

Jiaoyang Li

Curriculum Vitae

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Education

- 2017-Present **Ph.D. in Computer Science**, *University of Southern California (USC)*, Los Angeles, CA, USA.
- Advisor: Sven Koenig.
- 2013-2017 **B.Eng. in Automation**, *Tsinghua University (THU)*, Beijing, China.
- GPA: 91/100; Rank: 5/118.
- Excellent Graduate Awards of Department of Automation, Tsinghua and of Beijing.
- Thesis: Group decision making in car-following and lane-changing maneuvers for autonomous vehicles.

Research Experience

- 02/2020 Visiting Researcher (11 months), **Monash University**, Australia
- Advisor: Daniel Harabor and Peter J. Stuckey, Faculty of Information Technology.
- Project: Symmetry-Breaking for Multi-Agent Path Finding. Paper published at AAAI 2021.
- 05/2019 Research Intern (14 weeks), **Amazon Robotics**, USA
- Mentor: Andrew Tinka.
- Project: Multi-Agent Path Finding for Large-Scale Warehouses. Paper published at AAAI 2021.
- 12/2018, Visiting Student (5 weeks in total), **Ben-Gurion University**, Israel
11/2019 - Advisor: Ariel Felner, Department of Software and Information Systems Engineering.
- Project: Heuristics for Multi-Agent Path Finding. Paper published at IJCAI 2019.
- 08/2016 Visiting Student (5 weeks), **University of California, Berkeley**, USA
- Advisor: Zuojun (Max) Shen, Department of Industrial Engineering and Operations Research.
- Supported by Tsinghua Top Open Program and Tsinghua Spark Talents Program.
- Project: Electric Taxi Fleets Dispatching System. Paper published at ITEC-AP 2017.
- 06/2016 Visiting Student (6 weeks), **University of Southern California**, USA
- Advisor: Sven Koenig, Department of Computer Science.
- Supported by USC-Tsinghua Summer Research Program.
- Project: Lifelong Multi-Agent Pickup and Delivery Problem. Paper published at AAMAS 2017.
- 2014-2017 Research Assistant, **Tsinghua University**, China
- Advisor: Jianming Hu, Department of Automation.
- Project 1: Bus Routing and Scheduling Problem. Paper published at TST 2017.
- Project 2 (Bachelor Thesis): Decision Making and Trajectory Planning for Teams of Autonomous Vehicles. Nominated for Best Bachelor Thesis Award in Tsinghua.

Honors and Awards

Fellowships and Scholarships

- 2020 WiSE Qualcomm Top-Off Fellowship, *Women in Science and Engineering Program at USC*.
2017 Viterbi/Graduate School Fellowship, *USC*.
2017 Excellent Graduate Award of Beijing, *Beijing Municipal Education Commission*.
2016 Fellowship of USC-Tsinghua Summer Research Program, *Tsinghua and USC*.
2016 Top Open Program Summer Research Funding, *Tsinghua*, (200/3500).

- 2016 Tsinghua-AVIC Scholarship, *Tsinghua*, (top 5%).
- 2014-2016 3x Academic Excellence Award, *Tsinghua*.
- 2015 Fellowship of Spark Talents Program, *Tsinghua*, (50/3500) .
- 2015 “12.9” Scholarship, *Tsinghua*, (1/560).
- 2015 Weimin Zheng Scholarship, *Tsinghua*, (2/560).
- 2014 Tsinghua-Evergrande Scholarship, *Tsinghua*, (top 5%).

Research Awards

- 2020 Outstanding Student Paper Award, *International Conference on Automated Planning and Scheduling*.
- 2019 Technology Commercialization Award, *USC Stevens Center for Innovation Technology*.

Competition Awards

- 2020 Winner of both rounds of the 2nd Flatland Challenge: NeurIPS-2020 Competition on Multi-Agent Reinforcement Learning on Trains.
- 2016 Honorable Mention of Interdisciplinary Contest in Modeling.
- 2015 Third Price of the 26th Beijing College Students Math Competition.
- 2014 Third Price of the 31th Chinese National College Physics Competition.
- 2013 Silver Medal of the 28th Chinese Mathematical Olympiad (CMO) (ranked 4th in Gansu Province).
- 2012 Silver Medal of the 26th Chinese Chemistry Olympiad (CChO) (ranked 2nd in Gansu Province).
- 2012 First Price of the 29th Chinese Physics Olympiad in Gansu Province (ranked 22nd in Gansu Province).
- 2012 Silver Medal of the 11th Chinese Girls’ Mathematical Olympiad (CGMO).

