMAPF).

07/2019 **Using FastMap to Solve Graph Problems in a Euclidean Space**. International Conference on Automated Planning and Scheduling (ICAPS).

07/2019 **Disjoint Splitting for Multi-Agent Path Finding with Conflict-Based Search**. International Conference on Automated Planning and Scheduling (ICAPS).

01/2019 **Multi-Agent Path Finding for Large Agents**. AAAI Conference on Artificial Intelligence (AAAI).

01/2019 **Symmetry Breaking Constraints for Grid-Based Multi-Agent Path Finding**. AAAI Conference on Artificial Intelligence (AAAI).