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THE CHINESE UNIVERSITY OF HONG KONG

Department of Information Engineering

Seminar

Age-of-Information Optimization in Heterogeneous Multi-Channel Systems: A Partial-Index Approach

By

Prof. LIN Xiaojun
School of Electrical and Computer Engineering
Purdue University

Date : 25 February 2022 (Friday)
Time : 11:30am – 12:30pm
Zoom : https://cuhk.zoom.us/j/98263642295?pwd=Z1JtYUhEa1dUNzhGTFZtcjM3R1VNUT09

(Meeting ID: 982 6364 2295; Passcode: 736663)

Abstract

Many network control problems can be cast as a Markov Decision Process (MDP). However, as the network size increases, MDP is known to suffer from the curse-of-dimensionality. Although reinforcement learning methods can be used to learn the optimal control policies, since they often do not exploit model-based insights from the problem structure, they often take a long time to train, lead to control rules that are difficult to interpret, and are slow to adapt to changes. Thus, it remains an open question how to develop scalable, efficient, and interpretable solutions for such problems.

In this work, we study one example of such a problem, i.e., to schedule data sources in a wireless system with multiple heterogeneous and unreliable channels to minimize the total expected Age-of-Information (AoI). Although one could formulate this problem as a discrete-time MDP, it would suffer from the drawbacks described earlier. Our main contribution is to develop a new approach called partial index, which significantly generalizes the classical Whittle's index to systems with multiple heterogeneous resources. The partial index captures how much an agent/source values the service at each channel, and can be computed independently of other agents given all channels' current costs. As a result, it allows us to decompose the original large-scale MDP into per-agent MDPs with much lower complexity. This notion of partial index could be useful for many other problems where agents interact through sharing multiple resources. We conclude the talk with some discussions on future directions to integrate partial index with reinforcement learning, as well as the open problems.

Biography

Xiaojun Lin received his B.S. from Zhongshan University, Guangzhou, China, in 1994, and his M.S. and Ph.D. degrees from Purdue University, West Lafayette, Indiana, in 2000 and 2005, respectively. He is currently a Professor of Electrical and Computer Engineering at Purdue University. Prof. Lin's research interests are in the analysis, control and optimization of large and complex networked systems, including both communication networks and cyber-physical systems. He received 2005 best paper of the year award from Journal of Communications and Networks, IEEE INFOCOM 2008 best paper award, and ACM MobiHoc 2021 best paper award. He received the NSF CAREER award in 2007. He has served as an Associate Editor for IEEE/ACM Transactions on Networking, as an Area Editor for (Elsevier) Computer Networks journal, and as a Guest Editor for (Elsevier) Ad Hoc Networks journal. Dr. Lin is a Fellow of IEEE.

**** ALL ARE WELCOME ****

Host: Prof. Calvin C.K CHAN (Tel: 3943-8354, Email: ckchan@ie.cuhk.edu.hk)
Enquiries: Department of Information Engineering, CUHK (Tel.: 3943-8385)