

# **A Best-Response Algorithm with Voluntary Communication and Mobility Protocols for Mobile Autonomous Teams Solving the Target Assignment Problem**

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## **Abstract**

We consider a team of mobile autonomous robots with the aim to cover a given set of targets. Each robot aims to select a target to cover and physically reach it by the final time in coordination with other robots given the locations of targets. Robots are unaware of which targets other robots intend to cover. Each robot can control its mobility and who to send information to. We assume communication happens over a wireless channel that is subject to fading and failures. Given the setup, we propose a decentralized algorithm based on decentralized fictitious play in which robots reason about the selections and locations of other robots to decide which target to select, whether to communicate or not, who to communicate with, and where to move. Specifically, the communication actions of the robots are learning-aware, and their mobility actions are sensitive to the success probability of communication. We show that the decentralized algorithm guarantees that robots will cover their targets in finite time. Numerical simulations and experiments using a team of mobile robots confirm the target coverage in finite time and show that mobility control for communication and learning-aware voluntary communication protocols reduce the number of communication attempts in comparison to a benchmark distributed algorithm that relies on communication after every decision epoch.

## **Keywords**

Game theory, autonomous systems, networked control systems, mobile robotics, numerical algorithms.

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## **Biographies**

**Sarper Aydın** received the B.Sc. degree in industrial engineering from Bilkent University, Ankara, Turkey in 2017. During this period, he spent one semester as an exchange student at Queensland University of Technology, Brisbane, QLD, Australia. From 2017 to 2019, he was with Lehigh University, Bethlehem, PA, USA as a Ph.D. student. He joined Texas A&M University, College Station, TX, USA in 2019. Currently, he is working toward the Ph.D. degree in the Department of Industrial and Systems Engineering, Texas A&M University. His current research interests include decentralized control of multi-agent systems and game theoretic learning with applications to assignment problems in autonomous robot teams.

**Ceyhun Eksin** received the B.S. degree in control engineering from Istanbul Technical University, Istanbul, Turkey, in 2005, the M.S. degree in industrial engineering from Bogazici University, Istanbul, Turkey in 2008, the M.A. degree in statistics from Wharton Statistics Department, University of Pennsylvania, Philadelphia, PA, USA in 2015, and the Ph.D. degree in electrical and systems engineering from the Department of Electrical & Systems Engineering, University of Pennsylvania, Philadelphia, PA, USA in 2015. He was a postdoctoral researcher jointly affiliated with Schools of Biological Sciences, and Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, GA, USA. He is currently an assistant professor in the Department of Industrial and Systems Engineering at Texas A&M University, College Station, TX, USA. His research interests are in the applications of game theory, control theory, and statistical signal processing to networked multi-robot systems. His current research focuses on game theoretic learning, decentralized optimization, autonomous teams, epidemics and energy systems.

