

Oren Salzman

CURRICULUM VITÆ

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PERSONAL INFORMATION

Born: May 18th 1981, Israel
Address: NSH 4519, Robotics Institute, Carnegie Mellon University, Pittsburgh PA
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Research Interests: Robot motion planning, Path planning, Computational geometry

EDUCATION AND ACADEMIC POSITIONS

- 2018 – present** **Robotics Institute, Carnegie Mellon University, USA**
Research Scientist in the Search-Based Planning Lab and at the National Robotics Engineering Center (NREC).
- 2017 – 2018** **Robotics Institute, Carnegie Mellon University, USA**
Postdoctoral Fellow in the Search-Based Planning Lab.
Lab PI: Prof. Maxim Likhachev .
- 2016 – 2017** **Robotics Institute, Carnegie Mellon University, USA**
Postdoctoral Fellow in the Personal Robotics Lab.
Lab PI: Prof. Siddhartha Srinavassa.
- 2011 – 2016** **School of Computer Science, Tel-Aviv University, Israel**
Ph.D. in Computer Science.
Dissertation Topic: “Efficient high-quality motion planning in tight settings”.
Advisor: Prof. Dan Halperin.
- 2006 – 2011** **School of Computer Science, Tel-Aviv University, Israel**
M.Sc. in Computer Science, *cum laude*.
Thesis Topic: “Motion Planning via Manifold Samples”.
Advisor: Prof. Dan Halperin.
- 1999 – 2003** **Electrical Engineering Faculty, Technion, Israel**
B.Sc. in Computer Engineering, *cum laude*.
Majors: “Algorithms”, “Cryptography & Complexity”, “Artificial Intelligence”.

HONORS AND AWARDS

- 2018** Best-paper award at the International Conference on Automated Planning and Scheduling (ICAPS) (publication **C3**).
- 2018** RSS Pioneers.
- 2016** Excellency Grant, Deutsch Foundation.
- 2015** Travel Grant, Ministry of Science, Technology, and Space, Israel.
- 2014** Travel Grant, Ministry of Science, Technology, and Space, Israel.
- 2013** Travel Grant, Ministry of Science, Technology, and Space, Israel.
- 2003** Recipient of Electrical Engineering Dean’s Award for final project titled “Self-trained Neural-Network based Backgammon player”.
- 1999** Recipient of the “Prime Ministers Prize” for History final-term paper on the Holocaust denial phenomenon.
- 1999** Recipient of the “Ghetto Fighters Prize” for History final-term paper on the Holocaust denial phenomenon.

PUBLICATIONS AND MANUSCRIPTS

BOOK CHAPTERS

- B1** Dan Halperin, **Oren Salzman** and Micha Sharir, Algorithmic Motion Planning. In Third edition of the “Handbook of Discrete and Computational Geometry” edited by Csaba Toth, Joseph O’Rourke, Jacob E. Goodman.

JOURNAL PAPERS

- J1** Rachel Holladay, **Oren Salzman** and Siddhartha Srinivasa “Minimizing Task Space Frechet Error via Efficient Incremental Graph Search.” In IEEE Robotics and Automation Letters (RA-L), to appear.
- J2** Kiril Solovey, **Oren Salzman** and Dan Halperin “New perspective on sampling-based motion planning via random geometric graphs.” In International Journal of Robotics Research (IJRR), special issue dedicated to selected papers from RSS, 37(1), 2018.
- J3** Pankaj K. Agarwal, Kyle Fox and **Oren Salzman** “An Efficient Algorithm for Computing High-Quality Paths amid Polygonal Obstacles.” In Transactions on Algorithms (TALG) 14(4): 46:1-46:21 (2018).
- J4** Aviel Atias, Kiril Solovey, **Oren Salzman** and Dan Halperin “Effective Metrics for Multi-Robot Motion-Planning.” In International Journal of Robotics Research (IJRR), 37(11-14):1741-1759, 2018.
- J5** **Oren Salzman**, Kiril Solovey and Dan Halperin, “Motion Planning for Multi-Link Robots by Implicit Configuration-Space Tiling.” In IEEE Robotics and Automation Letters (RA-L), 1(2):760-767, 2016.

