Wei SUN

Personal Information

School of Aerospace and Mechanical Engineering
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Research Interests

Control systems, differential games, multiplayer pursuit-evasion games, reinforcement learning, trajectory optimization, stochastic dynamical systems

Education

Georgia Institute of Technology — Atlanta, GA
Ph.D. in Aerospace Engineering — Aug. 2011 – Aug. 2017
Area: Flight Mechanics and Control (Analytical Mechanics, Linear Control, Nonlinear Control)

M.S. in Aerospace Engineering — Dec. 2015

M.S. in Mathematics — July 2015

Peking University — Beijing, China
B.S. in Mathematics — June 2010

Professional Experience

University of Oklahoma, Norman, OK, USA

Aerospace and Mechanical Engineering, *Assistant Professor* — Nov. 2018 – present

University of Washington, Seattle, WA, USA

Autonomous Control Laboratory, *Postdoctoral Fellow* — March. 2018 – Nov. 2018

Research on motion planning under uncertainty and machine learning based control

Georgia Institute of Technology, Atlanta, GA, USA

Dynamics and Control Systems Laboratory, *Postdoctoral Fellow* — Aug. 2017 – March. 2018

Research on optimal control and pursuit-evasion games

Research Experience

Georgia Institute of Technology - Aerospace Engineering — Atlanta, GA
Graduate Research Assistant (Advisor: Prof. Panagiotis Tsiotras, co-advisor: Prof. Evangelos A. Theodorou) — Aug. 2012 – Aug. 2016

Pursuit Evasion under Envioronmental Disturbances in 3-Dimentional Space — Aug. 2016 - Aug. 2017

(Joint work with Prof. Yezzi at School of Electrical & Computer Engineering, Georgia Tech)

The project aims at extending previous results in multiplayer pursuit-evasion games in dynamic flow fields from the 2D space to the 3D space and attempts to deal with more realistic pursuit evasion problems among aircraft and unmanned aerial vehicles (UAVs).

Information-Theoretic Trajectory Optimization for Motion Planning and Control with Applications to Space Proximity Operations — Sep. 2014 - May 2017

The objective of this project was to develop unified perception and control guidance algorithms that utilize active exploration to enable robust sensing and planning of a free-flying space robot in the vicinity of another body in order to perform proximity operations. Continuous-time Differential Dynamic Programming was utilized to help realizing the project objective.

Environment-Agent Interaction in Autonomous Networked Teams With Applications — Aug. 2012 - Aug. 2016

The major goal of this project was to develop new motion coordination and path-planning algorithms for teams of agents using metrics that capture the interaction of these agents with the environment. A typical example is the case of a team of small UAVs/MAVs, whose motion is affected by (perhaps unknown) winds, or teams of marine or underwater vehicles affected by sea currents.

Multiplayer Pursuit-Evasion Games in Dynamic Flow Fields via Level Set Methods — June 2015 - March 2016

(Joint work with Prof. Lermusiaux's group at MIT)

The objective of this project was to utilize level set methods to find reachability sets, and to adopt a reachability-based approach to deal with the pursuit-evasion differential game between pursuers and evaders in the presence of dynamic environmental disturbances (e.g., winds, sea currents). Level set equations are defined and solved in order to generate the reachable sets of the pursuers and the evader. The corresponding time-optimal trajectories and optimal strategies can be retrieved afterwards.

Optimal Dynamic Soaring Trajectories for a Glider — Aug. 2013 - Dec. 2013

Solved the optimal control problem of dynamic soaring of a glider flying various patterns. The loiter and traveling flying patterns are investigated to minimize cycle time, to maximize cycle altitude, and to minimize wind gradient.

Game Theoretic Differential Dynamic Programming on Dynamical System with Learned Error Model — Aug. 2013 - Dec. 2013

Most of the system models we are dealing with nowadays are only approximate models and are affected by noise. We propose to learn the difference between the real model and the analytic model by machine learning methods, and to apply Game Theoretic Differential Dynamic Programming (GT-DDP) on the learned model to arrive at a feedback optimal control that accounts for both the model approximation error and the noise influence.

Maximum Range Optimal Glide after Engine Cut-off — Aug. 2011 - Dec. 2011

Safe landing in the event of engine cut-off at low altitude flight conditions during manned or unmanned flight is an important research topic. The goal of the project was to achieve maximum range in glide mode and this problem can be cast as an optimal control problem which can be solved using pseudo-spectral methods. Optimal trajectories based on the Minimum Principle are computed and the corresponding optimal controls are obtained.

Teaching Experience

Georgia Institute of Technology - Aerospace Engineering — Atlanta, GA

Teaching Assistant, AE 6580: Nonlinear Control — Spring 2016
Graded assignments, held office hours.

Teaching Assistant, AE 3515: System Dynamics and Controls — Fall 2016
Graded assignments, held office hours.

