

Omur Arslan, PhD

Contact Information

Autonomous Motion Department
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Education

PhD, Electrical and Systems Engineering University of Pennsylvania, Philadelphia, PA <i>Thesis:</i> Clustering-Based Robot Navigation and Control <i>Advisor:</i> Daniel E. Koditschek	Aug. 2016
MSc, Electrical Engineering University of Pennsylvania, Philadelphia, PA <i>Advisor:</i> Daniel E. Koditschek	Aug. 2012
MSc, Electrical and Electronics Engineering Bilkent University, Ankara, Turkey <i>Thesis:</i> Model-Based Methods for the Control and Planning of Running Robots <i>Advisors:</i> Ömer Morgül and Uluç Saranlı	July 2009
BSc (Major), Electrical and Electronics Engineering Middle East Technical University, Ankara, Turkey	June 2007
BSc (Minor), Mechatronics Middle East Technical University, Ankara, Turkey	July 2007
BSc, Electrical and Electronics Engineering Hacettepe University, Ankara, Turkey	Aug. 2004 (Transferred to METU)

Dissertation: Clustering-Based Robot Navigation and Control

Clustering, traditionally an unsupervised learning method, offers automated tools to discover hidden intrinsic structures in generally complex-shaped and high-dimensional configuration spaces of robotic systems. This dissertation demonstrates potential applications of such clustering tools to the problem of feedback motion planning and control. In particular, it presents a novel use of hierarchical clustering for provably correct, computationally efficient coordinated multirobot motion design; and it describes how robot-centric Voronoi diagrams can be used for provably correct safe robot navigation in forest-like cluttered environments, and for provably correct collision-free coverage and congestion control of mobile sensor networks.

Research Interests

Robotic systems are becoming an integral part of everyday life. In order to take an active role in this exciting development, my current research aims to design new adaptive sensor-based motion planning algorithms that integrate perception, control and learning for safe reactive operation of robots around people; for example, safe mobile manipulation with/around people and safe autonomous navigation in crowds of people. In general, my research interests include robotics, motion planning, control theory, dynamical systems, sensor networks, optimization, machine learning, and machine perception.

Academic Appointments

Research Scientist Autonomous Motion Department Max Planck Institute for Intelligent Systems, Tübingen, Germany	Oct. 2017 – present
Postdoctoral Researcher Department of Electrical and Systems Engineering University of Pennsylvania, Philadelphia, PA <i>Mentor:</i> Daniel E. Koditschek	Sep. 2016 – Oct. 2017
Research Assistant Department of Electrical and Systems Engineering University of Pennsylvania, Philadelphia, PA <i>Mentor:</i> Daniel E. Koditschek	Aug. 2009 – Sep. 2016
Research and Teaching Assistant Department of Electrical and Electronics Engineering Bilkent University, Ankara, Turkey <i>Mentors:</i> Ömer Morgül and Uluç Saranlı	Sep. 2007 – July 2009

Teaching Experience

• Research Mentor , ESE 290 Intro to ESE Research Methodology University of Pennsylvania, Philadelphia, PA	Spring 2017
• Project Advisor , ESE 450/451 ESE Senior Design University of Pennsylvania, Philadelphia, PA	Fall 2013, Spring 2014
• Teaching Assistant , ESE 539 Neural Networks and Applications University of Pennsylvania, Philadelphia, PA	Spring 2013
• Teaching Assistant , ESE 500 Linear System Theory University of Pennsylvania, Philadelphia, PA	Fall 2010
• Teaching Assistant , EEE 313 Electronic Circuit Design Bilkent University, Ankara, Turkey	Fall 2007, Spring 2009
• Teaching Assistant , EEE 444/544 Robust Feedback Theory Bilkent University, Ankara, Turkey	Fall 2008
• Teaching Assistant , EEE 351 Engineering Electromagnetics Bilkent University, Ankara, Turkey	Spring 2008

