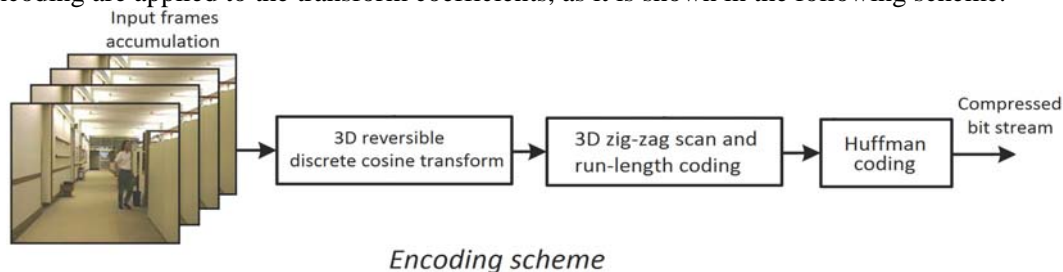


MSc Thesis Project

Lossless video coding based on 3D reversible discrete cosine transformation

Introduction: Lossless video coding is widely used in several applications such as movie production, medical diagnosis, screen compression, fine art archives and in many other areas where any loss is not acceptable. There are several approaches for lossless compression of a video data. Some are based on frame-by-frame lossless coding, where spatial similarity between neighbor pixels are exploited. For example, JPEG-LS uses four neighbour pixels to predict a value of the current pixel and then compresses the prediction error, while JPEG2000 decorrelates the input frame via reversible spatial 5/3 lifting wavelet transformation. To achieve a higher compression ratio, a temporal similarity between neighbour frames should be exploited too. For example, the Lagarith codec uses spatial prediction similar to JPEG-LS, but if the previous frame is mathematically identical to the current one, the current frame is discarded and the decoder will simply use the previous frame again [1]. H.264/AVC applies intra-prediction or inter prediction for each block. In case of intra-prediction the last row of pixels from the top neighbour block and the last column of pixels from the left neighbour block are used to calculate the prediction error. In case of inter-prediction, a similar block in previous frame(s) is searched for via motion estimation.

Contents: It is well known that conventional discrete cosine transform (DCT) is not reversible and cannot be used for lossless coding. However, in [2] it was proposed to use a reversible transformation, which is very close to DCT. Replacement of DCT by reversible DCT makes well known JPEG lossless. In this thesis work, it is proposed to extend this idea and apply three-dimensional (3D) reversible DCT for group of frames. In this approach a group of frames is divided into a non-overlapped cubes, say 8x8x8 in size. Then 3D reversible DCT is applied for each cube so that spatio-temporal similarities within each cube are taken into account. It could be more efficient than temporal decorrelation using one previous frame as in H.264/AVC. Then 3D zig-zag scan and entropy encoding are applied to the transform coefficients, as it is shown in the following scheme.



The goal of the thesis is to develop and optimize the algorithm as well as performing comparison with existing lossless video compression algorithms.

Prerequisites:

One of the courses 34240, 34241, or 34250 or knowledge and experience in Image or Video Processing.

Additional information and references:

[1] Lagarith codec, <https://lags.leetcode.net/codec.html>

[2] Ying Chen and Pengwei Hao, Integer reversible transformation to make JPEG lossless, 2004 7th International Conference on Signal Processing, 2004.

Practical details:

The project is intended for 1 or 2 students with 30 ECTS-points per student.

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