- J6** Kiril Solovey, **Oren Salzman** and Dan Halperin, “Finding a Needle in an Exponential Haystack: Discrete RRT for Exploration of Implicit Roadmaps in Multi-Robot Motion Planning.” In International Journal of Robotics Research (IJRR), special issue dedicated to selected papers from WAFR, 35(5):501-513, 2016.
- J7** **Oren Salzman**, and Dan Halperin, “Asymptotically near-optimal RRT for fast, high-quality, motion planning.” In IEEE Transactions on Robotics (TR-O), 32(3):473-483, 2016.
- J8** Yaki Setty and **Oren Salzman** “A Methodological, Task-Based Approach to Procedure-Specific Simulations Training.” In International Journal of Computer Assisted Radiology and Surgery (CARS), 11(12): 2317-2324, 2016.
- J9** **Oren Salzman**, Michael Hemmer and Dan Halperin, “On the Power of Manifold Samples in Exploring Configuration Spaces and the Dimensionality of Narrow Passages.” In IEEE Transactions on Automation Science and Engineering (T-ASE), 12(2):529-538, 2015.
- J10** **Oren Salzman**, Doron Shaharabani, Pankaj K. Agarwal and Dan Halperin, “Sparsification of Motion-Planning Roadmaps by Edge Contraction.” In International Journal of Robotics Research (IJRR), 33(14):1711-1725, 2014.
- J11** **Oren Salzman**, Michael Hemmer, Barak Raveh and Dan Halperin, “Motion Planning via Manifold Samaples.” In Algorithmica, 67(4):547-565, 2013.

CONFERENCE PROCEEDINGS

- C1** Fahad Islam, **Oren Salzman**, and Maxim Likhachev “Provable Infinite-Horizon Real-Time Planning for Repetitive Tasks” In International Conference on Automated Planning and Scheduling (ICAPS), 2019.
- C2** Sung-Kyun Kim, **Oren Salzman**, and Maxim Likhachev “POMHDP: Search-based Belief Space Planning using Multiple Heuristics” In International Conference on Automated Planning and Scheduling (ICAPS), 2019.
- C3** Aditya Mandalika, Sanjiban Choudhury, **Oren Salzman**, and Siddhartha Srinivasa “Generalized Lazy Search for Robot Motion Planning: Interleaving Search and Edge Evaluations via Event-based Toggles” In International Conference on Automated Planning and Scheduling (ICAPS), 2019.
- C4** Sherdil Niyaz, Alan Kuntz, **Oren Salzman**, Ron Alterovitz, and Siddhartha Srinivasa “Following Surgical Trajectories with Concentric Tube Robots via Nearest-Neighbor Graphs.” In International Symposium on Experimental Robotics (ISER), 2018
- C5** Fahad Islam, **Oren Salzman** and Maxim Likhachev “Online, interactive user guidance for high-dimensional, constrained motion planning.” In International Joint Conference on Artificial Intelligence (IJCAI), pages 4921-4928, 2018.
- C6** Nika Haghtalab, Simon Mackenzie, Ariel Procaccia, **Oren Salzman** and Siddhartha Srinivasa “The Provable Virtue of Laziness in Motion Planning.” In International Conference on Automated Planning and Scheduling (ICAPS), pages 106-113, 2018. **Best paper award.**

