Zachary K. Kingston

https://zkingston.com/
zak@rice.edu

Education

Rice University	Ph.D. in Computer Science	Aug. 2016–Dec. 2021
Houston, TX	Thesis: *Toward Efficient and General Multi-Modal Planning*	
	Advisor: Dr. Lydia E. Kavraki	
	M.S. in Computer Science	Aug. 2016–Dec. 2017
	Thesis: *A Unifying Framework for Constrained Sampling-Based Planning*	
	Advisor: Dr. Lydia E. Kavraki	
	B.S. in Computer Science	Aug. 2012–May 2016

Professional Experience

Purdue University	Assistant Professor	Aug. 2024–Present
at West Lafayette, IN	*in the Department of Computer Science*	
Kavraki Lab	Post-Doctoral Researcher and Lab Manager	Dec. 2021–Aug. 2024
at Rice University, Houston, TX	*Supervisor: Dr. Lydia Kavraki*	https://kavrakilab.org/
	Graduate Student	Aug. 2016–Dec. 2021
	Advisor: Dr. Lydia Kavraki	
	Undergraduate Researcher	Feb. 2015–Aug. 2016
	Advisor: Dr. Lydia Kavraki	
Dexterous Robotics Lab	NSTRF Fellow	Aug. 2017–Aug. 2021
at NASA JSC, Houston, TX	*Supervisor: Dr. Julia Badger*	https://er.jsc.nasa.gov/er4/
	USRA Intern	Summer 2017
	Supervisor: Dr. Julia Badger	
	Guest Researcher	Summer 2016
	Supervisor: Dr. Julia Badger	
Multi-Robot Systems Lab	Undergraduate Researcher	May 2014–May 2015
at Rice University, Houston, TX	*Advisor: Dr. James McLurkin*	http://mrsl.rice.edu/

Publications

All publications are available on my website: https://zkingston.com.

Peer-Reviewed Journal Articles

J1. S. Bora Bayraktar, Andreas Orthey, **Zachary Kingston**, Marc Toussaint, and Lydia E. Kavraki. Solving rearrangement puzzles using path defragmentation in factored state spaces. *IEEE Robotics and Automation Letters*, 8(8):4529–4536, 2023. doi:10.1109/LRA.2023.3282788. Presented at ICRA 2024

J2. **Zachary Kingston** and Lydia E. Kavraki. Scaling multi-modal planning: Using experience and informing discrete search. *IEEE Transactions on Robotics*, 39(1):128–146, 2023. doi:10.1109/TRO.2022.3197080

J3. Constantinos Chamzas, Carlos Quintero-Peña, **Zachary Kingston**, Andreas Orthey, Daniel Rakita, Michael Gleicher, Marc Toussaint, and Lydia E. Kavraki. MotionBenchMaker: A tool to generate and benchmark motion planning datasets. *IEEE Robotics and Automation Letters*, 7(2):882–889, 2021. doi:10.1109/LRA.2021.3133603

J4. **Zachary Kingston**, Mark Moll, and Lydia E. Kavraki. Exploring implicit spaces for constrained sampling-based planning. *The International Journal of Robotics Research*, 38(10–11):1151–1178, 2019. doi:10.1177/0278364919868530

J5. Neil T. Dantam, **Zachary Kingston**, Swarat Chaudhuri, and Lydia E. Kavraki. An incremental constraint-based framework for task and motion planning. *The International Journal of Robotics Research*, 37(10):1134–1151, 2018. doi:10.1177/0278364918761570

J6. **Zachary Kingston**, Mark Moll, and Lydia E. Kavraki. Sampling-based methods for motion planning with constraints. *Annual Review of Control, Robotics, and Autonomous Systems*, 1(1):159–185, 2018. doi:10.1146/annurev-control-060117-105226

Peer-Reviewed Conference Papers

C1. Clayton W. Ramsey, Zachary Kingston, Wil Thomason, and Lydia E. Kavraki. Collision-affording point trees: Simd-amenable nearest neighbors for fast collision checking. In *Robotics: Science and Systems*, 2024. URL https://arxiv.org/abs/2406.02807. Equal Contribution. To Appear

