Dr. Panpan Cai

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I am a roboticist. I have been conducting active research in decision making under uncertainty, robot learning, and integrating them to solve complex real-world robotics problems. My research vision is to enable robots to operate efficiently in large-scale, dynamic, and uncertain environments like human, and accomplish challenging tasks.

Education

Nanyang Technological University **Singapore**
Doctor of Philosophy *2011.8–2016.7*
Research on robotic motion planning, collision detection, and GPU computing.

Zhejiang University **Hangzhou, China**
Bachelor's Degree in Mathematics (specialized on Information and Computing Science)
Top student selected into the ChuKoChen Honors College *2007.8–2011.6*
Trained on Mathematics, scientific computing, and Computer Aided Geometric Design (CAGD).

Professional Experience

Qing Yuan Research Institute, Shanghai Jiao Tong University **China**
Associate professor *2022–now*
- Research scope: robot learning, robot decision making, reinforcement learning, integrating planning and learning.

Department of Computer Science, National University of Singapore **Singapore**
Senior postdoctoral research fellow *2021–2022*
- Conduct independent research and lead research projects on integrating planning with reinforcement learning;
- Publish in top robotics conferences and journals, including T-RO (accepted), RAL, RSS, and ICRA;
- Mentored an undergraduate student for an award-winning final year project, as well as master students and research interns for independent research;
- Organized an international workshop (main organizer) under a top robotics conference, RSS 2021;
- Taught two lectures in a graduate-level robotics class on POMDP planning, robot systems, and autonomous driving.

Department of Computer Science, National University of Singapore **Singapore**
Postdoctoral research fellow *2017–2020*
- Conduct independent research and lead research projects on decision making under uncertainty, integrating planning and learning, and autonomous driving in crowded environments;
- Publish in top robotics conferences and journals, including IJRR, RAL, RSS, ICRA, and IROS;
- Mentored PhD, undergraduate, and intern students for independent research;
- Taught a lecture in a graduate-level robotics class on sampling-based motion planning.

School of Mechanical and Aerospace Engineering, Nanyang Technological University **Singapore**
PhD student *2011–2016*
- Conduct independent research on parallel collision detection and motion planning in large-scale industrial environments;
- Publish in tier-one journals on industrial applications of robotics and automation;
- Close collaboration with a listed lifting service company;
- Published a patent on intelligent crane-lifting systems.
- Taught an undergraduate-level lab project.

Publications

Overview:
Citation: 428 (queried at 09.10.2022)
H-index: 9
i10-index: 9

Peer-reviewed journal papers:
- P. Cai and D. Hsu. Closing the Planning-Learning Loop with Application to Autonomous Driving in a Crowd. *IEEE Transactions on Robotics (T-RO) (accepted)*, 2022, arXiv:2101.03834. (Impact factor: 5.567; Citation: 1).
- (Equal-contribution first author, corresponding author) Y. Luo*, P. Cai*, D. Hsu, and WS Lee. GAMMA: A General Agent Motion Model for Autonomous Driving. *IEEE Robotics and Automation Letters (RAL)*, 2022, DOI:10.1109/LRA.2022.3144501. (Impact factor: 3.741; Citation: 19).
- P. Cai, Y. Luo, D. Hsu, and W.S. Lee. HyP-DESPOT: A Hybrid Parallel Algorithm for Online Planning under Uncertainty.

International Journal of Robotics Research (IJRR), 2021, DOI:10.1177/0278364920937074. (Impact factor: 4.703; Citation: 45).

