



THE CHINESE UNIVERSITY OF HONG KONG

Department of Information Engineering

Seminar

Asymmetric distributed source coding for sensor networks

by

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Abstract

We are concerned with addressing the worst-case distributed source coding (DSC) problem in asymmetric and interactive communication scenarios and its application to data-gathering wireless sensor networks in enhancing their lifetime.

First, we propose a unified canonical framework to address the variants of DSC problem, obtained by considering different communication constraints and objectives. Second, as for the worst-case information-theoretic analysis, the notion of information entropy cannot be used, we propose "information ambiguity", derive its various properties, and prove that it is a valid information measure. Third, for a few variants of our interest of DSC problem, we provide the communication protocols and prove their optimality.

In a typical data-gathering sensor network, the base-station that wants to gather sensor data is often assumed to be much more resourceful with respect to energy, computation, and communication capabilities compared to sensor nodes. Therefore, we argue that in such networks, the base-station should bear the most of the burden of communication and computation in the network. Our definition of sensor network lifetime allows us to reduce the worst-case network lifetime maximization problem to the problem of minimizing the worst-case number of bits communicated by the nodes, which is further reduced to the worst-case DSC problem in asymmetric and interactive communication scenarios, with the assumption that the base-station knows the support-set of sensor data. We demonstrate that the optimal solutions of the energy-oblivious DSC problem variants cannot be directly applied to the sensor networks, as those may be inefficient in the energy-constrained sensor networks. We address a few energy-efficient variants of DSC problem and provide optimal communication protocols for the sensor networks, based on those variants. Finally, we combine distributed source coding with two other system level opportunities of channel coding and cooperative nature of the nodes to further enhance the lifetime of the sensor networks. We address various scenarios and demonstrate the dependence of the computational complexity of the network lifetime maximization problem on the complex interplay of above system-level opportunities.

Biography

Samar holds B.Sc. and M.Sc. in Physics from University of Delhi and IIT-Kanpur, M.Sc.Engg. in Electrical Sciences from IISc-Bangalore. He is currently a PhD candidate nearing completion at IISc in Electrical Sciences. His current research interests include distributed source coding, information measures, generalized information theory, and interactive models of communication and computation. He also occasionally dabbles in chaos theory, genetics, game theory, and social psychology.

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