C2. Wil Thomason[†], **Zachary Kingston**[†], and Lydia E. Kavraki. Motions in microseconds via vectorized sampling-based planning. In *IEEE International Conference on Robotics and Automation*, 2024. URL https://arxiv.org/abs/2309.14545. † Equal Contribution

C3. Carlos Quintero-Peña, Wil Thomason, **Zachary Kingston**, Anastasios Kyrillidis, and Lydia E. Kavraki. Stochastic implicit neural signed distance functions for safe motion planning under sensing uncertainty. In *IEEE International Conference on Robotics and Automation*, 2024. URL https://arxiv.org/pdf/2309.16862.pdf

C4. Khen Elimelech, **Zachary Kingston**, Wil Thomason, Moshe Vardi, and Lydia E. Kavraki. Accelerating long-horizon planning with affordance-directed dynamic grounding of abstract skills. In *IEEE International Conference on Robotics and Automation*, 2024. URL http://khen.io/icra24appendix.pdf

C5. Rahul Shome, **Zachary Kingston**, and Lydia E. Kavraki. Robots as AI double agents: Privacy in motion planning. In *IEEE/RSJ International Conference on Intelligent Robots and Systems*, pages 2861–2868, 2023. doi:10.1109/IROS55552.2023.10341460

C6. Carlos Quintero-Peña, **Zachary Kingston**, Tianyang Pan, Rahul Shome, Anastasios Kyrillidis, and Lydia E. Kavraki. Optimal grasps and placements for task and motion planning in clutter. In *IEEE International Conference on Robotics and Automation*, pages 3707–3713, 2023. doi:10.1109/ICRA48891.2023.10161455

C7. Yiyuan Lee, Wil Thomason, **Zachary Kingston**, and Lydia E. Kavraki. Object reconfiguration with simulation-derived feasible actions. In *IEEE International Conference on Robotics and Automation*, pages 8104–8111, 2023. doi:10.1109/ICRA48891.2023.10160377

C8. **Zachary Kingston** and Lydia E. Kavraki. Robowflex: Robot motion planning with *MoveIt* made easy. In *IEEE/RSJ International Conference on Intelligent Robots and Systems*, pages 3108–3114, 2022. doi:10.1109/IROS47612.2022.9981698

C9. **Zachary Kingston**, Constantinos Chamzas, and Lydia E. Kavraki. Using experience to improve constrained planning on foliations for multi-modal problems. In *IEEE/RSJ International Conference on Intelligent Robots and Systems*, pages 6922–6927, 2021. doi:10.1109/IROS51168.2021.9636236

C10. Mark Moll, Constantinos Chamzas, **Zachary Kingston**, and Lydia E. Kavraki. HyperPlan: A framework for motion planning algorithm selection and parameter optimization. In *IEEE/RSJ International Conference on Intelligent Robots and Systems*, pages 2511–2518, 2021. doi:10.1109/IROS51168.2021.9636651

C11. Andrew M. Wells, **Zachary Kingston**, Morteza Lahijanian, Lydia E. Kavraki, and Moshe Y. Vardi. Finite horizon synthesis for probabilistic manipulation domains. *IEEE International Conference on Robotics and Automation*, pages 6336–6342, 2021. doi:10.1109/ICRA48506.2021.9561297

C12. Constantinos Chamzas, **Zachary Kingston**, Carlos Quintero-Peña, Anshumali Shrivastava, and Lydia E. Kavraki. Learning sampling distributions using local 3D workspace decompositions for motion planning in high dimensions. In *IEEE International Conference on Robotics and Automation*, pages 1283–1289, 2021. doi:10.1109/ICRA48506.2021.9561104

C13. **Zachary Kingston**, Andrew M. Wells, Mark Moll, and Lydia E. Kavraki. Informing multi-modal planning with synergistic discrete leads. In *IEEE International Conference on Robotics and Automation*, pages 3199–3205, 2020. doi:10.1109/ICRA40945.2020.9197545