- Y. Luo, P. Cai, A. Bera, D. Hsu, W.S. Lee, and D. Manocha. PORCA: Modeling and planning for autonomous driving among many pedestrians. *IEEE Robotics Automation Letters (RAL)*, 2018, DOI:10.1109/LRA.2018. 2852793. (Impact factor: 3.741; Citation: 121).
- P. Cai, Y. Cai, I. Chandrasekaran, and J. Zheng "Automatic Path Planning for Dual-Crane Lifting in Complex Environments Using a Prioritized Multi-objective PGA", *IEEE Transactions on Industrial Informatics (TII)*, 2017, DOI:10.1109/TII.2017.2715835. (Impact factor: 10.215; Citation: 32).
- P. Cai, Y. Cai, I. Chandrasekaran, and J. Zheng. "Parallel GA based automatic crane lifting path planning in complex environments", *Automation in Construction (AIC)*, 2016, DOI:10.1016/J.AUTCON.2015.09.007. (Impact factor: 7.7; Citation: 76).

Peer-reviewed conference papers:

- M. H. Danesh, P. Cai, D.Hsu. LEADER: Learning Attention over Driving Behaviors for Planning under Uncertainty. *Conference on Robot Learning (CoRL)*, Dec 2022, Auckland.
- Y. Lee and P. Cai, and D. Hsu. MAGIC: Learning Macro-Actions for Online POMDP Planning using Generator-Critic. *Robotics: Science & Systems (RSS)*, July 2021, DOI:10.15607/RSS.2021.XVII.041. (Research impact score: 5.45; Citation: 7).
- (Equal-contribution first author) P. Cai*, Y. Lee*, Y. Luo, D. Hsu. SUMMIT: A Simulator for Urban Driving in Massive Mixed Traffic. *International Conference on Robotics and Automation (ICRA)*, June 2020, DOI:10.1109/ICRA40945. 2020.9197228. (Research impact score: 5.75; Citation: 39).
- P. Cai, Y. Luo, A. Saxena, D. Hsu, W.S. Lee. LeTS-Drive: Driving in a Crowd by Learning from Tree Search. *Robotics: Science & Systems (RSS)*, June 2019, DOI:10.15607/RSS.2019.XV.018. (Research impact score: 5.45; Citation: 19).
- M. Meghjani, Y. Luo, Q.H. Ho, P. Cai, S. Verma, D. Rus, D. Hsu. Context and Intention Aware Planning for Urban Driving. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Nov. 2019, DOI:10.1109/IROS40897.2019. 8967873. (Research impact score: 10.06; Citation: 17).
- P. Cai, Y. Luo, D. Hsu, and W.S. Lee. HyP-DESPOT: A Hybrid Parallel Algorithm for Online Planning under Uncertainty. *Robotics: Science & Systems (RSS)*, June 2018, DOI:10.15607/RSS.2018.XIV.004. (Research impact score: 5.45; Citation: 45).
- L. Huang, Y. Zhang, J. Zheng, P. Cai, S. Dutta, Y. Yue, N. Thalmann and Y. Cai. Point cloud based path planning for tower crane lifting. Computer Graphics International Conference, June 2018, DOI:10.1145/3208159.3208186.
- P. Cai, Y. Cai, I. Chandrasekaran, and J. Zheng, "A GPU-enabled parallel genetic algorithm for path planning", 2013 Symposium on GPU Computing and Applications (Best Paper), Oct 2013, DOI:10.1007/978-981-287-134-3_1.

Book chapters:

- P. Cai, I. Chandrasekaran, Y. Cai, Y. Chen, and X. Wu. Simulation-enabled vocational training for heavy crane operations. In Simulation and Serious Games for Education (pp. 47-59), 2017, DOI: 10.1007/978-981-10-0861-0_4.
- P. Cai, C. Indhumathi, Y. Cai, J. Zheng, Y. Gong, T. Lim, and P. Wong. Collision detection using axis aligned bounding boxes. In *Simulations, Serious Games and Their Applications* (pp. 1-14), 2014, DOI:10.1007/978-981-4560-32-0_1.

Patent

- Y. Cai, P. Cai, C. Indhumathi, J. Zheng, N. M. Thalmann, P. Wong, T. S. Lim and Y. Gong, PEC Ltd and Nanyang Technological University. Method and system for intelligent crane lifting. WIPO (PCT), 2015, WO2015053711A1.

