# High quality image reconstuctions by wavelets

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University of Joensuu, Department of Mathematics, P.O. Box 111, 80101 Joensuu, Finland, e-mail: kauranne@csc.fi. Main purpose of this ECMI-project was to generate powerful wavelet compression sheme for digital images.

Compression program was designed for the purposes of Data - TV, which is using TV-signal for data transmission. Data - TV is using JPEG for compression and main idea for this project was to generate wavelet based compression scheme for high quality image reconstruction such that we are able to measure much more powerful compression rations than by JPEG.

Following properties are required.

- Firstly we are required to reconstruct images by very high quality because after transmission reconstructed images are published in magazines.
- We are required to minimize Compression Ratio(CR) because the transmission speed for total data to be transmit is very limited.
- Thirth requirement is to generate fast reconstruction.

In order to define compression scheme for high quality image reconstruction applications, JPEG will produce bad compression rations because of the global effect of the Discrete Cosine Transform.

In this work Average Interpolation Wavelet transformations are used in order to define wavelet coefficients at different resolutions and to generate fast implementation.

By losy compression scheme we will produce some dissortion of an original image by reconstruction. In order to define high quality reconstruction we are interested to minimize the reconstruction error, but also to define minimal compression ratio *i.e.* to use minimal number of bits in order to define reconstruction.

If we consider the case that the images are transmitted via some channel by limited transmission speed. Problem is that in which form the information of the images should be transmitted such, that compression ratio CR (average number of bits per pixel) is small enough, but also reconstruction quality is fulfilling our quality requairements.

By wavelet transforms we are analysing images at the different resolutions and we are able to control more accurately about what information and in which resolutions is more important to our purposes. Some of the information is considered non-relevant and it will be not transmitted. Only relevant information about the images will be transmitted. Control for relevant and non-relevant information can be made more accurately by wavelet methods, than for example by JPEG. Therefore we can produce very powerful compression ratio by wavelet methods, compared to JPEG, which is analysing images in global sense.

# 0.1 Encoding scheme

Intress is also in encoding scheme of the wavelet coefficients. We will define encoding method based on correlations of the locations of detail coefficients and also to the estimation of coarse scale coefficients by the basis of detail coefficients.

We will represent powerful compression method by wavelets, which produces high quality reconstructions. Average-interpolating wavelets and multiresolution analyses are used. Encoding scheme will be defined by using nature of wavelet transforms. Correlations of locations of the detail coefficients is used in order to define powerful encoding scheme for detail coefficients. Estimation of coarse scale wavelet coefficients will be done by the bases of detail coefficients.

### 0.2 Data-TV

Data-TV is a part of Yleisradio, which is main broadcasting company in Finland. Data-TV uses TV-signal for transmission of images. Images to be transmitted are 24-bit color images and they are transmitted for the purposes of magazines and newspapers. Therefore quality for reconstructed images is required to be very high.

On the other hand, because Data-TV has limited transmission speed, compression ratio is requaired to be small.

### 0.3 Main results

Results of reconstruction qualities and compression rations are compared to reconstructions of JPEG-compression by using different quality levels.

Main results are that by this wavelet compression program we are able to produce even 40% smaller binary files needed in order to generate transmission and reconstruction of the original image by same quality as for corresponding JPEG-reconstructions.