CS6351 November 4, 2021
Youssef

Homework 4
Due Date: December 2, 2021

In this assignment, you will investigate the effect of the block size on the dct-based compression, in a somewhat simplified way. Turn in your code (program) as an appendix in your homework.

Consider an $N \times M$ image G, to be processed block-wise where every block is $n \times n$, where different values of n will be tried: $n = 2, 4, 8, 16, 32, 64$.

1. Modify your code of the last problem of homework 3 to do the following:
    a. Apply dct2 on $n \times n$ blocks of G; (hint: change[8,8] to [n,n] in blockproc)
    b. Quantize all the DC terms of all the blocks as one data set, using a uniform 8-level quantizer in the range from $\lfloor \min(DC\ terms) \rfloor$ to $\lceil \max(DC\ term) + 10^{-6} \rceil$;
    c. Order the AC terms within each block in a counter-diagonal zigzag form;
    d. Among all the AC terms across all the blocks, let L=$\lfloor \min(AC\ terms) \rfloor$, and let H=$\lceil \max(AC\ term) + 10^{-6} \rceil$;
    e. Within each block, quantize the first floor($\frac{n^2-1}{10}$) AC terms with a 4-level uniform quantizer of the range [L, H), then quantize the next floor($\frac{n^2-1}{10}$) AC terms with a 2-level uniform quantizer of the range [L, H), and zero out all the remaining AC terms;
    f. Reconstruct the image by dequantizing the quantized values, and then applying block-wise idct2
    g. Compute the compression ratio and the SNR.
2. For each $n = 2, 4, 8, 16, 32, 64$, apply your code of part (1) on the grayscale version of the SkyAndBird image you used in Homework 3, recording the SNR. You obtain 6 SNR's, 6 compression ratios, and 6 reconstructed images.
3. Display the original image and the 6 reconstructed images, with clear caption.
4. Graph the SNR's as a function of n. Which block size gives the best SNR?
5. Repeat your work with one difference: Apply DPCM row-wise on the DC terms before you quantize them. That is, you compute the DC residuals and then quantize those residuals, where a DC residual is the difference between a DC term and the DC term of the previous block in the same row of blocks. The residual of the first DC term in every row of blocks is that same DC term. The range of the uniform quantizer for the DC residuals is $\lfloor \min(DC\ residuals) \rfloor$ to $\lceil \max(DC\ residuals) + 10^{-6} \rceil$.