Umut Demir

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Aerospace Research Engineer
Aerospace Phd Program

Istanbul, Turkey
https://umutworks.github.io

Machine Learning, Optimization, Data Driven Optimization: Deep Learning, Deep Reinforcement Learning, , Imitation Learning, Data-driven Decision Making Systems, Decision Making Under Uncertainty, Linear Programming.
Autonomous Multi-Agent Systems: Unmanned Aerial Vehicles (UAVs), Multi-UAV Coordination and Trajectory Planning Algorithms, Probabilistic Trajectory Prediction, Military and Civil Swarm Applications, Multi-Agent Reinforcement Learning.
High Accuracy Guidance, Navigation and Control: Control System Design and Maneuver Planning for Agile Fighter Aircraft, Guidance and Control of Ballistic and Interceptor Missiles, Orbital Mechanics, High-Accuracy Simulations.

Education

Master of Science in Aerospace Engineering, *Istanbul Technical University* 2022
Bachelor of Science in Astronautical Engineering, *Istanbul Technical University* 2020

Skills

Programming	Python, Matlab, LaTeX, Julia
Tools	Simulink, Tensorflow, Pytorch, Keras, Scikit-Learn, Git, Systems Tool Kit, NASA GMAT
Communication	English(TOEFL IBT: 99/120), Turkish(Native)
Hobbies	Electric Guitar Player at Rock/Metal Bands, Photography, Astrophotography, Gaming

Experience

Graduate Researcher at ITU AI and Data Science Application and Research Center **2020-Present**

Project: Large Scale Swarm to Swarm Air Combat Strategies(SUMRU) **2022-Present**
Partners: Presidency of Defence Industries of Turkey
Supervisor: Assoc. Prof. Dr. Nazım Kemal Ure

- Developed guidance, navigation and control framework for swarm to swarm air combat with Deep Reinforcement Learning and Game Theory(Pursuit-Evasion Games).
- Developed a reinforcement learning framework that controls the density of a large-scale swarm for engaging with adversarial swarm attacks in continuous environments.
- Published ICRA and SciTech papers in the first 6 months.

Project: Trajectory Prediction and Weapon Task Allocation **2022-Present**
Partners: ASELSAN
Supervisor: Assoc. Prof. Dr. Nazım Kemal Ure

- Developed an algorithm to predict trajectory of adversarial units up to 5 minutes time horizon using Deep Learning and Probabilistic Methods.
- Using predicted trajectories implemented a Mixed-Integer Linear Programming algorithm to solve large scale Weapon Task Allocation Problems.
- Implemented Monte Carlo simulations of high-fidelity aircrafts, helicopters, missiles and UAVs.
- Developed an user interface for adversarial attack simulations and optimization environment for engagement decisions.

Agile Aircraft Pilot Behavior Cloning **2020-2022**
Partners: Turkish Aerospace Industries (TAI)
Supervisor: Assoc. Prof. Dr. Nazım Kemal Ure

- Developed deep neural network models for behavioral cloning of fighter aircraft maneuvers.

- Using Turkish Airforce pilot data on Hurjet Aircraft, implemented a behavior cloning algorithm that can mimic the behavior using only one flight data.
- Transferred the learned behavior to other aircrafts using transfer learning methods.
- Developed a framework to generalize pilot behavior for any aircraft with Deep Reinforcement Learning.
- Developed an User Interface for Python Deep Reinforcement Learning libraries and Matlab/Simulink aircraft simulation environments.
- Developed a maneuver and pilot behavior ranking system
- Writing a Aerospace Science and Technology Journal paper.