Professional Services

Program and Organization Committees:

- Associate Editor, IEEE International Conference on Robotics and Automation (ICRA), 2023.
- Program committee member, International Conference on Automated Planning and Scheduling (ICAPS), 2022.
- Main organizer, RSS 2021 workshop on Integrating Planning and Learning.
- Organization committee member, RSS Pioneers Workshop, 2021.
- Program committee member, Robotics: Science & Systems (RSS), 2020.
- Program committee member, Conference on Robot Learning (CORL), 2019.
- Organization committee member, CS research week 2019, School of Computing, NUS.

Paper Review:

- International Journal of Robotics Research (IJRR)
- IEEE Transactions on Robotics (T-RO)
- IEEE Robotics and Automation Letters (RAL)

- Autonomous Robots (AURO)
- IEEE International Conference on Robotics and Automation (ICRA)
- International Conference on Intelligent Robots and Systems (IROS)
- American Control Conference (ACC)
- International Joint Conference on Artificial Intelligence (IJCAI)

Teaching & Mentoring

Lecturing:

- Co-lecturing, Module CS4278/CS5478 "Intelligent Robots: Algorithms and Systems", Semester 1&2, 2021/2022, NUS.
  - Graduate-level course, covering more than 100 students.
  - Delivered Lecture 11 "POMDP planning."
  - Delivered Lecture 12 "Robot systems."
- Co-lecturing, Module CS6244 "Robot Motion Planning & Control", Semester 1, 2017/2018, Lecture 3, NUS.
  - Graduate-level course, covering 20-30 students.
  - Delivered Lecture 3 "Sampling-based motion planning."
- Teaching assistance, Project P3.6 "Vibration Testing of Multiple DOF Systems" for AY 2015/16, S1 & S2, NTU.
  - Undergraduate-level class, covering 12 students.
  - Delivered a series of short lectures on the theory of mechanical vibration and guided lab experiments.

Mentoring:

- Co-supervising Mr. Yunfan Lu for his master research.
- Supervising Mr. Mohamad Danesh for his research internship.
- Co-supervised Mr. Yiyuan Lee for his Final Year Project; He is now a PhD candidate at Rice University.
- Supervised Ms. Shuyuan Jin for her Final Year Project. She is now a Software Engineer at Facebook.
- Co-supervised Dr. Yuanfu Luo for his PhD research. He is now an algorithm engineer at Da-Jiang Innovations.
- Supervised Mr. Arthur Wandzel for his research internship. He is now the co-founder of JAMM, an AI startup.
- Supervised Mr. Aseem Saxena for his research internship. He is now a master student at Oregon State University.

Research Talks

- Invited talk at the Computer Science Department at Brown University. "How does a robot drive better than us?", Aug 2020.
- AI lunch talk at the School of Computing, National University of Singapore. "Hybrid intelligence of robots: modeling, decision making, and learning", Oct 2019.
- Invited talk at ISEE AI, an MIT startup on autonomous driving. "How can a robot drive better than us?", Nov 2019.
- Invited talk at the School of Mathematical Sciences, Zhejiang University. "Planning under uncertainty in robotics: theory to practice, and serial to parallel", May 2018.

References

- Dr. David Hsu (IEEE Fellow).
  Provost's Chair Professor. Department of Computer Science. National University of Singapore.
  Relationship: Postdoc supervisor.
  Email: dyhsu@comp.nus.edu.sg
  Phone: +65 6825 4200
- Dr. Wee Sun Lee.
  Professor, Head of Department. Department of Computer Science. National University of Singapore.
  Relationship: close collaborator.
  Email: leews@comp.nus.edu.sg
  Phone: +65 6516 4526
- Dr. Yiyu Cai.
  Associate professor. School of Mechanical and Aerospace Engineering. Nanyang Technological University.
  Relationship: PhD supervisor.
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