- C7** Vinitha Ranganeni, **Oren Salzman** and Maxim Likhachev “Focusing footstep planning for humanoids using homotopy-class guidance.” In International Conference on Automated Planning and Scheduling (ICAPS), pages 500-508, 2018.
- C8** Aditiya Mandalika, **Oren Salzman** and Siddhartha Srinivasa “Efficient shortest-path algorithm for graphs with expensive edge evaluation via lazy lookahead.” In International Conference on Automated Planning and Scheduling (ICAPS), pages 476-484, 2018.
- C9** Daqing Yi, Rohan Thakker, Cole Gulino, **Oren Salzman** and Siddhartha Srinivasa “Sampling-based Kinodynamic Planning via Markov Chain Monte Carlo”. In IEEE International Conference on Robotics and Automation (ICRA), pages 7063-7070, 2018.
- C10** **Oren Salzman**, Brian Hou and Siddhartha Srinavassa, “Efficient motion planning for problems lacking optimal substructure”, In International Conference on Automated Planning and Scheduling (ICAPS), pages 531-539, 2017.
- C11** Shushman Choudhury, **Oren Salzman**, Sanjiban Choudhury and Siddhartha Srinavassa “Densification Strategies for Anytime Motion Planning over Large Dense Roadmaps” In IEEE International Conference on Robotics and Automation (ICRA), pages 3770-3777, 2017.
- C12** Michal Kleinbort, **Oren Salzman** and Dan Halperin “Collision detection or nearest-neighbor search? On the computational bottleneck in sampling-based motion planning.” In Workshop on the Algorithmic Foundations of Robotics (WAFR), 2016.
- C13** Kiril Solovey, **Oren Salzman** and Dan Halperin “New perspective on sampling-based motion planning via random geometric graphs.” In Robots, Science and Systems (RSS), 2016. Invited to a special issue of the International Journal of Robotics Research (IJRR).
- C14** Pankaj K. Agarwal, Kyle Fox and **Oren Salzman** “An Efficient Algorithm for Computing High-Quality Paths amid Polygonal Obstacles.” In ACM-SIAM Symposium on Discrete Algorithms (SODA), pages 1179-1192, 2016.
- C15** **Oren Salzman** and Dan Halperin, “Asymptotically-Optimal Motion Planning using Lower Bounds on Cost.” In IEEE International Conference on Robotics and Automation (ICRA), pages 4167-4172, 2015.
- C16** Michal Kleinbort, **Oren Salzman** and Dan Halperin, “Efficient High-Quality Motion Planning by Fast All-Pairs r -Nearest- Neighbors.” In IEEE International Conference on Robotics and Automation (ICRA), pages 2985-2990, 2015.
- C17** **Oren Salzman** and Dan Halperin, “Shortest-path planning for a tethered robot: The multi-query case with optimal-solution paths.” In IEEE International Conference on Robotics and Automation (ICRA), pages 4161-4166, 2015.
- C18** Kiril Solovey, **Oren Salzman**, and Dan Halperin, “Finding a Needle in an Exponential Haystack: Discrete RRT for Exploration of Implicit Roadmaps in Multi-Robot Motion Planning.” In Workshop on the Algorithmic Foundations of Robotics (WAFR), pages 591-607, 2014. Invited to a special issue of the International Journal of Robotics Research (IJRR).
- C19** **Oren Salzman**, and Dan Halperin, “Asymptotically near-optimal RRT for fast, high-quality, motion planning.” In IEEE International Conference on Robotics and Automation (ICRA), pages 4680-4685, 2014.

- C20** Doron Shaharabani, **Oren Salzman**, Pankaj K. Agarwal and Dan Halperin, “Sparsification of Motion-Planning Roadmaps by Edge Contraction.” In IEEE International Conference on Robotics and Automation (ICRA), pages 4083-4090, 2013.
- C21** **Oren Salzman**, Michael Hemmer and Dan Halperin, “On the Power of Manifold Samples in Exploring Configuration Spaces and the Dimensionality of Narrow Passages.” In Workshop on the Algorithmic Foundations of Robotics (WAFR), pages 313-329, 2012. Invited to a special issue of the IEEE Transactions on Automation Science and Engineering (T-ASE).
- C22** **Oren Salzman**, Michael Hemmer, Barak Raveh and Dan Halperin, “Motion Planning via Manifold Samples.” In European Symposium on Algorithms (ESA), pages 493-505, 2011. Invited to a special issue of *Algorithmica*.

JOURNAL PAPERS (UNDER REVIEW)

- J12** **Oren Salzman** “Computational Challenges and Algorithms in Robot Motion Planning.”
- J13** **Oren Salzman**, Nika Haghtalab, Chris Dellin, Simon Mackenzie, Ariel D. Procaccia, Siddhartha S. Srinivasa “The Virtue of Laziness in Motion Planning.”

CONFERENCE PAPERS (UNDER REVIEW)

- C23** Mengyu Fu, Alan Kuntz, **Oren Salzman**, and Ron Alterovitz “Towards Asymptotically-Optimal Inspection Planning via Efficient Near-optimal Graph Search”

DISSERTATIONS

- D1** **Oren Salzman**,
 “Effient high-quality motion planning in tight settings.”
PhD dissertation, Tel Aviv University, July 2016, Advisor: Prof. Dan Halperin.
- D2** **Oren Salzman**,
 “Motion Planning via Manifold Samples.”
Master’s thesis, Tel Aviv University, September 2011, Advisor: Prof. Dan Halperin.