Publications

Conferences

- 2021 [C23] J. Li, Z. Chen, Y. Zheng, S. Chan, D. Harabor, P. Stuckey, H. Ma and S. Koenig. **Scalable Rail Planning and Replanning: Winning the 2020 Flatland Challenge**. In *Proceedings of the International Conference on Automated Planning and Scheduling (ICAPS)*, (in print), 2021.
- [C22] T. Walker, N. R. Sturtevant, H. Zhang, J. Li, S. Koenig, A. Felner and T. K. S. Kumar. **Conflict-Based Increasing Cost Search**. In *Proceedings of the International Conference on Automated Planning and Scheduling (ICAPS)*, (in print), 2021.
- [C21] J. Li, W. Ruml and S. Koenig. **EECBS: Bounded-Suboptimal Search for Multi-Agent Path Finding**. In *Proceedings of the AAAI Conference on Artificial Intelligence (AAAI)*, (in print), 2021. Acceptance rate: 1692/7911=21.4%.
- [C20] J. Li, A. Tinka, S. Kiesel, J. Durham, T. K. S. Kumar and S. Koenig. **Lifelong Multi-Agent Path Finding in Large-Scale Warehouses**. In *Proceedings of the AAAI Conference on Artificial Intelligence (AAAI)*, (in print), 2021. Acceptance rate: 1692/7911=21.4%.
- [C19] J. Chen, J. Li, C. Fan and B. Williams. **Scalable and Safe Multi-Agent Motion Planning with Nonlinear Dynamics and Bounded Disturbances**. In *Proceedings of the AAAI Conference on Artificial Intelligence (AAAI)*, (in print), 2021. Acceptance rate: 1692/7911=21.4%.
- [C18] Z. Chen, D. Harabor, J. Li and P. Stuckey. **Symmetry Breaking for k-Robust Multi-Agent Path Finding**. In *Proceedings of the AAAI Conference on Artificial Intelligence (AAAI)*, (in print), 2021. Acceptance rate: 1692/7911=21.4%.
- 2020 [C17] P. Surynek, J. Li, H. Zhang, S. Kumar and S. Koenig. **Mutex Propagation for SAT-Based Multi-Agent Path Finding**. In *Proceedings of the International Conference on Principles and Practice of Multi-Agent Systems (PRIMA)*, (in print), 2020. Acceptance rate: 19/50=38.0%.
- [C16] D. Atzmon, J. Li, A. Felner, E. Nachmani, S. Shperberg, N. R. Sturtevant and S. Koenig. **Multi-Directional Heuristic Search**. In *Proceedings of the International Joint Conference on Artificial Intelligence (IJCAI)*, pages 4062-4068, 2020. Acceptance rate: 592/4717=12.6%.

