Oktay Arslan

CONTACT INFORMATION

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OBJECTIVE

To develop personal abilities and explore potential career fields through a full-time position in autonomy, planning, learning and control for autonomous systems, preferably in robotics, automotive, and aerospace.

RESEARCH INTERESTS

Motion planning, machine learning, computer vision, control of multi-agent systems, dynamic modeling, guidance, navigation and control of robotic systems and autonomous vehicles.

WORK EXPERIENCE

A^3 by Airbus — Sunnyvale, CA
AI/Robotics Software Engineer — Sep 2019 – present

Autonomy for Commercial Aircrafts, Self-flying Taxis

Working on the perception software for various autonomy projects (autonomous detect and avoid for drones, runway detection for autonomous taxi, take-of and landing,certification of perception algorithms)

Working on the deployment of machine learning models (deep learning) on embedded computing platforms (CUDA, Nvidia GPUs).

Tesla, Inc. - Autopilot Department — Palo Alto, CA
Staff Autopilot Software Engineer — May 2018 – Jun 2019

Planning and Controls Stack for Model 3, S, X Cars

I contributed two main features: navigate on autopilot and enhanced summon.

I implemented the decision software for traffic-aware safe lane change, merging to on-ramp, off-ramp cases in high-speed highway driving.

I implemented the path planner for the enhanced summon feature to navigate in unstructed environments among moving objects (pedestrians, vehicles, etc).

I contribute to production codes for autopilot software (C++) and perform drive tests on a daily basis.

Voyage Auto, Inc. - Planning and Controls Group — Santa Clara, CA
Robotics Technologist — Oct 2017 – Apr 2018

Fast, Reliable Motion Planning and Controls Stack for Self-driving Cars

I worked on the design of the overall autonomy architecture for vehicle intelligence, specifically defined interfaces between route planner, behavior executive, path planner, velocity planner, low-level controls stacks.

I led the development and field testing of the real-time motion planner software, which includes the path and velocity planners, to implement behaviors such as lane changing, lane keeping, adaptive cruise control, etc.

NASA Jet Propulsion Laboratory - Mobility and Robotic Systems Section Pasadena, CA
Robotics Technologist — Oct 2015 – Oct 2017

Autonomous Robotic Inspection of Tankers, joint work with Chevron

The objective was to develop quadrotors that use 3D imaging technology to help engineers pinpoint and assess structural damage, oil leakages, and other weaknesses in large fuel tankers in offshore seas. I implemented the autonomous exploration and navigation stack (ROS) for quadrotors, which uses frontier-based exploration strategy, sampling-based planners for point-to-point navigation and dynamic programming based algorithms for collision avoidance in unstructured environments.

Aggressive Quadrotor Flight, joint work with Google Tango Team

The objective was to develop a highly agile quadrotor platform and autonomous software to outperform human pilots. I prototyped differential dynamic programming based trajectory generation algorithms for perception-aware motion planning (**demo**).

Robust, Multi-sol, Autonomous Navigation for Self-reliant Rovers

The objective was to develop an autonomous navigation software for future space missions such as Mars 2020 and beyond. I worked on implementation of a robust motion planner that can handle vehicle kinematic constraints, localization uncertainty, terramechanic effects such slippage.

Autonomous Mapping of Small-bodies in Space

The objective was to develop autonomous decision making capabilities for a spacecraft for exploration and mapping of unknown small bodies in space. I contributed to development of a high-fidelity, physics-based spacecraft model and integrated NASA JPL spacecraft GNC flight software to the simulated model for software-in-the-loop testing of mission scenarios.

Next-generation Autonomous Navigation for Mars Rovers

The objective was to develop state-of-the-art motion planners for navigation of Mars rovers. I worked on implementation of a sampling-based motion planner (RRT$^{\#}$ with closed-loop prediction) which utilizes kinematic rover model for generation of smooth trajectories. The final navigation stack was successfully tested on a Mars Rover platform (**demo**).

Tactical Coordinated Behavior for Autonomous Ground Vehicles

The objective was to develop autonomous decision making algorithms for navigation of a team of ground vehicles in unstructured environments. I worked on multi-vehicle path planning algorithms for reshuffling of vehicles between different formations and developed drivers for consistent operation of range measurement sensors.

