

May 9, 2025 – Lorenzo Zino, Polytechnic University of Turin

Title: An adaptive-gain controller to solve the equilibrium selection problem

Abstract: We deal with the equilibrium selection problem, which arises whenever a controller wants to steer a population of individuals engaged in strategic interactions to a desired collective behavior. A powerful mathematical method to describe a population engaged in strategic interactions is by means of evolutionary game theory. The replicator equation has emerged as an elective tool to study the evolution of the collective behavior of the population. Hence, the equilibrium selection problem can be studied as a control problem for the replicator equation, which is ultimately a nonlinear ordinary differential equation. In the literature, this problem has been often tackled using open-loop strategies, by designing the game in such a way that the desired equilibrium becomes globally attractive. However, the applicability of open-loop strategies is limited by the need of accurate a priori information on the game and by their scarce inherent robustness to uncertainty and noise. To overcome these limitations, we propose a closed-loop strategy in which we encapsulate an adaptive-gain control scheme within the replicator equation. For most classes of games, we establish sufficient conditions to design a controller that guarantees convergence of the replicator equation to the desired equilibrium, requiring limited a-priori information on the game.

Bio: Lorenzo Zino is an Assistant Professor with the Department of Electronics and Telecommunications, Politecnico di Torino, Italy, since 2022. He received the BS (2012), MS (summa cum laude, 2014), and PhD (with honors, 2018) in Applied Mathematics from Politecnico di Torino. He held Research Fellowships at Politecnico di Torino (Italy), University of Groningen (The Netherlands), and New York University (US), and visiting positions at Lund University (Sweden) and Curtin University (Australia). His research interests include modeling, analysis, and control of dynamics over networks, applied probability, and game theory. He has co-authored more than 70 international scientific publications, including 50 journal papers. He is Senior Member of the IEEE and, in 2024, he was the recipient of the Best Young Author Journal Paper Award from the IEEE CSS Italy Chapter. He is member of the Editorial Board of Scientific Reports, Associate Editor of the Journal of Computational Science, and member of the CEB for IEEE CSS and EUCA.