- [C15] E. Boyarski, A. Felner, D. Harabor, P. Stuckey, L. Cohen, **J. Li** and S. Koenig. **Iterative-Deepening Conflict-Based Search**. In *Proceedings of the International Joint Conference on Artificial Intelligence (IJCAI)*, pages 4084-4090, 2020. Acceptance rate: 592/4717=12.6%.
- [C14] **J. Li**, G. Gange, D. Harabor, P. Stuckey, H. Ma and S. Koenig. **New Techniques for Pairwise Symmetry Breaking in Multi-Agent Path Finding**. In *Proceedings of the International Conference on Automated Planning and Scheduling (ICAPS)*, pages 193-201, 2020. Acceptance rate: 69/216=31.9%.
- [C13] H. Zhang, **J. Li**, P. Surynek, S. Koenig and T. K. S. Kumar. **Multi-Agent Pathfinding with Mutex Propagation**. In *Proceedings of the International Conference on Automated Planning and Scheduling (ICAPS)*, pages 323-332, 2020. Acceptance rate: 69/216=31.9%. [Outstanding student paper award](#).
- [C12] **J. Li**, K. Sun, H. Ma, A. Felner, T. K. S. Kumar and S. Koenig. **Moving Agents in Formation in Congested Environments**. In *Proceedings of the International Joint Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, pages 726-734, 2020. Acceptance rate: 186/808=23.0%.
- 2019 [C11] **J. Li**, E. Boyarski, A. Felner, H. Ma and S. Koenig. **Improved Heuristics for Conflict-Based Search for Multi-Agent Path Finding**. In *Proceedings of the International Joint Conference on Artificial Intelligence (IJCAI)*, pages 442-449, 2019. acceptance rate: 850/4752=17.9%.
- [C10] **J. Li**, A. Felner, S. Koenig and T. K. S. Kumar. **Using FastMap to Solve Graph Problems in a Euclidean Space** (short paper). In *Proceedings of the International Conference on Automated Planning and Scheduling (ICAPS)*, pages 273-278, 2019.
- [C9] **J. Li**, D. Harabor, P. Stuckey, A. Felner, H. Ma and S. Koenig. **Disjoint Splitting for Multi-Agent Path Finding with Conflict-Based Search** (short paper). In *Proceedings of the International Conference on Automated Planning and Scheduling (ICAPS)*, pages 279-283, 2019.
- [C8] M. Liu, H. Ma, **J. Li** and S. Koenig. **Task and Path Planning for Multi-Agent Pickup and Delivery**. In *Proceedings of the International Joint Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, pages 1152-1160, 2019. Acceptance rate: 189/781=24.2%.
- [C7] **J. Li**, P. Surynek, A. Felner, H. Ma, T. K. S. Kumar and S. Koenig. **Multi-Agent Path Finding for Large Agents**. In *Proceedings of the AAAI Conference on Artificial Intelligence (AAAI)*, pages 7627-7634, 2019. Acceptance rate: 1150/7095=16.2%.
- [C6] **J. Li**, D. Harabor, P. Stuckey, H. Ma and S. Koenig. **Symmetry Breaking Constraints for Grid-Based Multi-Agent Path Finding**. In *Proceedings of the AAAI Conference on Artificial Intelligence (AAAI)*, pages 6087-6095, 2019. Acceptance rate: 1150/7095=16.2%.
- [C5] H. Ma, D. Harabor, P. Stuckey, **J. Li** and S. Koenig. **Searching with Consistent Prioritization for Multi-Agent Path Finding**. In *Proceedings of the AAAI Conference on Artificial Intelligence (AAAI)*, pages 7643-7650, 2019. Acceptance rate: 1150/7095=16.2%.
- 2018 [C4] A. Felner, **J. Li**, E. Boyarski, H. Ma, L. Cohen, T. K. S. Kumar and S. Koenig. **Adding Heuristics to Conflict-Based Search for Multi-Agent Path Finding** (short paper). In *Proceedings of the International Conference on Automated Planning and Scheduling (ICAPS)*, pages 83-87, 2018. Acceptance rate: 69/209=33.0%.
- [C3] H. Ma, G. Wagner, A. Felner, **J. Li**, T. K. S. Kumar and S. Koenig. **Multi-Agent Path Finding with Deadlines**. In *Proceedings of the International Joint Conference on Artificial Intelligence (IJCAI)*, pages 417-423, 2018. Acceptance rate: 710/3470=20.5%.
- 2017 [C2] H. Ma, **J. Li**, T. K. S. Kumar and S. Koenig. **Lifelong Multi-Agent Path Finding for Online Pickup and Delivery Tasks**. In *Proceedings of the International Joint Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, pages 837-845, 2017. Acceptance rate: 155/595=26.1%.
- [C1] Y. Jia, H. Chen, **J. Li**, F. He, M. Li, Z. Hu, and Z. Shen. **Planning for Electric Taxi Charging System from the Perspective of Transport Energy Supply Chain: A Data-Driven Approach in Beijing**. In *Proceedings of IEEE Transportation Electrification Conference & EXPO Asia-Pacific (ITEC-AP)*, pages 1-6, 2017.

Journals

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

Symposiums, Forums and Workshops

* Symposium, forums and workshop papers with a conference version are not listed below.

- 2020 [W4] S. Chan, J. Li, D. Harabor, P. J. Stuckey, G. Gange, L. Cohen and S. Koenig. **Nested ECBS for Bounded Suboptimal Multi-Agent Path Finding**. In *the IJCAI-20 Workshop on Multi-Agent Path Finding (WoMAPF)*, 2020.
- [W3] T. Neller, S. Keeley, M. Guershoy, W. Hoenig, J. Li, S. Koenig, A. Soni, K. Thomason, L. Zhang, B. Sebastian, C. Resnick, A. Oliver, S. Bhupatiraju, K. Agrawal, J. Allingham, S. Yoon, J. Chen, T. Larsen, M. Neumann, N. Norouzi, R. Hausen and M. Evett. **Model AI Assignments 2020**. In *Proceedings of the Symposium on Educational Advances in Artificial Intelligence (EAAI)*, 2020.
- [W2] R. Stern, N. R. Sturtevant, A. Feler, S. Koenig, H. Ma, T. Walker, J. Li, D. Atzmon, L. Cohen, T. K. S. Kuamr, E. Boyarski and R. Bartak. **Multi-Agent Pathfinding: Definitions, Variants, and Benchmarks** (position paper). In *Proceedings of the Symposium on Combinatorial Search (SoCS)*, pages 151-159, 2019. Acceptance rate: 14/31=45.2%.
- [W1] J. Li, H. Zhang, M. Gong, Z. Liang, W. Liu, Z. Tong, L. Yi, R. Morris, C. Pasareanu and S. Koenig. **Scheduling and Airport Taxiway Path Planning under Uncertainty**. In *Proceedings of the AIAA Aviation and Aeronautics Forum and Exposition (AIAA AVIATION Forum)*, 2019.

