YÜKSEL ARSLANTAŞ

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SUMMARY

I am currently pursuing a Master's in Electrical and Electronics Engineering at Bilkent University, building on my Bachelor's foundation from the same institution. Under Dr. Muhammed Sayın's guidance in the Games, Decisions, and Networks Lab, my focus spans algorithmic game theory, control theory, and multi-agent reinforcement learning. My research aims to bridge theory and practical applications in these areas.

EDUCATION

Bilkent University, Ankara *September 2022 –*
M.Sc. in Electrical and Electronics Engineering

Bilkent University, Ankara *September 2016 – August 2021*
B.Sc. in Electrical and Electronics Engineering

WORK EXPERIENCE

Games, Decisions and Networks Lab September 2022 –
Graduate Researcher

· At GDN Lab, our primary focus revolves around cultivating a comprehensive comprehension of learning and autonomy within complex, dynamic, and multi-agent systems. In my research endeavors, I concentrate on the analytical examination of real-world scenarios, particularly investigating the heterogeneties within learning dynamics and identifying vulnerabilities therein, along with strategies for their exploitation. Our primary motivation in such scenarios lies in their implications for the digital economy and cybersecurity.

Aselsan June 2021 - July 2021
Summer Intern

· During my summer internship at ASELSAN, I worked within the Digital Circuit Design Unit of the Avionic Hardware Design Department. Throughout this experience, I completed two design projects. The first project involved designing, manufacturing, and testing an RS232-RS422 board. The second project focused on the design of an I2C peripheral integrated board.

GazeteBilkent April 2019 - June 2021
Writer

· During my undergraduate years, I contributed articles to the History Unit of Gazete Bilkent, Turkey's first and largest student newspaper.

TEACHING EXPERIENCE

EEE 440/540 - Advanced Mathematics for Signals, Systems, Control and Communications Spring 2024
Teaching Assistant

· As a teaching assistant for EEE 440/540 - Advanced Mathematics for Signals, Systems, Control, and Communications, under the supervision of Asst. Prof. Muhammed Ömer Sayın during the Spring 2024 semester, I contributed to the instruction of a comprehensive course exploring the theory and applications of mathematical methods in signals and

systems. This included topics such as Linear Vector Spaces, Hilbert Spaces, Integration, Distribution Theory, Fourier Transforms, Linear Systems, and Optimization, providing students with a robust understanding applicable to signal processing, communications, control, and optimization domains.

EEE 447/547 - Introduction to Robotics Fall 2022, 2023
Teaching Assistant

· As a teaching assistant for EEE 447/547 - Introduction to Robotics, instructed by Prof. Billur Barshan during Fall 2022 and 2023, I assisted students in comprehending a broad spectrum of robotic concepts and applications. This included topics such as robot arm kinematics and dynamics, trajectory planning, various sensing techniques (ranging from range sensing to tactile and force sensing), as well as mobile robot functionalities like localization, mapping, and navigation.

EEE 361 - Linear Algebra in Data Analysis and Machine Learning Spring 2023, 2024
Teaching Assistant

· As a teaching assistant for EEE 361 - Linear Algebra in Data Analysis and Machine Learning, taught by Prof. Orhan Arıkan during Spring 2023 and 2024, I supported students in understanding the fundamental concepts of linear algebra and their applications in data science and machine learning. This included topics such as singular value decomposition, weighted least squares approximations, principal component analysis, covariance matrices, and their relevance in signal processing, image analysis, and neural networks.

PUBLICATIONS

Convergence of Heterogeneous Learning Dynamics in Zero-sum Stochastic Games
arXiv preprint, 2023

· We present new families of algorithms for the repeated play of two-agent (near) zero-sum games and two-agent zero-sum stochastic games. For example, the family includes fictitious play and its variants as members. Commonly, the algorithms in this family are all uncoupled, rational, and convergent even in heterogeneous cases, e.g., where the dynamics may differ in terms of learning rates, full, none or temporal access to opponent actions, and model-based vs model-free learning. The convergence of heterogeneous dynamics is of practical interest especially in competitive environments since agents may have no means or interests in following the same dynamic with the same parameters. We prove that any mixture of such asymmetries does not impact the algorithms' convergence to equilibrium (or near equilibrium if there is experimentation) in zero-sum games with repeated play and in zero-sum (irreducible) stochastic games with sufficiently small discount factors.

Team Collaboration vs Competition: New Fictitious Play Dynamics for Multi-team Zero-Sum Games
arXiv preprint, 2024

· We present a new variant of fictitious play (FP) called team-fictitious-play (Team-FP) that can reach equilibrium in multi-team competition, different from the other variants of FP. We specifically focus on zero-sum potential team games with network separable interactions (ZSPTGs), unifying potential games (if there is a single team) and zero-sum polymatrix games (if each team has a single member) due to their wide range of applications from robotics to financial markets beyond two-team games. Similar to the FP dynamics, in Team-FP, agents follow a simple behavioral rule where they respond (with some inertia and exploration in the update of actions) to the last actions of the neighboring team members and the beliefs formed about the other neighbors' strategies as if the opponents are playing according to some stationary strategy. We show the almost sure convergence of the empirical averages of teams' action profiles to near team-Nash equilibrium in ZSPTGs under standard assumptions on the step sizes used. We formulate a bound on the approximation error, decaying with the exploration in the agents' responses. We further examine the performance of the Team-FP dynamics numerically.

Strategizing against Q-learners: A Control-theoretical Approach
arXiv preprint, 2024

· We explore the susceptibility of the Q-learning algorithm (a classical and widely used reinforcement learning method) to strategic manipulation of sophisticated opponents in games. We quantify how much a strategically sophisticated agent

can exploit a naive Q-learner if she knows the opponent's Q-learning algorithm. To this end, we formulate the strategic actor's problem as a Markov decision process (with a continuum state space encompassing all possible Q-values) as if the Q-learning algorithm is the underlying dynamical system. We also present a quantization-based approximation scheme to tackle the continuum state space and analyze its performance both analytically and numerically.

PROJECTS

Coordinated Task Execution of Robots Using Relative Sensors

- As an industrial design project, autonomous mobile robots with heterogeneous hardware configurations are developed for collective task execution without communication between the robots, or global mapping systems. Collective tasks such as converging on a predefined target are executed with three robots with different hardware configurations. Without communication (i.e. RF, LoRa) between robots, and global localization systems (i.e. GPS), robots make use of both visual data from cameras, and distance data from LiDAR to local mapping of their environment. Visual, and distance data is used to further augmented with object identification, and localization so that robots can identify obstacles, peer robots, and objectives in the environment. Local mapping of the environment is then used by a custom obstacle avoidance algorithm to perform collective task execution. The robots' collective ability to execute common objectives are evaluated using five different scenarios.

Precise Electromagnetic Platform Elevation Control System

- As part of Engineering Electromagnetics course, we focused on improving the precision of 3D printers' elevation systems. This involved a departure from the conventional use of step motors, opting instead for electromagnets and permanent magnets. The shift not only bolstered precision but also underscored the potential for advancements in 3D printing technology.

Acoustic Gas Sensing with MEMS based devices

- For my third-year project, I collaborate with Asst. Prof. Erdinç Tatar to develop an acoustic gas sensor utilizing MEMS-based technology aimed at addressing the selectivity and sensitivity challenges present in current sensors. The project entails thorough research into gas sensing mechanisms. Using MATLAB tools, we analyze and test various gas types and concentrations to optimize the intended technique.

TECHNICAL STRENGTHS

Programming Skills	Python, MATLAB, Julia, Java
Circuit Design Tools	Altium, AWR, LTSpice, KiCad