

Isin Mert Balci

PHD STUDENT IN AEROSPACE ENGINEERING

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Summary

Ph.D. student in Aerospace Engineering with a special focus on Control Theory, Autonomous Systems, and Robotics. Exploring the theory and applications of stochastic optimal control and reinforcement learning for uncertain, safety-critical systems. Eager to expand the knowledge on stochastic controls, motion planning, and probabilistic trajectory optimization into real-world problems where randomness is ubiquitous and safety is utterly important.

Education

Bogazici University

BS IN MECHANICAL ENGINEERING

- Graduated with First Class Honours
- GPA: 3.89/4.0

Istanbul, Turkey

Sep. 2013 - Jun. 2018

Georgia Institute of Technology

BS IN MECHANICAL ENGINEERING

- Reciprocal Exchange Student
- GPA: 4.0/4.0

Atlanta, GA

Aug. 2016 - Dec. 2016

University of Texas at Austin

MS/PHD IN AEROSPACE ENGINEERING IN CONTROLS, AUTONOMY AND ROBOTICS TRACK

- Advisor: Assoc. Prof. Efstathios Bakolas
- GPA: 3.88/4.0, Expected Graduation Date: May 2023
- Selected Coursework: Convex Optimization, Stochastic Processes, Optimal Control Theory, Statistical Estimation Theory, Statistical Machine Learning

Austin, TX

Aug. 2018 - Current

Skills

Programming	Python (Advanced), MATLAB (Advanced), C (Beginner), Julia (Beginner)
Mathematical	Mathematical Optimization, Optimal Control, Stochastic Control, Trajectory Optimization, Reinforcement Learning
Language	Turkish (Native), English

Research Projects

Optimal Trajectory Generation using Differential Dynamic Programming Algorithm

UNDERGRADUATE RESEARCHER

- DDP algorithm is learned and applied to inverted pendulum problem
- Simulation of inverted pendulum is conducted in MATLAB environment
- Open loop optimal control sequence is generated using different cost functions

Atlanta, GA

(Completed) Dec. 2016

Gaussian Processes for Safe Imitation Learning

GRADUATE RESEARCH ASSISTANT

- Trained GPs for inverted pendulum task in OpenAI-gym environment
- Multiple GPs are combined to get a better result with MCMC algorithm
- A reversible jump MCMC algorithm is implemented for policy inference

Austin, TX

(Completed) Aug. 2019

Covariance Control of Linear Systems with Soft Terminal Constraints

GRADUATE RESEARCH ASSISTANT

- Formulated the covariance steering with wasserstein terminal cost problem as a difference of convex program
- Solved the DCP using convex-concave procedure, compared results with general purpose nonlinear programming solvers
- Extended the problem formulation for uncertain trajectory optimization for robotic systems
- Results have been submitted for publication in International Conferences

Austin, TX

May 2020 - Ongoing

Publications and Preprints

PREPRINTS

1. I.M. Balci, E. Bakolas, “Covariance Steering of Discrete-Time Stochastic Linear Systems Based on Distribution Distance Terminal Costs”
2. I.M. Balci, E. Bakolas, “Covariance Control of Discrete-Time Gaussian Linear Systems Using Affine Disturbance Feedback Control Policies”
3. I.M. Balci, E. Bakolas, A. Halder, “On the Convexity of Discrete Time Covariance Steering in Stochastic Linear Systems with Wasserstein Terminal Cost”

CONFERENCE

1. I. M. Balci and E. Bakolas, “Covariance Steering of Discrete-Time Stochastic Linear Systems Based on Wasserstein Distance Terminal Cost,” in IEEE Control Systems Letters, doi: 10.1109/LCSYS.2020.3047132.

Work Experience

Baykar Technologies

Istanbul, Turkey

ENGINEERING INTERN IN R&D DEPARTMENT

Jan. 2017 - Aug. 2017

- Obtained mathematical models for turboprop jet engines
- Dynamic simulations are performed for turboprop jet engine on Simulink
- Conducted Performance Simulations of UAVs using MATLAB and Simulink

UT Austin

Austin, TX

GRADUATE RESEARCH ASSISTANT

Aug. 2018 - Current

- Studied ADMM algorithm for distributed optimization of exponential cone programs
- Studied blending Gaussian Processes with imitation learning for safety guarantees
- Studied covariance steering of linear systems under soft terminal constraints

Course Projects

Aircraft Pitch Control

Istanbul, Turkey

ME 43A: APPLICATION OF CONTROL SYSTEMS

Nov, 2017

- Mathematical models are obtained using flight dynamics equations
- Design specifications are determined and a lead/lag compensator is designed to control the pitch angle
- Validity of controller is verified with extensive simulations on MATLAB

Safe Reinforcement Learning via Shield Synthesis

Austin, TX

ASE 396: DESIGN AND VERIFICATION OF CYBER-PHYSICAL SYSTEMS

Dec, 2018

- Shield for preventing unsafe actions with respect to LTL safety specification is generated
- Together with the environment abstraction, shield is synthesized for a gridworld agent
- Complete algorithm is tested on a gridworld environment with the Q-learning algorithm

Event-Triggered Control for Stabilization of Rotary Inverted Pendulum

Austin, TX

ASE 396: NETWORKED CONTROL SYSTEMS

April, 2019

- Triggering Rule based on linearized dynamics are obtained
- Event-triggered control law is tested on both simulations and real-time experiments
- Communication between controller and sensors are reduced by up to 30% in real-time experiments