Dynamic Modeling of Autonomous Maritime Vehicles

I worked on implementation of high fidelity dynamic model of vessels and its integration to maritime vehicles simulation software.

Risk-Aware Motion Planning for Resilient Spacecraft Operations

I worked on implementation of a robust sampling-based motion planner (RRT$^{\#}$) which minimizes not only the cost of the plan but also the uncertainty associated with it.

Mitsubishi Electric Research Laboratories - Mechatronics Group Cambridge, MA
Graduate Research Intern Jun 2015 – Aug 2015

Motion Planning and Control for Autonomous Systems

The objective was to develop efficient motion planners for point-to-point navigation of a self-driving car in an urban environment. I worked on implementation of recently developed asymptotically optimal algorithms (e.g. RRT*, RRT$^{\#}$) which utilize higher fidelity car models for generation of kinodynamically feasible trajectories.

MIT Laboratory for Decision and Information Systems Cambridge, MA
Visiting Researcher Aug 2014 – Aug 2015

Machine Learning Algorithms for Incremental Sampling-based Algorithms

I was the visiting researcher at LIDS and worked on novel sampling-based algorithms (RRTs) which utilize machine learning techniques to speed up the search process in high-dimensional planning problems.

Aurora Flight Sciences - Autonomy, Controls, and Estimation Group Cambridge, MA
Robotics/Software Engineer Aug 2014 – May 2015

High-level Route Planning for Autonomous Rotorcrafts

The Autonomous Aerial Cargo Utility System (AACUS) was a five-year, $98 million program announced by the Office of Naval Research (ONR) to develop advanced autonomous capabilities for reliable resupply/retrograde by a robotic VTOL air vehicle under adverse conditions.

I designed and implemented the high-level route planner for the autonomous helicopter and helped the GNC engineers for integration to flight software. Our team won a $13.7 million contract for the Phase II of the development, against competition from Lockheed Martin. Links: **press**, **demo**.

Motion Planning in Dynamically Changing Environment — Jun 2013 – Aug 2013

The objective was to implement fast and novel motion planners for an autonomous helicopter. Our team explored anytime, asymptotically optimal motion planners that can work for planning in dynamically-changing environments, especially in the presence of no-fly zones.

I developed a sampling-based motion planner which uses the RRT$^{\#}$ algorithm for path-planning of an autonomous helicopter in C++ and optimized the low-level procedures, i.e., collision checking, replanning, etc., used by the algorithm for real-time executions. The final planner was able to compute a solution within 5% suboptimality bound under 1 s for 98% of trials.

Georgia Institute of Technology - Aerospace Engineering — Atlanta, GA
Graduate Research Assistant — Aug 2009 – Sep 2016

Reinforcement Learning for Autonomous Robotic Systems with Path Integral Stochastic Optimal Control — Aug 2013 - Sep 2016

The objective was to develop efficient online algorithms for solutions of a class of stochastic optimal control problems which arise in robotic applications. Our goal was to make novel connections between Rapidly-exploring Random Trees (RRT) and Path Integral (PI) formulation of stochastic optimal control problems and to compute control policies in realtime for high dimensional autonomous systems, e.g., manipulators, humanoid robots, quadrotors.

Neuro-Inspired Adaptive Perception and Control for Agile Mobility of Autonomous Vehicles in Uncertain and Hostile Environments, by DOD — Aug 2011 - Sep 2016

The objective was to develop new algorithms for real-time perception, navigation and control of highly-maneuverable, autonomous and semi-autonomous (primarily, ground) vehicles operating at high speed and at the limits their performance envelope. The inspiration comes from human cognitive (decision) and execution (control) models, especially those of expert human race drivers (`http://amav.gatech.edu`).

I developed a new incremental sampling-based algorithm, which utilizes ideas from rapidly-exploring random graphs, dynamic programming and relaxation algorithms, for optimal motion planning and worked on a parallel implementation of the algorithm and trajectory generation for aggressive maneuvers of autonomous ground vehicle.

Darpa Robotics Challenge HUBO Team — Jan 2013 – May 2013

The objective was to develop robots and capabilities to perform entire search and rescue missions. Our group was assigned to the tasks of removal of clutter and cutting through walls. We applied our algorithms to a HUBO+ robot platform to validate these and other intelligent actions performed by the robot such as walking and general manipulation.