C14. **Zachary Kingston**, Mark Moll, and Lydia E. Kavraki. Decoupling constraints from sampling-based planners. In Nancy M. Amato, Greg Hager, Shawna Thomas, and Miguel Torres-Torriti, editors, *Robotics Research*, pages 913–928. Springer International Publishing, Cham, 2020. ISBN 978-3-030-28619-4. doi:10.1007/978-3-030-28619-4_62

C15. Golnaz Habibi, Sándor P. Fekete, **Zachary Kingston**, and James McLurkin. Distributed object characterization with local sensing by a multi-robot system. In Roderich Groß, Andreas Kolling, Spring Berman, Emilio Frazzoli, Alcherio Martinoli, Fumitoshi Matsuno, and Melvin Gauci, editors, *Distributed Autonomous Robotic Systems: The 13th International Symposium*, volume 6, pages 205–218. Springer Proceedings in Advanced Robotics, 2018. doi:10.1007/978-3-319-73008-0_15

C16. William Baker, **Zachary Kingston**, Mark Moll, Julia Badger, and Lydia E. Kavraki. Robonaut 2 and you: Specifying and executing complex operations. In *IEEE Workshop on Advanced Robotics and its Social Impacts*, pages 1–8, Austin, TX, March 2017. doi:10.1109/ARSO.2017.8025204

C17. Neil T. Dantam, **Zachary Kingston**, Swarat Chaudhuri, and Lydia E. Kavraki. Incremental task and motion planning: A constraint-based approach. In *Robotics: Science and Systems*, Ann Arbor, MI, June 2016. doi:10.15607/RSS.2016.XII.002

C18. **Zachary Kingston**, Neil T. Dantam, and Lydia E. Kavraki. Kinematically constrained workspace control via linear optimization. In *IEEE-RAS International Conference on Humanoid Robots*, pages 758–764, Nov 2015. doi:10.1109/HUMANOIDS.2015.7363455

C19. Golnaz Habibi, **Zachary Kingston**, Zijian Wang, Mac Schwager, and James McLurkin. Pipelined consensus for global state estimation in multi-agent systems. In *Proceedings of the 2015 International Conference on Autonomous Agents and Multiagent Systems*, pages 1315–1323. International Foundation for Autonomous Agents and Multiagent Systems, 2015. ISBN 9781450334136. doi:10.5555/2772879.2773320

C20. Golnaz Habibi, **Zachary Kingston**, William Xie, Mathew Jellins, and James McLurkin. Distributed centroid estimation and motion controllers for collective transport by multi-robot systems. In *IEEE International Conference on Robotics and Automation*, pages 1282–1288, 2015. doi:10.1109/ICRA.2015.7139356

Book Chapters

B 1. **Zachary Kingston**. *Encyclopedia of Robotics*, chapter Planning Under Manifold Constraints, pages 1–9. Springer Berlin Heidelberg, 2020. ISBN 978-3-642-41610-1. doi:10.1007/978-3-642-41610-1_174-1

Workshop Papers

W 1. Carlos Quintero-Peña, Wil Thomason, **Zachary Kingston**, Anastasios Kyrillidis, and Lydia E. Kavraki. Stochastic implicit neural signed distance functions for safe motion planning under sensing uncertainty. In *IEEE ICRA 2024 Workshop—Back to the Future: Robot Learning Going Probabilistic*, 2024. URL https://arxiv.org/pdf/2309.16862.pdf

W 2. Clayton W. Ramsey, **Zachary Kingston**[†], Wil Thomason[†], and Lydia E. Kavraki. Dynamic motion planning from perception via accelerated point cloud collision checking. In *IEEE ICRA 2024 Workshop—Agile Robotics: From Perception to Dynamic Action*, 2024. † Equal Contribution

W 3. Qingxi Meng[†], Carlos Quintero-Peña[†], **Zachary Kingston**, Nicole M. Fontenot, Shannan K. Hamlin, Vaibhav Unhelkar, and Lydia E. Kavraki. Monitoring constraints for robotic tutors in nurse education: A motion planning perspective. In *IEEE ICRA 2024 Workshop—Workshop on Nursing Robotics*, 2024. † Equal Contribution

