EE398: Project Proposal
Distributed Compression of Light fields using a Wavelet Transform Coder

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Distributed source coding is a paradigm where the complexity of the system lies in the decoder while keeping the encoders very simple in contrast to traditional approaches. Distributed image and video coding is well suited for applications such as wireless sensor networks and disposable digital cameras. The theoretical foundations of distributed source coding lie in the Slepian-Wolf theorem [1] for lossless source coding with side information available at the decoder alone. The corresponding lossy compression scheme is based on the Wyner-Ziv theorem [1], which can be thought of as a quantizer followed by a Slepian-Wolf coder [1].

Recently, practical schemes have been proposed in order to implement distribute image and video compression [2, 4, 5]. In particular, [2] investigates distributed compression of light fields using large camera arrays. In that work, half the camera views are encoded conventionally using JPEG2000 [6] and are transmitted as side information (Key frames) while the rest of the views are encoded as Wyner-Ziv frames. Pixel domain encoding is used and the benefits over encoding all the views conventionally have been investigated. In [4], the same framework is used for random access for rendering from the light field data set, replacing the pixel domain encoder with a 4x4 DCT. In contrast, [3] approaches the problem in a more ad hoc fashion using correspondence analysis and super-resolution techniques instead of Wyner-Ziv coding.

In this project, we propose to extend the work presented in [2, 4]. The first step in this work is to bring together the blocks shown in Fig. 1. Our first contribution would be the replacement of the DCT with a wavelet transform [5]. The performance of the blind inclusion of the wavelet coder would be analyzed and compared with the DCT and pixel domain methods.

To further improve the performance, a statistical analysis of the different wavelet transform coefficients would be done. We expect the low frequency components between the different views of the light field data set to be highly correlated and hence can be encoded as Wyner-Ziv frames. The large frequencies however are not expected to exhibit much correlation and hence may be encoded conventionally. The performance improvements of this hybrid coding scheme will be investigated.

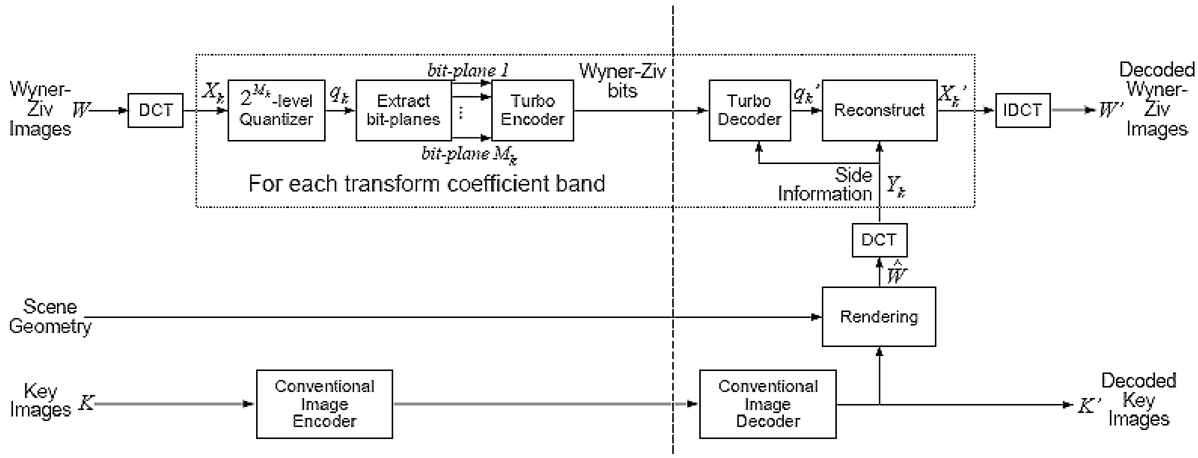

Figure 1: Distributed compression of image - Figure obtained from [4]

Finally, time permitting, the use of a scalable conventional encoder, such as JPEG2000 [6] will be investigated which allows us to trade-off the rate of the conventional encoders and the quality of the side information. Once this trade-off is quantified, we can tradeoff the rates of the key frames and the conventional frames to achieve the best possible reconstruction quality (in terms of distortion), given a total rate constraint at the encoder.

References

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