ECE 285, Spring 2019
Image and Video Compression

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LAB 3: Simple JPEG

We learned about JPEG and one 8x8 block coding in detail at class. For practical usage, we need one more step. That is, we need to write a coded bitstream into a JPEG file format (.jpg) with another detail coding information, especially the Huffman table and quantization scale factor. We can call the all of related operations as parsing. You can find a good tutorial from the reference 2.

In this lab, we will implement JPEG codec **without the parser**, which is named as the simple JPEG. The simple JPEG encoder evaluates its coding performance with the decoding path, which is colored as gray in the below block. It consists of iq, idct and level-shift up. The encoder doesn't need to decode the coded bitstream to evaluate coding performance since the entropy coding is lossless. The coding performance is evaluated from $PSNR = 10\log_{10}\frac{255^2}{D}$, where average distortion $D = \frac{1}{N}\sum_{i=0}^{N-1}((x_i - \hat{x}_i)^2)$ and N is the number of the luma samples within an image. Thus, $PSNR$ is usually calculated to the luma samples, denoted as $Y - PSNR$. All the tables and figures are described in the reference 1. Use the following table information to complete this lab. For each quality factor, you need to calculate $Y - PSNR$ and its coded bits after entropy coding. Finally, you need to draw the rate-distortion curve as described in the predictive coding lecture. The ForemanCIF_Y.mat files has 352×288 luma pixels, and you can use modhuffman_tables.m for Table K.3 and Table K.5.

Quality factor	75, 50, 25, 12.5
8x8 quantization matrix for luma	Table K.1
zig-zag scan	Figure A.6
FDCT	matlab dct2
IDCT	matlab idct2
Huffman table for luminance DC coefficient differences	Table K.3
Huffman table for luminance AC coefficient	Table K.5

Programming language: Matlab

References

1. JPEG standard: ITU Recommendation T.81 `https://www.w3.org/Graphics/JPEG/itu-t81.pdf`

2. JPEG Huffman Coding Tutorial `http://www.impulseadventure.com/photo/jpeg-huffman-coding.html`

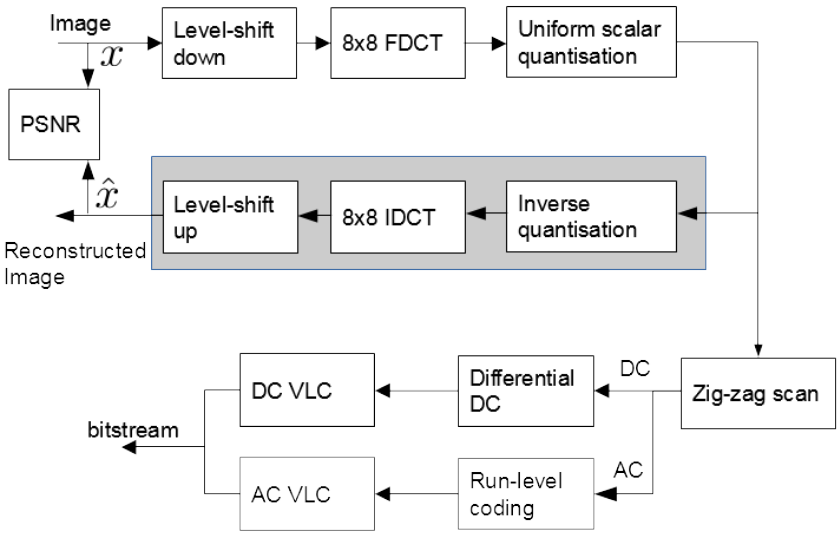
Image
x
Level-shift down
8x8 FDCT
Uniform scalar quantisation
PSNR
$\hat{x}$
Level-shift up
8x8 IDCT
Inverse quantisation
Reconstructed Image
DC VLC
Differential DC
DC
Zig-zag scan
bitstream
AC VLC
Run-level coding
AC