Theses

T 1. **Zachary Kingston**. *Toward Efficient and General Multi-Modal Planning*. PhD thesis, Rice University, Houston, TX, 2021

T 2. **Zachary Kingston**. A unifying framework for constrained sampling-based planning. Master's thesis, Rice University, Houston, TX, 2017

Invited Contributor

I 1. Claire Le Goues, Sebastian Elbaum, David Anthony, Z Berkay Celik, Mauricio Castillo-Effen, Nikolaus Correll, Pooyan Jamshidi, Morgan Quigley, Trenton Tabor, and Qi Zhu. Software engineering for robotics: Future research directions; report from the 2023 workshop on software engineering for robotics, 2024. URL https://arxiv.org/pdf/2401.12317.pdf

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Selected Funding

Authored

G 1. Rahul Shome, Jenny L. Davis, **Zachary Kingston**, and Lydia E. Kavraki. Virtues of Robot Inaction: Towards Theories of Automated Reasoning of Inaction in Human Contexts, 2023. URL https://services.anu.edu.au/research-support/funding-opportunities/computing-for-social-good-seed-grants-2023. ANU Humanising Machine Intelligence Computing for Social Good Seed Research Grant, AU$25,000

Co-Authored

cG 1. Lydia E. Kavraki and Anshumali Shrivastava. A Framework for Manipulation Planning and Execution under Uncertainty in Partially-Known Environments, 2024–2027. URL https://www.nsf.gov/awardsearch/showAward?AWD_ID=2336612. NSF CCF 2336612, $715,312

cG 2. Lydia E. Kavraki and Vaibhav Unhelkar. Collaborative Research: FW-HTF-R: The Future of Robot-Assisted Nursing: Interactive AI Frameworks for Upskilling Nurses and Customizing Robot Assistance, 2022–2023. URL https://nsf.gov/awardsearch/showAward?AWD_ID=2222876. NSF HRD 2222876, $121,713

cG3. Lydia E. Kavraki. RI: Small: A Novel Framework for Informed Manipulation Planning, 2020–2023. URL https://nsf.gov/awardsearch/showAward?AWD_ID=2008720. NSF IIS 2008720, $441,000

Awards and Honors

A1. Rice Innovation Fellow, Liu Idea Lab for Innovation and Entrepreneurship, 2024
A2. *C8.* Nominated, Best Paper in Industrial Robotics Research for Practicality, IEEE/RSJ IROS, 2022
A3. *C12.* Nominated, Best Paper in Cognitive Robotics, IEEE-RAS ICRA, 2021
A4. Future Faculty Fellowship, Rice Engineering, 2020–21
A5. Best Presentation in COMP 600, Rice University Computer Science Department, 2018, 2020
A6. NASA Space Technology Research Fellowship, NASA, 2017–2021
A7. NSF Graduate Research Fellowship Program, NSF, 2017
A8. Graduate Research Fellowship, Rice University Computer Science Department, 2016
A9. Distinction in Research and Creative Works, Rice University, 2016
A10. President's Honor Roll, Rice University, 2015–16

Research Supervision

Ph.D. Students	Akshaya Agrawal, Clayton Ramsey[1], Qingxi Meng, Yiyuan Lee
Masters Students	Weihang Guo, Xiaoyu Yuan, Thomas Herring
Undergraduate Students	Stefan Bukorovic, Sofia Paola Medina-Chica, Andreja Andrejic, Aedan Cullen, Luis Leal[2]

[1] Awarded NSTGRO and NDSEG 2024

[2] Award for Excellence in Poster Presentations, Rice Summer Undergraduate Research Symposium

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Service

Associate Editor:
- IEEE Robotics and Automation Letters (Planning and Simulation 1) (RA-L), 2024–Present
- IEEE International Conference on Robotics and Automation (ICRA), 2024