Extended Abstracts

* Extended abstracts with a conference version are not listed below.

- 2021 [E2] J. Li, Z. Chen, D. Harabor, P. Stuckey and S. Koenig. **Anytime Multi-Agent Path Finding via Large Neighborhood Search** (extended abstract). In *Proceedings of the International Joint Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, (in print), 2021. Acceptance rate: 246/612=40.2%.
- 2019 [E1] J. Wang, J. Li, H. Ma, S. Koenig and T. K. S. Kumar. **A New Constraint Satisfaction Perspective on Multi-Agent Path Finding: Preliminary Results** (extended abstract). In *Proceedings of the International Joint Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, pages 2253-2255, 2019. Acceptance rate: 407/781=52.1%.

Media Coverage

- 05/2020 **Amazon studies anti-collision method for robots to increase throughput**, *Supply Chain Dive*, <https://www.supplychaindive.com/news/amazon-robots-from-colliding-increasing-throughput-warehouse/578599/>.
- 05/2020 **Amazon's AI tool can plan collision-free paths for 1,000 warehouse robots**, *Venture Beat*, <https://venturebeat.com/2020/05/18/amazons-ai-tool-can-plan-collision-free-paths-for-1000-warehouse-robots/>.

Teaching and Mentoring Experience

Teaching Assistant

- Spring 2021 Advanced Analysis of Algorithms, CSCI670 at USC.
- Fall 2019 Introduction to Artificial Intelligence, CSCI360 at USC.

Student Mentor

- Spring 2021 Shuyang Zhang (Undergraduate Student in Computer Science at USC), *Center for Undergraduate Research in Viterbi Engineering (CURVE) Program*.
- Fall 2020 Xinyi Zhong (Master Student in Computer Science at Simon Fraser University).

- Summer & Fall 2020 Wooju Yim (Undergraduate Student in Computer Science at USC); Leon Durrenberger (Undergraduate Student in Computer Science at USC), *Directed Research Project*; and Eugene (Zijun) Lin (Master Student in Computer Science at USC).
- Fall 2019 Moli Yang (Master Student in Computer Science at Melbourne University), *Visiting student*.
- Summer & Fall 2018 Jiangxing Wang (Undergraduate Student in Computer Science at USC), *Directed Research Project*. Paper published at AAMAS, 2019.
- Summer 2018 Minghua Liu (Undergraduate Student in Computer Science at Tsinghua University, now a PhD student at UCSD), *USC-Tsinghua Summer Research Program*. Paper published at AAMAS, 2019.

Academic Activities

Conference and Workshop Organizing Committee

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

Conference and Workshop (Senior) Program Committee

- 2021 PC at International Conference on Automated Planning and Scheduling (ICAPS)
- 2021 PC at AAAI Conference on Artificial Intelligence (AAAI)
- 2021 PC at International Conference of the Florida Artificial Intelligence Research Society (FLAIRS)
- 2021 SPC at International Joint Conference on Artificial Intelligence (IJCAI)
- 2020 PC at International Joint Conference on Artificial Intelligence (IJCAI)
- 2019, 2020 PC at International Conference on Autonomic and Autonomous Systems (ICAS)
- 2019 PC at IJCAI Workshop on Multi-Agent Path Finding (WoMAPF)

Conference and Workshop Reviewer (of Individual Papers)

- 2021 IEEE International Conference on Robotics and Automation (ICRA)
- 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 Reviewer

- 2021 Artificial Intelligence (AIJ)
- 2020 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)
- 2019, 2020 3x IEEE Robotics and Automation Letters (RA-L)
- 2017 Tsinghua Science and Technology (TST)

Panel Membership

- 2021 Grad Student Panel at AAAI-2021 Undergraduate Consortium
- 2020 Flatland Townhall Panel at NeurIPS-2020 Competition Track

Talks and Presentations

Invited Talks

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

Presentations at Conferences

- 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).