SIGNIFICANCE MAP EXPLOITATION FOR BIT RATE REDUCTION AND ERROR RESILIENCE IMPROVEMENT

By

Yang Hu

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Approved by the
Examining Committee:

William A. Pearlman, Thesis Adviser

John W. Woods, Member

Gary J. Saulnier, Member

Mukkai S. Krishnamoorthy, Member

Rensselaer Polytechnic Institute
Troy, New York

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ABSTRACT

Set partition coding (SPC) is a source coding technique mostly used for visual data compression. It is well known for the flexibility to achieve various modes of scalability and bitstream embeddedness for precise rate control, in addition to the competitive compression efficiency and low computational complexity. In SPC, the significance map takes an important role. It conveys the execution path of the encoder to the decoder and takes a high percentage of the coded bitstream. In this thesis, the significance map is exploited in order to meet the challenges that SPC methods encounter in three research areas of visual signal coding.

First, in centralized video coding, an auxiliary key frame coding structure, called motion differential SPC, is proposed. It re-uses the significance map and sign data of a previous SPC coded frame to predict the locations and signs of the significant coefficients in the correlated frame. In this way, the inter-frame dependencies are exploited. The decoding of any individual frame involves only the self-data of that frame and the re-used map and sign data and is separate from the decoding of any other frame. Such a coding structure has higher compression efficiency compared with the all intra-frame coding methods, while maintaining the beneficial features of all-intra-coding, such as computational simplicity, parallel processing, non-propagation of error to other frames, and random access to any individual frame.

Secondly, for image transmission in error-prone environments, the conventional SPC codestream is vulnerable, because the significance map is sensitive to channel errors. We propose a progressive expression on the location information of the significant coefficients. This so-called progressive significance map includes two parts: a variable-length-coded sub-map and a fixed-length-coded one. With an error-free variable-length sub-map, the fixed-length sub-map is robust to bit errors, in the sense that the decoding errors in the fixed-length sub-map only introduce local damages instead of propagating to the whole following codestream. Such a progressive significance map allows us to improve its error resilient property at the price of

slight sacrifice in compression efficiency and at the similar low level of computational complexity compared with the conventional one.

Third, we apply the SPC with progressive significance map to the distributed video coding scenario. Conventionally, only the value data of SPC can be Slepian-Wolf coded, because of two difficulties on Slepian-Wolf coding of significance map. On the one hand, it is hard to generate an effective side information significance map at the decoder, which should be of the same length as the original map and simultaneously should be bit-wise correlated with the original one. On the other hand, conventional significance map is error sensitive, but decoding errors are unavoidable for Slepian-Wolf decoder even though the error rate could be very low. The progressive significance map enables part of the map (the fixed-length-coded sub-map) to be Slepian-Wolf coded. The fixed-length feature facilitates side information generation and the error resilient feature prevents error propagation. With more data Slepian-Wolf coded, the proposed system provides improved coding efficiency.