上海交通大学自动化系
Department of Automation
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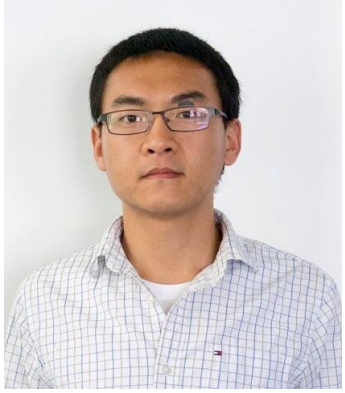
系统控制与信息处理教育部重点实验室
Key Laboratory of System Control and Information Processing, Ministry of Education

学术报告会

时间：6月29日(周五) 10:00-11:00

地点：电院群楼2-406会议室



Markov Chains with Maximum Return Time Entropy for Robotic Surveillance

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Abstract:

Motivated by robotic surveillance applications, we study the novel problem of maximizing the return time entropy of a Markov chain, subject to a graph topology with travel times and stationary distribution. The return time entropy is the weighted average, over all graph nodes, of the entropy of the first return times of the Markov chain; this objective function is a function series that does not admit in general a closed form.

The talk features theoretical and computational contributions. First, we obtain a discrete-time delayed linear system for the return time probability distribution and establish its convergence properties. We show that the objective function is continuous over a compact set and therefore admits a global maximum; a unique globally-optimal solution is known only for complete graphs with unitary travel times. We then establish upper and lower bounds between the return time entropy and the well-known entropy rate of the Markov chain. To compute the optimal Markov chain numerically, we establish the asymptotic equality between entropy, conditional entropy and truncated entropy, and propose an iteration to compute the gradient of the truncated entropy. Finally, we apply these results to the robotic surveillance problem. Our numerical results show that, for a model of rational intruder over prototypical graph topologies and test cases, the maximum return time entropy chain performs better than several existing Markov chains.

Biography:

Xiaoming Duan obtained his B.E. degree in Automation from the Beijing Institute of Technology, Beijing, China, in 2013, and his Master's Degree in Control Science and Engineering from Zhejiang University, Hangzhou, China, in 2016. He is currently working toward the PhD degree in the Department of Mechanical Engineering at the University of California, Santa Barbara. His research interests include distributed control and the design of stochastic surveillance strategies for robotic networks. He is a peer reviewer for Automatica, IEEE TCNS, IJNRC, etc. He has published papers on IEEE TAC, Automatica, IEEE TIE, etc.