Honors & Awards

• Best Paper Award Nominee on Multi-Robot Systems IEEE International Conference on Robotics and Automation	May 2018
• Best Paper Award Nominee 12th International Workshop on the Algorithmic Foundations of Robotics	Dec. 2016
• Bilkent University Scholarship (full tuition waiver + full stipend + on-campus lodging)	Sep. 2007 – July 2009
• The Scientific and Technical Research Council of Turkey (TUBITAK) 2228-National MSc Scholarship	Sep. 2007 – July 2009
• The Scientific and Technical Research Council of Turkey (TUBITAK) 2224-International Scientific Meetings Fellowship	May 2009
• Graduation Project Committee Award Middle East Technical University, Ankara, Turkey	June 2007
• High Honors Graduate Electrical & Electronics Engineering (5th rank among 351 graduates) Middle East Technical University, Ankara, Turkey	June 2007
• Associate Professor Bülent Kerim Altay Award Middle East Technical University, Ankara, Turkey Awarded for attaining the highest rank in a semester with GPA 4.00/4.00	Fall 2004, Spring 2004, Spring 2005, Fall 2006

Journal Articles

- [J7] O. Arslan, “**Statistical Coverage Control of Mobile Sensor Networks,**” *IEEE Transactions on Robotics (T-RO)*, May 2019.
- [J6] O. Arslan and D.E. Koditschek, “**Sensor-Based Reactive Navigation in Unknown Convex Sphere Worlds,**” *The International Journal of Robotics Research (IJRR)*, vol. 38(2–3):196–223, March 2019.
- [J5] O. Arslan, D.P. Guralnik and D.E. Koditschek, “**Discriminative measures for comparison of phylogenetic trees,**” *Discrete Applied Mathematics (DAM)*, vol. 217(3):405–426, January 2017.
- [J4] O. Arslan, D.P. Guralnik and D.E. Koditschek, “**Coordinated robot navigation via hierarchical clustering,**” *IEEE Transactions on Robotics (T-RO)*, vol. 32(2):352–371, April 2016.
- [J3] O. Arslan and D.E. Koditschek, “**On the optimality of Napoleon triangles,**” *Journal of Optimization Theory and Applications (JOTA)*, vol. 1(1):1–10, March 2016.
- [J2] O. Arslan and U. Saranlı, “**Reactive planning and control of planar spring–mass running on rough terrain,**” *IEEE Transactions on Robotics (T-RO)*, vol. 28(3):567–579, June 2012.
- [J1] U. Saranlı, O. Arslan, M. M. Ankaralı and Ö. Morgül, “**Approximate analytic solutions to non-symmetric stance trajectories of the passive spring-loaded inverted pendulum with damping,**” *Nonlinear Dynamics*, vol. 62(4):729–742, December 2010.

Conference Proceedings

- [C16] Z. Li, O. Arslan and N. Atanasov, “**Safe, Stable, and Fast Path-Following Control using Explicit Ellipsoid Trajectory Bounds and Reference Governors,**” (*submitted to*) *IEEE Conference on Decision and Control (CDC)*, Nice, France, December 2019.
- [C15] J. Huh, O. Arslan and D.D. Lee, “**Probabilistically Safe Corridors to Guide Sampling-Based Motion Planning,**” (*submitted to*) *The International Symposium on Robotics Research (ISRR)*, Hanoi, Vietnam, October 2019.
- [C14] O. Arslan, H. Min and D.E. Koditschek, “**Voronoi-based coverage control of pan/tilt/zoom camera networks,**” *IEEE International Conference on Robotics and Automation (ICRA)*, Brisbane, Australia, May 2018. (**Best Paper Award Nominee on Multirobot Systems**)
- [C13] V. Pacelli, O. Arslan and D.E. Koditschek, “**Integration of local geometry and metric information in sampling-based motion planning,**” *IEEE International Conference on Robotics and Automation (ICRA)*, Brisbane, Australia, May 2018.
- [C12] V. Vasilopoulos, W. Vega-Brown, O. Arslan, N. Roy and D.E. Koditschek, “**Sensor-based reactive symbolic planning in partially known environments,**” *IEEE International Conference on Robotics and Automation (ICRA)*, Brisbane, Australia, May 2018.
- [C11] V. Vasilopoulos, O. Arslan, A. De and D.E. Koditschek, “**Sensor-based legged robot homing using range-only target localization,**” *IEEE International Conference on Robotics and Biomimetics (ROBIO)*, pp. 2630–2637, Macau, December 2017.
- [C10] O. Arslan, V. Pacelli and D.E. Koditschek, “**Sensory steering for sampling-based motion planning,**” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 3708–3715, Vancouver, BC, Canada, September 2017.
- [C9] O. Arslan and D.E. Koditschek, “**Smooth extensions of feedback motion planners via reference governors,**” *IEEE International Conference on Robotics and Automation (ICRA)*, pp. 4414–4421, Singapore, May 2017.
- [C8] D.P. Guralnik, B. Moran, A. Pezeshki and O. Arslan “**Detecting poisoning attacks on hierarchical malware classification systems,**” *Cyber Sensing, SPIE Defense + Security*, Anaheim, CA, May 2017.
- [C7] O. Arslan and D.E. Koditschek, “**Sensor-based reactive navigation in unknown convex sphere worlds,**” *The 12th International Workshop on the Algorithmic Foundations of Robotics (WAFR)*, San Francisco, CA, December 2016. (**Best Paper Award Nominee**)

