

Title: A game theoretic approach towards integration of learning, decision-making and control for autonomous agents

Abstract: While the overlapping among learning, optimization and control has been well recognized even in the early days of modern control theory, never before have we seen such booming research activities aiming to bring the three together in the focused area of autonomous multi-agent systems. Case studies flourish in applications of autonomous sensors and robots, smart energy grids, intelligent traffic networks, and cognitive manufacturing systems. A central challenge, however, stands out as researchers try to balance conflicting performance requirements that are rooted in self-interested agent autonomy. We show game theory, in particular evolutionary game theory, when combined with control theory, can provide a rigorous theoretical framework to quantify performance tradeoffs and lead to powerful control algorithms. We take each agent as a decision-maker that interacts with her peers and the stochastic environment; she learns over time using game-play feedbacks; and the optimal team performance emerges as long-run strategies stabilize among agents. This new game theoretic approach not only realizes the integration of learning, optimization and control, but also points to a promising new direction to the design, implementation and improvement of social autonomous systems.



Biography: Ming Cao has since 2016 been a professor of networks and robotics with the Engineering and Technology Institute (ENTEG) at the University of Groningen, the Netherlands, where he started as an assistant professor in 2008. He received the Bachelor degree in 1999 and the Master degree in 2002 from Tsinghua University, China, and the Ph.D. degree in 2007 from Yale University, USA. From 2007 to 2008, he was a Research Associate at Princeton University, USA. He worked as a research intern in 2006 at the IBM T. J. Watson Research Center, USA. He is the 2017 and inaugural recipient of the Manfred Thoma medal from the International Federation of Automatic Control (IFAC) and the 2016 recipient of the European Control Award sponsored by the European Control Association (EUCA). He is an IEEE fellow (class 2022). He is a Senior Editor for Systems and Control Letters, an Associate Editor for IEEE Transactions on Automatic Control, IEEE Transaction of Control of Network Systems and IEEE Robotics & Automation Magazine, and was an associate editor for IEEE Transactions on Circuits and Systems and IEEE Circuits and Systems Magazine. He is a member of the IFAC Conference Board and a vice chair of the IFAC Technical Committee on Large-Scale Complex Systems. His research interests include autonomous robots and multi-agent systems, complex networks and decision-making processes.