Omur Arslan, PhD

Contact Information

Department of Mechanical Engineering
Eindhoven University of Technology
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Education

PhD, Electrical and Systems Engineering — Aug. 2016
University of Pennsylvania, Philadelphia, PA
Thesis: Clustering-Based Robot Navigation and Control
Advisor: Daniel E. Koditschek

MSc, Electrical Engineering — Aug. 2012
University of Pennsylvania, Philadelphia, PA
Advisor: Daniel E. Koditschek

MSc, Electrical and Electronics Engineering — July 2009
Bilkent University, Ankara, Turkey
Thesis: Model-Based Methods for the Control and Planning of Running Robots
Advisors: Ömer Morgül and Uluç Saranlı

BSc (Major), Electrical and Electronics Engineering — June 2007
Middle East Technical University, Ankara, Turkey

BSc (Minor), Mechatronics — July 2007
Middle East Technical University, Ankara, Turkey

BSc, Electrical and Electronics Engineering — Aug. 2004
Hacettepe University, Ankara, Turkey — (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

Assistant Professor   Nov. 2019 – present
Department of Mechanical Engineering
Eindhoven University of Technology, Eindhoven, Netherlands

Research Scientist   Oct. 2017 – Nov. 2019
Autonomous Motion Department
Max Planck Institute for Intelligent Systems, Tübingen, Germany

Postdoctoral Researcher   Sep. 2016 – Oct.2017
Department of Electrical and Systems Engineering
University of Pennsylvania, Philadelphia, PA
Mentor: Daniel E. Koditschek

Research Assistant   Aug. 2009 – Sep. 2016
Department of Electrical and Systems Engineering
University of Pennsylvania, Philadelphia, PA
Mentor: Daniel E. Koditschek

Research and Teaching Assistant   Sep. 2007 – July 2009
Department of Electrical and Electronics Engineering
Bilkent University, Ankara, Turkey
Mentors: Ömer Morgül and Uluç Saranlı

Teaching Experience

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

Honors & Awards

- **Best Paper Award Nominee on Multi-Robot Systems**   May 2018
  IEEE International Conference on Robotics and Automation
- **Best Paper Award Nominee**   Dec. 2016
  12th International Workshop on the Algorithmic Foundations of Robotics
- **Bilkent University Scholarship**   Sep. 2007 – July 2009
  (full tuition waiver + full stipend + on-campus lodging)
- **The Scientific and Technical Research Council of Turkey**   Sep. 2007 – July 2009
  (TUBITAK) 2228-National MSc Scholarship
- **The Scientific and Technical Research Council of Turkey**   May 2009
  (TUBITAK) 2224-International Scientific Meetings Fellowship
- **Graduation Project Committee Award**   June 2007
  Middle East Technical University, Ankara, Turkey
- **High Honors Graduate**   June 2007
  Electrical & Electronics Engineering (5th rank among 351 graduates)
  Middle East Technical University, Ankara, Turkey

- **Associate Professor Bülent Kerim Altay Award** Fall 2004, Spring 2004,
  Middle East Technical University, Ankara, Turkey Spring 2005, Fall 2006
  Awarded for attaining the highest rank in a semester with GPA 4.00/4.00

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

[C15] J. Huh*, O. Arslan* and D.D. Lee, **"Probabilistically safe corridors to guide sampling-based motion planning,"** The International Symposium on Robotics Research (**ISRR**), Hanoi, Vietnam, October 2019 (**equally contributed*).

[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,**" *arXiv:1901.00101 [cs.RO]*, January 2019 (*equally contributed*).

[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

[S9] O. Arslan, **"Statistical Coverage Control of Mobile Sensor Networks,"** IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS**), Macau, China, November 2019.

[S8] O. Arslan, **"Safe motion planning via reference governors: From simple navigation policies to their smooth extensions"**, Department of Mechanical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands, May 2019.

[S7] O. Arslan, **"Safe motion planning via reference governors: From simple navigation policies to their smooth extensions"**, Cognitive Robotics Department, Delft University of Technology, Delft, Netherlands, April 2019.

[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), IEEE Transactions on Control Systems Technology (TCST), IEEE Transactions on Control of Network Systems (TCNS), 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 Symposium on Robotics Research (ISRR), International Symposium on Experimental Robotics (ISER), 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