- [C6] O. Arslan and D.E. Koditschek, “**Exact robot navigation using power diagrams,**” *IEEE International Conference on Robotics and Automation (ICRA)*, pp. 1-8, Stockholm, Sweden, May 2016.
- [C5] O. Arslan and D.E. Koditschek, “**Voronoi-based coverage control of heterogeneous disk-shaped robots,**” *IEEE International Conference on Robotics and Automation (ICRA)*, pp. 4259-4266, Stockholm, Sweden, May 2016.
- [C4] O. Arslan, D.P. Guralnik and D.E. Koditschek, “**Hierarchically clustered navigation of distinct Euclidean particles,**” *Annual Allerton Conference on Communication, Control, and Computing (Allerton)*, pp. 946-953, Monticello, IL, October 2012.
- [C3] O. Arslan, U. Saranlı and Ö. Morgül, “**Reactive footstep planning for a planar spring mass hopper,**” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 160-166, St. Louis, MO, October 2009.
- [C2] M. M. Ankaralı, O. Arslan, and U. Saranlı, “**An analytical solution to the stance dynamics of passive spring-loaded inverted pendulum with damping,**” *International Conference on Climbing and Walking Robots and the Support Technologies for Mobile Machines (CLAWAR)*, pp. 693-700, World Scientific, Istanbul, Turkey, September 2009.
- [C1] O. Arslan, U. Saranlı and Ö. Morgül, “**An approximate stance map of the spring mass hopper with gravity correction for nonsymmetric locomotions,**” *IEEE International Conference on Robotics and Automation (ICRA)*, pp. 2388-2393, Kobe, Japan, May 2009.

Book Chapters

- [B1] O. Arslan, D. P. Guralnik and D. E. Koditschek, “**Navigation of distinct Euclidean particles via hierarchical clustering,**” *Algorithmic Foundations of Robotics XI*, vol. 107:19-36, Springer Tracts in Advanced Robotics, April 2015.

Reviewed Workshop Papers

- [W2] O. Arslan, D.P. Guralnik and D.E. Koditschek, “**Clustering-based robot navigation and control,**” Workshop on Emerging Topological Techniques in Robotics at *IEEE International Conference on Robotics and Automation (ICRA)*, Stockholm, Sweden, May 2016.
- [W1] O. Arslan and D.E. Koditschek, “**A recursive, distributed minimum spanning tree algorithm for mobile ad hoc networks,**” Workshop on Communication-aware Robotics: New Tools for Multi-Robot Networks, Autonomous Vehicles, and Localization (CarNet Workshop) at *Robotics: Science and Systems (RSS)*, Berkeley, CA, USA, July 2014.