Computer Skills

Languages : C, C++, Python
Softwares : Visual Studio, Matlab, Mathematica, Maple, GPOPS
Platforms : Windows, Linux, Mac OS

Language Skills

English, Chinese

Publications

Journals

14. **W. Sun**, P. Tsiotras and A. J. Yezzi, *Multiplayer Pursuit Evasion Games in 3-Dimensional Flow Fields* (submitted to Dynamic Games and Applications)
13. **W. Sun**, Y. Pan, J. Lim, E. A. Theodorou, and P. Tsiotras, *Min-Max Differential Dynamic Programming: Continuous and Discrete Time Formulations*, AIAA Journal of Guidance, Control, and Dynamics, Vol. 41, No. 12, pp. 2568-2580, 2018.
12. V. R. Makkapati, **W. Sun**, and P. Tsiotras, *Optimal Evading Strategies for Two-Pursuers/One-Evader Problems*, AIAA Journal of Guidance, Control, and Dynamics, Vol. 41, No. 4, pp. 851-862, 2018.
11. T. Rajpurohit, W. Haddad, and **W. Sun**, *Stochastic Differential Games and Inverse Optimal Control and Stopper Policies*, International Journal of Control, 2017.

10. **W. Sun**, P. Tsiotras, T. Lolla, D. N. Subramani and P. F. J. Lermusiaux, *Multiple-Pursuer-One-Evader Pursuit Evasion Game in Dynamic Flow Fields*, AIAA Journal of Guidance, Control, and Dynamics, Vol. 40, No. 7, pp. 1627-1637, 2017.
9. **W. Sun**, and P. Tsiotras, *Sequential Pursuit of Multiple Targets Under External Disturbances via Zermelo-Voronoi Diagrams*, Automatica, Vol. 81, pp. 253-260, 2017.

Referred Conferences

8. V. R. Makkapati, **W. Sun**, and P. Tsiotras, *Pursuit-Evasion Problems Involving Two Pursuers and One Evader*, 2018 AIAA Guidance, Navigation, and Control Conference, AIAA SciTech Forum, 2018.
7. **W. Sun**, P. Tsiotras, T. Lolla, D. N. Subramani and P. F. J. Lermusiaux, *Pursuit-Evasion Games in Dynamic Flow Fields via Reachability Set Analysis*, 2017 American Control Conference, pp. 4595–4600, May 24–26, 2017.
6. **W. Sun**, E. A. Theodorou, and P. Tsiotras, *Stochastic Game Theoretic Trajectory Optimization in Continuous Time*, 55th IEEE Conference on Decision and Control, pp. 6167-6172, December 12-14, 2016.
5. **W. Sun**, E. A. Theodorou, and P. Tsiotras, *Game Theoretic Continuous Time Differential Dynamic Programming*, 2015 American Control Conference, pp. 5593-5598, July 1–3, 2015.
4. **W. Sun**, and P. Tsiotras, *Pursuit Evasion Game of Two Players under an External Flow Field*, 2015 American Control Conference, pp. 5617-5622, July 1–3, 2015.
3. **W. Sun**, and P. Tsiotras, *An Optimal Evader Strategy in a Two-Pursuer One-Evader Problem*, 53rd IEEE Conference on Decision and Control, pp. 4266-4271, December 15-17, 2014.
2. **W. Sun**, E. A. Theodorou, and P. Tsiotras, *Continuous-Time Differential Dynamic Programming with Terminal Constraints*, 2014 IEEE Symposium on Adaptive Dynamic Programming and Reinforcement Learning, pp. 1-6, December 9-12, 2014.
1. **W. Sun**, and P. Tsiotras, *A Sequential Pursuer-Target Assignment Problem Under External Disturbances*, 52nd IEEE Conference on Decision and Control, pp. 3994-3999, December 10-13, 2013.

Presentations

5. **W. Sun**, P. Tsiotras, T. Lolla, D. N. Subramani and P. F. J. Lermusiaux *Multiple-Pursuer-One-Evader Pursuit Evasion Game in Dynamic Flow Fields.* Georgia Tech Decision & Control Student Symposium 2016, April 8, 2016
4. **W. Sun**, E. A. Theodorou, and P. Tsiotras, *Game Theoretic Continuous Time Differential Dynamic Programming*, 2015 American Control Conference, July 1–3, 2015
3. **W. Sun**, and P. Tsiotras, *Pursuit Evasion Game of Two Players under an External Flow Field*, 2015 American Control Conference, July 1–3, 2015.
2. **W. Sun**, and P. Tsiotras, *An Optimal Evader Strategy in a Two-Pursuer One-Evader Problem*, 53rd IEEE Conference on Decision and Control, December 15-17, 2014.
1. **W. Sun**, E. A. Theodorou, and P. Tsiotras, *Continuous-Time Differential Dynamic Programming with Terminal Constraints*, 2014 IEEE Symposium Series on Computational Intelligence, December 9-12, 2014.

Honours and Awards

Student Travel Award, American Control Conference, 2015