I helped to the team who works on locomotion for bipedal robots and visual servoing for manipulation tasks.

Multiscale, Beamlet-Based Data Processing for the Solution of Shortest-Path Problems with Applications to Embedded Vehicle Autonomy, by NSF — Aug 2009 – Jul 2011

I integrated multiscale, beamlet-based data processing algorithms with A*, LPA* search algorithms to compute curvature bounded shortest paths for autonomous vehicles.

Istanbul Technical University - Controls and Avionics Laboratory — Istanbul, Turkey
Research Assistant (Supervisor: Gökhan İnalhan) — Jul 2006 – Jul 2009

Design of Decision Support Architecture for Human Operators and Multi-Vehicle Mission Simulator, by TUBITAK — Aug 2006 - Jul 2009

I developed a decision support system for human operators involving command and control of UAV fleets, contributed to the development of an experimental multi-vehicle mission simulator for joint real-time simulation across manned-unmanned fleets, and the mission control center.

Education

Georgia Institute of Technology — Atlanta, GA

Ph.D. in Robotics (GPA: 4.0/4.0) — Dec 2015
Area: Robotics and Intelligent Systems (Artificial Intelligence, Mechanics, Controls)

M.S. in Computer Science (GPA: 3.91/4.0)
Area: Machine Learning

M.S. in Aerospace Engineering (GPA: 3.58/4.0) — Jun 2012
Area: Flight Mechanics and Control (Analytical Mechanics, Linear Control, Nonlinear Control)

Istanbul Technical University — Istanbul, Turkey

M.S. in Defense Technologies (Information Technology, GPA: 3.67/4.0) — Aug 2009

B.S. in Computer Engineering (double major, GPA: 3.46/4.0) — Aug 2007

B.S. in Electrical Engineering (best of the 55 students, GPA: 3.77/4.0) — Jun 2006

Teaching Experience

MIT - Beaver Works Summer Institute — Cambridge, MA

JPL Representative, Mini Grand Prix Challenge — Jun 2016, 2017

Coordinated with MIT faculties and Lincoln Laboratory researchers to organize a robotic summer school for high-school students; led JPL team to teach lectures in vision, machine learning, planning and control in robotics

Taught lectures on "Motion Planning and Control for Autonomous Ground Vehicles", mentored students for fast, autonomous navigation of small racecars, complete with camera, LIDAR sensors and a NVIDIA processor with ROS, in a complex environment.

MIT - Department of Aeronautics and Astronautics — Cambridge, MA

Guest Lecturer, 16.410/16.413: Principles of Autonomy and Decision Making — Oct 27, 2014
Taught a lecture on "Randomized Planning Algorithms for Robotic Motion Planning".

Georgia Institute of Technology - Aerospace Engineering — Atlanta, GA

Teaching Assistant, AE 6511: Optimal Guidance and Control — Jan 2014 - May 2014
Graded assignments, held office hours.

Georgia Tech Courses

Computer Science: Game Theory and Multiagent Systems, Computer Vision, Machine Learning, Pattern Recognition, Stochastic Optimal Control and Reinforcement Learning, Artificial Intelligence, Robot Intelligence: Planning in Action, Humanoid Robotics, Introduction to Robotics Research, Robotics Research Fundamentals I & II

Control Theory: Linear Systems and Control, Robust Control I, Optimal Guidance and Control, Aerospace Nonlinear Control I, Advanced Nonlinear Control, Networked Control Systems, Kalman Filtering, Reliable Control Software, Dynamic System Modeling

Mathematics: Linear Algebra, Introduction to Hilbert Spaces, Operator Theory, Ordinary Differential Equations I, Nonlinear Optimization

Mechanics: Advanced Dynamics I, Advanced Flight Dynamics

Computer Skills

Languages : C, C++ (advanced), Python (intermediate), Haskell (beginner),
Softwares : Eclipse, Visual Studio, Matlab, Simulink, Mathematica, Octave, Player/Stage, Gazebo, Dart/GRIP, Flightgear, GPOPS, ROS, Navigation Stack
Platforms : Ubuntu, Windows, Mac OS
Libraries : STL, Boost, MPICH, OpenMP, Octave C++, NumPy, SciPy, SciKit-Learn