Preprints

- [P7] J. Huh, O. Arslan and D.D. Lee, “**Probabilistically Safe Corridors to Guide Sampling-Based Motion Planning (Extended version),**” *arXiv:1901.00101 [cs.RO]*, January 2019.
- [P6] V. Vasilopoulos, W. Vega-Brown, O. Arslan, N. Roy and D.E. Koditschek, “**Technical Report: Sensor-Based Reactive Symbolic Planning in Partially Known Environments,**” *arXiv:1709.05474 [cs.RO]*, Feb 2018.
- [P5] O. Arslan and D.E. Koditschek, “**Sensor-based reactive navigation in convex sphere worlds,**” *ESE Technical Report*, January 2016.
- [P4] O. Arslan and D.E. Koditschek, “**Voronoi-based coverage control of heterogeneous disk-shaped robots (Extended version),**” *arXiv:1509.03842 [cs.RO]*, September 2015.
- [P3] O. Arslan and D.E. Koditschek, “**Anytime hierarchical clustering,**” *arXiv:1404.3439 [stat.ML]*, April 2014.
- [P2] O. Arslan, D.P. Guralnik and D.E. Koditschek, “**Navigation of distinct Euclidean particles via hierarchical clustering (Extended version),**” *ESE Technical Report*, October 2013.
- [P1] O. Arslan, D.P. Guralnik and D.E. Koditschek, “**Discriminative measures for comparison of phylogenetic trees (A dynamical system perspective),**” *arXiv:1310.5202v1[q-bio.PE]*, October 2013.

Seminars, Talks & Poster Presentations

- [S6] O. Arslan, “**Safe motion planning via reference governors: From simple navigation policies to their smooth extensions**”, Computational Robotics Lab, ETH Zurich, Switzerland, November 2018.
- [S5] O. Arslan, “**Clustering-based motion planning and control**,” Robotic Systems and Power Tools, Robert Bosch GmbH Center for Research and Development, Renningen, Germany, July 2018.
- [S4] O. Arslan, “**Navigation in the space of hierarchies**,” Max Planck Institute for Intelligent Systems, Tübingen, Germany, February 2018.
- [S3] O. Arslan, “**Motion planning via reference governors: Towards closing the gap between high-level and low-level motion planning**,” Middle East Technical University, Ankara, Turkey, July 2017.
- [S2] O. Arslan, “**Motion planning via reference governors: Towards closing the gap between high-level and low-level motion planning**,” Autonomous Motion Department, Max Planck Institute for Intelligent Systems, Tübingen, Germany, June 2017.
- [S1] O. Arslan, “**Clustering-based robot navigation and control**,” ESE PhD Colloquium, University of Pennsylvania, Philadelphia, USA, February 2016.

Theses

- [T4] H. Min, “**On balancing event and area coverage in mobile sensor networks**,” MSc Thesis, University of Pennsylvania, PA, May 2018. *(Co-supervised with Daniel E. Koditschek)*
- [T3] V. Pacelli, “**Joint exploitation of local metrics and geometry in sampling-based planning**,” MSc Thesis, University of Pennsylvania, PA, August 2017. *(Co-supervised with Daniel E. Koditschek)*
- [T2] O. Arslan, “**Clustering-based robot navigation and control**,” PhD Thesis, University of Pennsylvania, Philadelphia, PA, August 2016.
- [T1] O. Arslan, “**Model-based methods for the control and planning of running robots**,” MSc Thesis, Bilkent University, Ankara, Turkey, July 2009.

Professional Activities

Reviewer:

- **Journals:** IEEE Transaction on Robotics (T-RO), IEEE Robotics and Automation Letters (RA-L), IEEE Transactions on Automatic Control (TAC), Automatica, Autonomous Robots, Frontiers in Robotics and AI.
- **Conferences:** IEEE International Conference on Robotics and Automation (ICRA), IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), International Conference on Advanced Robotics (ICAR), IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechatronics (BioRob), IEEE Conference on Decision and Control (CDC), American Control Conference (ACC).

Society Memberships:

IEEE, Member	2017 – present
IEEE, Robotics and Automation Society	2008 – present
IEEE, Control Systems Society	2016 – present
IEEE, Student Member	2008 – 2017

Government Activities:

Panelist, NSF Smart & Autonomous Systems	2017
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