Organizer:
- Evaluating Motion Planning Performance Workshop, IROS 2022

Referee:
- Robotics: Science and Systems (RSS), 2024
- IEEE Robotics and Automation Letters (RA-L), 2020–2024
- IEEE International Conference on Robotics and Automation (ICRA), 2018, 2022–2024
- Journal of Artificial Intelligence Research (JAIR), 2024
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2020–2024
- IEEE Transactions on Robotics (T-RO), 2022–2023
- IEEE/ASME Transactions on Mechatronics, 2020
- IEEE Transactions on Automation Science and Engineering (T-ASE), 2020

☛ Workshop on the Algorithmic Foundations of Robotics (WAFR), 2020
☛ International Symposium on Robotics Research (ISRR), 2017

Maintainer of OMPL Motion Planning Software	Dec. 2021–Present
Core Contributor to the *MoveIt* Robot Motion Planning Software	Mar. 2019–Jun. 2020
Maintainer of the *MoveIt* Robot Motion Planning Software	Sep. 2018–Mar. 2019
Computer Science Representative, Graduate Student Association	Mar. 2018–May 2020
Consultant for Rice's Center for Academic and Professional Communication	Aug. 2018–May 2019
Treasurer, Computer Science Graduate Student Association	Aug. 2017–May 2019

Teaching

Physical Computing   Instructor of Record   Spring 2024
COMP 650 at Rice University

Algorithmic Robotics   Lecturer   Fall 2020
COMP/ELEC/MECH 450/550 at Rice University   https://www.clear.rice.edu/comp450/

Algorithmic Robotics   Teaching Assistant   Fall 2016–2019, 2022
COMP/ELEC/MECH 450/550 at Rice University   https://www.clear.rice.edu/comp450/

Intro. to Computer Systems   In-Lab Teaching Assistant   Spring 2015, 2018
COMP 321 at Rice University   https://www.clear.rice.edu/comp321/

Intro. to Computational Thinking   In-Class Teaching Assistant   Fall 2015
COMP 140 at Rice University

Intro. to Engineering Systems   In-Class Teaching Assistant   Fall 2014
ENGI 128 at Rice University   https://www.clear.rice.edu/engi128/

Invited Talks

Efficient and General Planning for Robot Manipulation

UCSD ECE Seminar	*at La Jolla, CA*	Mar. 2024
Purdue Computer Science Seminar	*at West Lafayette, IN*	Feb. 2024
Texas A&M Computer Science Seminar	*at College Station, TX*	Feb. 2024

Motions in Microseconds via Vectorized Sampling-Based Planning

Intelligent Autonomous Systems Group	*virtual at TU Darmstadt, w/ Wil Thomason*	Jan. 2024
Pumps & Pipes	*at the ION, w/ Wil Thomason*	Dec. 2023

Scaling Multi-Modal Planning

AI, ML, and Friends Seminar	*virtual at ANU School of Computing*	Feb. 2023
University of Utah Robotics Seminar	*virtual*	Jul. 2021

Learning and Intelligent Systems Lab ▶️ *virtual at TU Berlin*   Jul. 2021

Robonaut 2 and You: Specifying and Executing Complex Operations

International Workshop on AI-Powered Space   *at the ION*   Nov. 2023
Humanoid Users Conference   *at NASA JSC*   May 2017

Robowflex: Simplifying Planning and Benchmarking with MoveIt

2022 MoveIt Community Meeting ▶️ *virtual*   Feb. 2022

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Outreach

Museum Exhibit   Consultant   Jan. 2015–May 2015
  at the Museum of Science and Industry, Chicago, IL
                                        http://www.msichicago.org/... /robot-revolution/

Summer Swarm Camp   Summer Camp Staff   Jul. 2014
  at Rice University, Houston, TX
                                                   http://mrsl.rice.edu/robot-camp

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Open Source Software

Maintainer

The Open Motion Planning Library (OMPL)   https://ompl.kavrakilab.org/
Robowflex   https://github.com/KavrakiLab/robowflex
MotionBenchMaker   https://github.com/KavrakiLab/motion_bench_maker
HyperPlan   https://github.com/KavrakiLab/hyperplan
Vector-Accelerated Motion Planner (VAMP)   https://github.com/KavrakiLab/vamp

Contributor

MoveIt Robot Motion Planning Software   https://moveit.ros.org/