Invention Disclosures

Patents

3. E. Musk and **O. Arslan** et al, *Autonomous and User Controlled Vehicle Summon to a Target*, Feb 11, 2019 (submitted)
2. M. Gildner and **O. Arslan** et al, *Autonomous Robotic Airship Inspection System For Large-Scale Tank Interiors*, US Patent App. 15/714, 693, 2017 (submitted)
1. K. Berntorp and **O. Arslan**, *System and Method for Controlling Autonomous Vehicles*, US Patent App. 14/968, 848, 2017

Publications

Journals, Book Chapters, Technical Reports and Refereed Conferences

20. **O. Arslan**, and K. Berntorp, and P. Tsiotras, *Sampling-based Algorithms for Optimal Motion Planning using Closed-loop Prediction*, IEEE International Conference on Robotics and Automation, May 29-June 3, 2017.
19. **O. Arslan**, and P. Tsiotras, *On Connections Between Incremental Sampling-based Motion Planning Algorithms and Dynamic Programming* (in preparation)
18. **O. Arslan**, and P. Tsiotras, *Incremental Sampling-based Motion Planners using Policy Iteration Methods*, IEEE 55th Conference on Decision and Control, December 12-14, 2016.
17. C. L. McGhan, T. Vaquero, A. R. Subrahmanya, **O. Arslan**, R. Murray, M. D. Ingham, M. Ono, T. Estlin, B. Williams, M. Elaasar, *The Resilient Spacecraft Executive: An Architecture for Risk-Aware Operations in Uncertain Environments*, American Institute of Aeronautics and Astronautics Space, September 17, 2016.
16. **O. Arslan**, and P. Tsiotras, *Machine Learning Guided Exploration for Sampling-based Motion Planning Algorithms*, IEEE/RSJ International Conference on Intelligent Robots and Systems 2015, September 28 - October 02, 2015.
15. **O. Arslan**, and P. Tsiotras, *Dynamic Programing Guided Exploration for Sampling-based Motion Planning Algorithms*, IEEE International Conference on Robotics and Automation 2015, May 26-30, 2015.
14. **O. Arslan**, E. A. Theodorou, and P. Tsiotras, *Information-Theoretic Stochastic Optimal Control via Incremental Sampling-based Algorithms*, IEEE Symposium on Adaptive Dynamic Programming and Reinforcement Learning 2014, December 9-12, 2014.
13. **O. Arslan**, and P. Tsiotras, *Use of Relaxation Methods in Sampling-Based Algorithms for Optimal Motion Planning*, IEEE International Conference on Robotics and Automation 2013, May 6-10, 2013.
12. **O. Arslan**, and P. Tsiotras, *An Efficient Sampling-based Algorithm for Motion Planning with Optimality Guarantees*, Technical Report DCSL-12-09-010, Georgia Institute of Technology, School of Aerospace Engineering, September 2012.
11. **O. Arslan**, P. Tsiotras, and X. Huo, *Solving Shortest Path Problems with Curvature Constraints Using Beamlets*, IEEE/RSJ International Conference on Intelligent Robots and Systems 2011, September 25-30, 2011.
10. Y. Lu, X. Huo, **O. Arslan**, and P. Tsiotras, *Multiscale LPA* with Low Worst-Case Complexity Guarantees*, IEEE/RSJ International Conference on Intelligent Robots and Systems 2011, September 25-30, 2011.
9. Y. Lu, X. Huo, **O. Arslan**, and P. Tsiotras, *An Incremental, Multi-Scale Search Algorithm for Dynamic Path Planning with Low Worst Case Complexity*, IEEE Transactions on Systems, Man, and Cybernetics, Part B: Cybernetics, no. 99, pp.1-15, 2011.
8. **O. Arslan**, B. Armagan, and G. Inalhan, *Development of a Mission Simulator for Design and Testing of C2 Algorithms and HMI Concepts Across Real and Virtual Manned-Unmanned Fleets*, Optimization and Cooperative Control Strategies, Lecture Notes in Control and Information Sciences, Volume 381/2009, Springer Berlin, October 18, 2008.
7. **O. Arslan**, and G. Inalhan, *Design of a Decision Support Architecture for Human Operators in UAV Fleet C2 Applications*, 14th International Command and Control Research and Technology Symposium 2009, June 15-17, 2009.
6. **O. Arslan**, and G. Inalhan, *An Event Driven Decision Support Algorithm for Command and Control of UAV Fleets*, American Control Conference 2009, June 10-12, 2009.

