Special issue on distributed video coding

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Video coding technologies have evolved tremendously over past decades in line with the rapidly increasing demand over vastly expanding application domains. The research on video coding has been traditionally dominated by the work on MPEG and ITU-T H.26x standardisations based systems. It is widely known that the video encoders are far more complex than their compatible decoders. This architecture is motivated by many of the conventional one-to-many type video applications including broadcasting (DVB), video streaming etc, where the decoder cost need to be maintained considerably low for the benefit of large number of viewers compared to the limited number of content providers. However, more recently, this architecture has been challenged by new consumer applications where the cost of the encoder is also a prime concern due to the necessity of vast deployments of video sensors. Security surveillance systems, mobile video conferencing, monitoring of the disabled people and children, and disaster zone monitoring are a few potential scenarios, which are largely benefited by massive encoder deployments.

Distributed Video Coding (DVC) is an emerging video coding technology designed with a modified complexity balance between the encoder and decoder in line with the necessities of these applications. The dramatically low complexity of the DVC encoder helps to: (i) reduce the production cost of the signal processors of the video sensors, (ii) reduce the requirement of digital memory and (iii) reduce the power consumption which is generally a scarce resource at remote sites. In DVC, the shift of complexity balance is achieved by moving the major source correlation exploitation tasks that achieve the compression into the decoder. DVC defines two picture types: key frames and Wyner-Ziv frames. A sequence of 'selected' original frames is generally passed to the decoder using an intra frame coding scheme and are called as key-frames. The frequency of key-frame transmission could vary on the DVC implementation strategy as determined by the Group of Picture (GOP) size. In Wyner-Ziv frames coding, the decoder generates an estimation of the frame which is defined as side information for the Wyner-Ziv frame. Different techniques have been proposed for the side information estimation ranging from simple frame interpolation/

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extrapolation to more complex and accurate motion estimation and compensation techniques. The estimated side information is modelled with the original Wyner-Ziv frame and an additive white noise (AWN) term. The quantification of the statistical distribution properties of this hypothetical noise is a part of the ongoing research activity. The side information is used for decoding with the parity bit stream transmitted over the channel from the encoder. The encoder generates this parity bit stream by passing the original video sequence through a channel encoder. This parity bit sequence is generally subjected to puncturing. Parity puncturing and the quantisation are the primary mechanisms that achieve the video compression in DVC. Transform coding (e.g., DCT) has been proposed for improving the compression efficiency of DVC, even though the DCT algorithm somewhat compromises the extremely low complexity in the pixel domain DVC encoder structure.

DVC makes use of and operates within the theoretical framework and guidelines of distributed source coding set in the Slepian-Wolf theorem and the current DVC implementations are based on the Wyner-Ziv model. According to Wyner-Ziv model, the maximum compression efficiency is limited by the level of correlations between the side information (estimated) and the original Wyner-Ziv frame information and hence the main focus in DVC research is the design of accurate estimation algorithms.

DVC is currently identified as a premature technology, yet with immense potential for the future. The idea of this special issue is to push forward the concept of DVC into reality, possibly targeting future research and commercial deployments. The papers presented in this special issue are of considerable value in the sense that they collectively provide insight into various complex issues in distributed video coding, detail recent advances in certain aspects of the field, and highlight some of the current trends.

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