TALKS AND PRESENTATIONS

INVITED TALKS

- T1** “Following Task-Space Paths for Robots—Computational Geometry Meets Surgical Robots.” GRAND seminar, George Mason University, October 2018.
- T2** “Computational Challenges and Algorithms in Planning for Robotic Systems.” National Robotics Engineering Center (NREC), May 2018.
- T3** “Computational Challenges and Algorithms in Planning for Robotic Systems.” Interactive Robotics Laboratory (IRL), West Virginia University May 2018.

- T4** “The Provable Virtue of Laziness in Motion Planning.” The Kavraki Lab, Rice University, December 2017.
- T5** “The Provable Virtue of Laziness in Motion Planning.” The Robotics Colloquium, University of Washington, November 2017.
- T6** “The Provable Virtue of Laziness in Motion Planning.” Stanford Laboratory for Autonomous Systems Laboratory, Stanford University, November 2017.
- T7** “The Provable Virtue of Laziness in Motion Planning.” Design of Robotics and Embedded systems, Analysis, and Modeling Seminars (DREAMS), Berkeley University, November 2017.
- T8** “New perspective on sampling-based motion planning via random geometric graphs.” OR seminar, IE&M faculty, Technion—Israel Institute of Technology, March 2016.
- T9** “Decomposable Configuration Spaces for Faster Online Motion Planning.” Berkeley Laboratory for Automation Science and Engineering, Berkeley University, August 2015.
- T10** “Asymptotically near-optimal RRT for fast, high-quality, motion planning.” Apple, Cupertino, August 2015.
- T11** “Decomposable Configuration Spaces for Faster Online Motion Planning.” Center for foundations of Robotics, Carnegie Mellon University, August 2015.
- T12** “Asymptotically near-optimal RRT for fast, high-quality, motion planning.” Biomedical Robotics Lab, Ben Gurion University of the Negev, July 2015.
- T13** “Efficient Representation and Exploration of High-Dimensional Configuration Spaces.” IBM, Haifa Research Labs, October 2014.
- T14** “Optimality vs. Near-Optimality in Sampling-Based Motion-Planning Algorithms.” Personal Robotics Lab, Carnegie Mellon University, August 2014.
- T15** “Optimality vs. Near-Optimality in Sampling-Based Motion-Planning Algorithms.” Computational Robotics Research Group Seminar, University of North Carolina at Chapel Hill, August 2014.
- T16** “Motion Planning via Manifold Samples.” Theoretical Computer Science Research Group, Freie Universität Berlin, September 2011.

PRESENTATIONS AT SCIENTIFIC MEETINGS

- P1** “Open problem on risk aware motion planning in the plane.” International Workshop on the Algorithmic Foundations of Robotics (WAFR), 2016.
- P2** “Asymptotically near-optimal RRT for fast, high-quality, motion planning.” Israeli Conference on Robotics (ICR), 2016.
- P3** “Lazy, Goal-Biased LBT-RRT.” Workshop on Optimal Robot Motion Planning—workshop at the International Conference on Robotics and Automation (ICRA) 2015.
- P4** “Sparsification of Motion-Planning Roadmaps by Edge Contraction.” Israeli Conference on Robotics (ICR) 2013.

- P5** “Sparsification of Motion-Planning Roadmaps by Edge Contraction.” Computational Geometry Learning workshop 2013.
- P6** “Motion Planning via Manifold Samples.” Young Researches Forum—workshop at the Symposium on Computational Geometry (SoCG) 2012.

TEACHING EXPERIENCE

- 2016 (Spring)** Teaching assistant in Computational Models course.
- 2015 (Spring)** Teaching assistant in Computational Models course.
- 2014 (Spring)** Teaching assistant in Computational Models course.
- 2013 (Spring)** Teaching assistant in Computational Models course.
- 2013 (Spring)** Planning High Quality Motion Paths for Robots, software workshop.
- 2012 (Spring)** Planning High Quality Motion Paths for Robots, software workshop.