Posters & Presentations:

5. **O. Arslan** and P. Tsiotras, *Dynamic Programming Principles for Sampling-based Motion Planners*. Optimal Robot Motion Planning Workshop in ICRA 2015, May 30, 2015
4. **O. Arslan** and P. Tsiotras, *Dynamic Programming Algorithms for Motion Planning and Control*. New England Machine Learning Day 2015, Microsoft Research, May 18, 2015
3. **O. Arslan** and P. Tsiotras, *Machine Learning for Samping-based Motion Planning*. Amazon 2014 Fall Graduate Research Symposium, Amazon Headquarter, Nov. 7, 2014
2. **O. Arslan**, B. G. Ulualan, and G. Inalhan, *Design and Implementation of Communication and Information Distribution Modules for Cooperative Unmanned-Manned Vehicle Networks*. 8th International Conference on Cooperative Control and Optimization, Jan. 30 - Feb. 1, 2008
1. A. Cetinkaya, S. Karaman, **O. Arslan**, M. Aksugur, and G. Inalhan, *Design of a Distributed C2 Architecture for Interoperable Manned/Unmanned Fleets*, 7th International Conference on Cooperative Control and Optimization, Jan. 31-Feb. 2, 2007

Grants & Contracts

As Principal Investigator

5. "Development of Efficient Algorithms for Inference, Estimation, and Control Problems in Autonomous Systems," amount $25K, Caltech JPL (Center for Academic Partnerships), Oct 2017 - Sep 2018.
4. "MIT Beaver Works Bootcamp Program," amount $25K, Caltech JPL (Center for Academic Partnerships), Jun 2017 - Sep 2018.

As Co-Investigator

3. "Safety-critical, Verifiable Autonomy for Space Missions: Integrating Control Objectives with Task Specifications," amount $400K, Caltech JPL (Presidents and Directors Fund), Oct 2017 - Sep 2018.
2. "Self-Reliant Rovers for Increased Mission Productivity," amount $700K, Caltech JPL (Research and Technology Development Fund, Strategic Initiative), Oct 2016 - Sep 2017.
1. "Next-generation Autonomous Navigation for Future Mars Rovers," amount $425K, Caltech JPL (Research and Technology Development Fund, Topic Area), Oct 2015 – Sep 2017.

Honours and Awards

NASA JPL Team Bonus Award, Caltech JPL Autonomous Systems Division	2016, 2017
Travel Grant, IEEE International Conference on Intelligent Robots and Systems	2011, 2015
Travel Grant, IEEE International Conference on Robotics and Automation	2015
EducationUSA Opportunity Grant, The Turkish Fulbright Commission	2009
14th ICCRTS Student Scholarship, The Command and Control Research Program	2009
Graduate Research Fellowship, TUBITAK	2007-2009
Werner von Siemens Excellence Award, Siemens Turkey	2006
Control Engineering Best Student Award, Istanbul Technical University	2006
High Honors Student in Istanbul Technical University	2002-2006

Professional Affiliations & Services

American Institute of Aeronautics and Astronautics (AIAA)	**2010 – present**
Institute for Electronic and Electrical Engineers (IEEE), IEEE Control Systems Society, IEEE Robotics and Automation Society	**2008 – present**
Society for Industrial and Applied Mathematics (SIAM), Association for Computing Machinery (ACM), SIAG on Optimization	**2008 – present**

Miscellaneous

Georgia Tech Summer School on Cyber-Physical Systems Georgia Institute of Technology, Atlanta, USA	**23 - 25 Jun. 2010**
Player Summer School on Cognitive Robotics 2007 Technical University of Munich, Munich, Germany	**13 -20 Aug. 2007**
Summer School on Parallel Programming National Center for High Performance Computing, Istanbul, Turkey	**16 - 20 Jul. 2007**

References

Available upon request.