

EE 398 Project Proposal: Hash Codes for Motion Estimation of Video

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I. INTRODUCTION

Block-based motion-compensation is ubiquitous in modern video coding standards, leading to substantial rate-distortion improvement over simpler methods such as frame differences or conditional replenishment. This method, however, increases the complexity of the encoder, which might not be desirable in some applications, such as distributed video coding [1]. Therefore, to move the complexity of motion estimation to the decoder, the method of estimating the motion remotely should be investigated, which motivates this project.

For the remote motion estimation, the encoder should send a compact version of current frame with low but sufficient rate, to enable the decoder to have enough information on the image to estimate the motion together with the previously decoded frame. The 'Hash code', $T = t(X)$, where X is a block in the original frame, can be a candidate of the compact version of the image [2]. Clearly, the distortion regarding the estimating motion occurs due to the low rate. Hence, the smart design of hash code together with appropriate metric to find the motion-compensated block in the previous frame, is essential in getting a better rate-distortion trade-off curve. Also, a lossless coding scheme for hash code needs to be developed or selected among the existing schemes to effectively minimize the rate.

II. SCOPE OF THE PROJECT

The objective of this project is to design hash codes together with motion estimators and lossless coding methods for them. The performance of the various schemes will be compared by their rate-distortion performance.

A. Designing Hash Code and Motion Estimator

The hash code should provide a good helper information to the decoder so that the decoder can generate a motion compensated side information close enough to the current frame. To achieve this, the hash code should catch the unique information of the block that reflects the difference in different blocks, which means the close blocks should be mapped to hash codes which are also close. The hash code can be obtained from various transform coefficients such as those of DCT and Wavelet Transform. In [2], the low frequency components were used, but the other frequency components or properly weighted components can be also useful, possibly resulting in more accurate motion estimation. Instead of finding signature of an image block in the spatial

frequency domain, it can be done also in other domains such as spatial domain itself.

The motion estimation is essentially to find the optimally matched block in the previous frame given the hash code of the current block. To define the optimality we need to come up with a smart compare function and a metric to measure the closeness of the blocks. The estimation can be done both in the original spatial domain or in the hash code domain and the metrics can be l_1 and l_2 matrix norm of the subtraction of the blocks. Also, the cross-correlation of the blocks can be also useful.

B. Designing lossless coding method

Currently, the widely known lossless coding schemes such as Arithmetic Coding and run-length/Golomb coding are in consideration. If time is allowed, more lossless compression schemes will be studied or even a new scheme can be suggested.

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