DECODER-LEARNING BASED DISTRIBUTED SOURCE CODING FOR HIGH-EFFICIENCY, LOW-COST AND SECURE MULTIMEDIA COMMUNICATIONS

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ABSTRACT

Conventional multimedia compression leverages the source statistics at the encoder side. This is not suitable for some emerging applications such as wireless sensor networks, where the encoders usually have limited functionalities and power supplies, therefore it is desired to shift the bulk of computational burden to the decoder side. The resulting new coding paradigm is called distributed source coding (DSC). Most practical DSC schemes only achieve good results when *a priori* knowledge about the source statistics is assumed. For DSC of real-world sources such as images and videos, such knowledge is not really available. In this dissertation, we focus on designing decoder-side learning schemes for better understanding of the source statistics, based on which practical DSC systems can be built for high-efficiency, low-cost, and secure multimedia communications.

We have studied distributed video coding and compression of encrypted images and videos. We propose to enable partial access to the current source through progressive decoding, such that the decoder's knowledge about the source statistics can be progressively refined. The resulting schemes have achieved significant improvement in coding efficiency. We also studied the rate allocation problem to optimize the power consumption in transmitting multiple correlated sources over a wireless sensor network. The framework developed in this dissertation will provide significant insights and become important building blocks in distributed video applications, including those that are of significant importance to the national security, agriculture, economy, and healthcare.