Co-Founder and CEO at Orbyte Aerospace Technologies **2021 - Present**

- Orbyte Aerospace Technologies was founded in Istanbul in 2021 with the initial purpose of providing assistance for spacecraft missions and the eventual goal of playing a significant role in deep space exploration.
- Orbyte offers high-fidelity space simulation software, which powered with AI, that answers to all needs of both LEO and extraterrestrial mission design.
- Orbyte is recieved 200,000TL support from The Scientific and Technological Research Council of Turkey.
- Orbyte is about to recieve 4,000,000TL support from The Scientific and Technological Research Council of Turkey
- Finalist of Lean Space and ClearSpace Hackathon in Bremen at Space Tech Expo.
- Attended to the Student Entrepreneurship International Summit at Sorbonne University International Conference Centre in France.

Undergraduate Researcher at ITU Aerospace Research Center, Control and Avionics Lab **2018 - 2020**

Probabilistic Trajectory Prediction for Structured and Coordinated Attack Patterns
Partners: ASELSAN
Supervisor: Assoc. Prof. Nazım Kemal Ure

- Developed fast, efficient, real time machine learning algorithms for predicting future maneuvers and positions of threats executing structured attack patterns.
- Published an American Control Conference paper.

Research Intern at Space Mechatronics and Robotics Lab, Polish Academy of Sciences **Summer 2018**

- Worked on a research project to capture a tumbling, uncooperative spacecraft in on-orbit environment with an another spacecraft.
- After internship collobrated with Dr. Tomasz Barcinski, the head of the Space Mechatronics and Robotics Laboratory, on a project that aims to calculate landing requirements for Mars Moon Phobos.
- Completed course of Aerospace Project Management orginized by Miquel Pastor Vinader, ESA.

Intern at Turkish Aerospace Industries - Space Assembly, Integration and Test Center **Summer 2017**

- Designed an instrument for the application of multi layer insulation to Turksat 5A Satellite.
- Attended to the thermal vacuum tests, vibration tests and electromagnetic compatibility tests for satellite systems.

Activities

Astronautical Engineering Project 2018 - 2019

Multi-Use Lunar Transportation Vehicle Utilizing Deep Space Gateway is a design project of a space vehicle that will be operated from the Deep Space Gateway to the lunar surface.
3rd Place at AIAA 2018-2019 Space Design Competition

Pars Rocket Team Avionics Member 2015 - 2017

6th Place at Intercollegiate Rocket Engineering Competition (IREC) 2016
Designed and manufactured the first hybrid rocket in Turkey

Turkish Technology Team Foundation 2016 - 2017

Instructor of programming language courses for disadvantaged children.
Scholarship (given to 100 students among 10,000 applications)

Publications

1. **Demir, U**, A. S. Satir, G. G. Sever and N. K. Ure, "Agile Aircraft Pilot Behaviour Cloning" (Will be submitted to Aerospace Science and Technology in December 2022, and will be available at https://umutworks.github.io)

2. **Demir, U**, A. S. Satir, G. G. Sever and N. K. Ure, "Scalable Planning and Learning Framework Development for Swarm-to-Swarm Engagement Problems" arXiv preprint arXiv: 2212.02909 (Accepted to SciTech2023)

3. **Demir, U**, and Ure, NK. "A Scalable Reinforcement Learning Approach for Attack Allocation in Swarm to Swarm Engagement Problems." arXiv preprint arXiv:2210.08319 (2022). (Submitted to ICRA2023)

4. **Demir, U**, A. S. Satir, G. G. Sever and N. K. Ure, "Nonlinear Model Based Guidance with Deep Learning Based Target Trajectory Prediction Against Aerial Agile Attack Patterns," *2021 American Control Conference (ACC)*, 2021, pp. 2607-2612

5. **Demir, U**, Gul, E "Multi-Use Lunar Transportation Vehicle Utilizing Deep Space Gateway", *8. National Aerospace Conference, Turkey, 2020*

References

Prof. Nazim Kemal Ure
Assoc. Prof. at Istanbul Technical University, Department of Artificial Intelligence and Data Engineering
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Vice Dean of Research
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Prof. Altan Cakir
Prof. at Istanbul Technical University, Department of Physics
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