

Modeling cyber-physical human systems via an interplay between reinforcement learning and game theory

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Abstract

Predicting the outcomes of cyber-physical systems with multiple human interactions is a challenging problem. In this talk, I will present my group's recent results about this topic, created together with our international collaborators. Specifically, the talk will focus on a game theoretical approach, where reinforcement learning is employed to predict the time-extended interaction dynamics. The most attractive feature of the method is proposing a computationally feasible approach to simultaneously model multiple humans as decision makers, instead of determining the decision dynamics of the intelligent agent of interest and forcing the others to obey certain kinematic and dynamic constraints imposed by the environment. I will talk about two recent implementations of the method to model (1) a mixed airspace consisting of unmanned and manned aircraft, and (2) highway traffic. I will also touch upon ongoing work on improving and validating the method, together with open problems and research opportunities.

Biography



Yildiray Yildiz is an assistant professor and the director of the Systems Laboratory at Bilkent University, Ankara, Turkey. He received the Ph.D. degree in mechanical engineering with a mathematics minor from Massachusetts Institute of Technology, in 2009. He held postdoctoral associate and associate scientist positions with NASA Ames Research Center, from 2009 to 2010, and from 2010 to 2014, respectively. He is the recipient of the ASME Best Student Paper in Conference award (2008), two NASA Group Achievement Awards (2012, 2016), the Turkish Science Academy's Young Scientist Award (2017), the Science Academy, Turkey's Young Scientist Award (2017), Parlar Foundation's Research Incentive Award (2018), and IEEE Control Systems Society (CSS) outstanding service award (2021). He has been an associate editor for IEEE Control Systems Magazine since 2016, European Journal of Control since 2019, and IEEE Transactions on Control Systems Technology since 2020. He was a member of IEEE CSS Board of Governors for the 2020 term. His research interests are the theory and application of system dynamics and control. He is especially interested in cyber physical human systems, adaptive control, reinforcement learning and game theory, and applications in the aerospace and automotive domains.