Course INF5081
Vårsemester 2008

Oblig 1

(To be completed by May, 15th, 2008)

For the compulsory project 1 (Oblig 1) please develop a small application that implements the following functionality:

1. Read image data from a file, coded in PGM format. PGM (which stands for Portable Gray Map) is a part of PPM (Portable Pix Map). PPM is explained in http://en.wikipedia.org/wiki/Portable_pixmap. Libraries to read and write PPM files in are available, e.g., http://netpbm.sourceforge.net/doc/pgm.html
2. Transform the image with these three transforms:
   - Haar wavelet transform
   - Lazy wavelet transform (is explained below)
   - DCT transform
3. Write the result to output files in PGM format
4. Implement also the inverse transforms, and test these for the transformed images.

The implementation can be done in a programming language of your choice, using a programming environment and operating system of your choice. You will find images available in the **Oblig1** area in the course pages. Please transform these with your program.

The teaching assistant for the course is Svetlana Boudko. She will be available for questions at her email address Svetlana.Boudko@nr.no. Please send your final solution (program, including some documentation) to her before the 15th of May, 2008. Please put the resulting images on your Ifi-homepage, and send the URLs for these to Svetlana, too.

The Lazy Wavelet transform

The Lazy wavelet forward and inverse transforms are defined below.

Forward transform:

High band filter: $Y_{(2i+1)} = X_{(2i+1)} - [\frac{(X_{(2i)} + X_{(2i+2)})}{2}]_{lb}$

Low band filter: $Y_{(2i)} = X_{(2i)} + [\frac{(Y_{(2i-1)} + Y_{(2i+1)} + 2)}{4}]_{lb}$

Inverse transform:

Even sample values: $X_{(2i)} = Y_{(2i)} - [\frac{(Y_{(2i-1)} + Y_{(2i+1)} + 2)}{4}]_{lb}$

Odd sample values: $X_{(2i+1)} = Y_{(2i+1)} + [\frac{(X_{(2i)} + X_{(2i+2)})}{2}]_{lb}$

In the formulas above the $X_{(i)}$ denote the sample values of the input stream and the $Y_{(i)}$ denote the coefficients of the output stream. The expression $[\,]_{lb}$ denotes the low bound. Sample values and coefficients are numbered starting with the index 0. Use the $Y_{(2i)}$ (i.e., with even index) for the lowpass subband, and the $Y_{(2i+1)}$ (i.e., with odd index) for the highpass subband.

For the forward transform the odd coefficients (highpass subband) are computed first from the sample values and then the even coefficients are computed from the even sample values and the odd coefficients of the output signal.

For the inverse transform the even sample values are computed first from the even coefficients and then the odd sample values are computed from the odd coefficients and the even sample values.

Note, that the transform should be done both horizontally and vertically. Don't forget mirroring of coefficients at the edges of the image:
$X_{(2)} X_{(1)} X_{(0)} X_{(1)} X_{(2)} X_{(3)} \ldots X_{(n-2)} X_{(n-1)} X_{(n)} X_{(n-1)} X_{(n-2)}$.

For your reference see also:

http://www.jpeg.org/public/fcd15444-1.pdf, pages 118 and 126.

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