RRY025-- Image Processing

Exercises 9 – Lecture 11 – Compression III

EX 1. Threshold and zonal masks.

Perform DCT threshold masking and zonal masking on the cameraman image. Use the entire image (i.e., not block coding). For threshold masking, use as a threshold a value that nullifies ~80% of the dct coefficients. For zonal masking, use a mask that nullifies ~80% of the coefficients with highest frequencies.

The image reconstructed after zonal coding should have familiar artifacts. Can you identify the reason for why these artifacts are present?

ANSWER: Example given as a .mlx file. The wave artifacts after the Zonal masking originate from the abrupt edges of the Zonal filter. This is similar to what we saw in Fourier filtering, when ideal filters (e.g., tophat) were applied on images. It results from the fact that a Fourier transform of a tophat function is a sinc function (which is "wavy").

EX 2. JPG compression quality

Determine empirically (subjectively) how aggressive a JPEG quantizer can be so that an image is still visually "good enough". You can use the cameraman, or any other picture.

One possible roadmap:

Write a simplistic jpg encoder that consists of a mapper and quantizer (no symbol encoder in the end). Encode the image. Then decode it and compare the result visually with the original image. By setting different values for the quality parameter q, you will get different quality results (as in the lecture notes).

Once you have determined the lowest "good enough" compression, determine the entropy in bits / pixel (and hence the limit for lossless compression) for the cosine-transformed block data.

You can also look at the rms error as a function of the quality parameter to decide what is "good enough".

More detailed hints:

Remember first the 2*k*-1 scaling. The mapper should split the image in 8 x 8 pixel blocks. There are many ways to do this. One easy way is to use the 'cell' variable type in Matlab and the functions to manipulate subarrays as cells. Helpful functions: mat2tiles() (downloadable wrapper for mat2cell() function) and cell2mat().

Do a discrete cosine transform of the blocks individually. The quantizer should then apply the standard jpg quantizer on the blocks. Remember the rounding operation.

For the entropy... The answer is around 1-2 bits per pixel for the cameraman picture.

ANSWER: @@@.