SOFTWARE

- 2015** Developer of an open source nearest-neighbor library based on randomly shifted grids. For more details see <http://acg.cs.tau.ac.il/projects/rtg/RTG>
- 2013** Contributor to the Open Motion Planning Library (OMPL) open source project. Developed and contributed the LBT-RRT algorithm for efficient near-optimal motion planning. For more details see http://ompl.kavrakilab.org/classompl_1_1geometric_1_1LBTRRT.html#gLBTRRT
- 2011 - 2013** Developer in the Computational Geometry Algorithms Library (CGAL) open source project. Developed part of the CGAL `Arrangement_2` package that allows for efficient manipulation of curves represented by rational functions. For more details see http://www.cgal.org/Manual/latest/doc_html/cgal_manual/Arrangement_on_surface_2_ref/Chapter_intro.html

COMMUNITY SERVICE

WORKSHOP ORGANIZER

- “Mathematical Models, Algorithms, and Human-Robot Interaction”—RSS 2017 Workshop.

COMMITTEES

- Program Committee 2019 International Conference on Autonomous Agents and Multiagent Systems (AAMAS) special track on Robotics .
- Program Committee 2019 Florida Artificial Intelligence Research Society (FLAIRS) special track on Autonomous Robots and Agents.

- Program Committee AAAI-19.
- Program Committee for IROS 2018 Workshop on Machine Learning in Robot Motion Planning.
- Motion Planning for Manipulation subcommittee—IROS 2017 Workshop on development of benchmarking protocols for robotic manipulation.

JOURNAL REVIEWER

International Journal of Robotics Research (IJRR); IEEE Transactions on Robotics (T-RO); IEEE Robotics and Automation Letters (RA-L); ACM Transactions on Human-Robot Interaction (T-HRI); IEEE Transactions on Automation Science and Engineering (T-ASE); Geoinformatica; Advanced Robotics International Journal of Advanced Robotic Systems (IJARS); IEEE Transactions on Aerospace and Electronic Systems (T-AES); Autonomous Robots (AURO); PLOS ONE; Journal of Robotics; Robotics and Autonomous Systems; Computational Intelligence; SIAM Journal on Computing (SICOMP);

CONFERENCE REVIEWER

International Workshop on the Algorithmic Foundations of Robotics (WAFR); Robotics: Science and Systems (RSS); IEEE International Conference on Robotics and Automation (ICRA); IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS); ACM Symposium on Computational Geometry (SoCG); Algorithm Engineering & Experiments (ALENEX); Association for the Advancement of Artificial Intelligence (AAAI); IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM); International Symposium on Experimental Algorithms (SEA); ACM Symposium on Principles of Distributed Computing (PODC); International Conference on Intelligent Transportation Systems (ITSC); International Conference on Information, Communication and Automation Technologies (ICAT); International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)

WORK EXPERIENCE

2011–2014 3D MTP—SENIOR PROGRAMMER

- Part-time job in algorithmic R&D for computational-geometry related problems in the field of 3D printing.
- Designed and implemented robust and efficient algorithms that are in the core of the companies' product.
- Job required solving state-of-the-art problems without the ability to consult with peers in the field and performing integration of software packages without support.

2010 RAFAEL—NETWORK RESEARCHER

- Consultant to the Israeli Defence Force as an analyst for network-based topics (e.g. Quality of Service (QoS) research for service providers; Tactical IP middleware simulation).
- Consultant to both technical and managerial teams of the customers.
- Job required quick learning skills and multi-disciplinary collaboration.

2003–2009 IDF—SIGNAL OFFICER IN THE ISRAELI DEFENSE FORCES (IDF), COMMUNICATION DEVELOPMENT CENTER

- Release rank: Captain.
- Technical leader of a communication project with a foreign country on behalf of Israel's Ministry of Defense.
- Technical representative for outsourced projects: Designed, characterized, coordinated and managed technical aspects of network projects (tactical routing and data optimization above IP, cellular, VHF and WLAN networks) and video projects (tactical video streaming).
- Programmer for a network-simulation team.
- Job included corresponding, collaborating and conducting negotiations with both technical and managerial personnel in-house, with the Israeli communications industry as well as with foreign industries, and serving as the direct supervisor of three programmers.

2001 IBM—SOFTWARE DEVELOPER IN HARDWARE VERIFICATION TOOLS TEAM (GPRO)

- Part-time job as programmer.