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Final Project Abstract/Proposal

I propose to a partial recreation of the results detailed in “Inverse polynomial reconstruction method in DCT domain”. The paper derives a method to denoise piecewise functions with an efficacy directly related to the number of DCT coefficients used from the series expansion. I propose a recreation of Figure 2(a-b) and Figure 4(a-b) from the paper showing example functions and the corresponding DCT coefficients (up to the number of elements of the constituent function). I will then recreate the 1D inverse polynomial reconstruction method (IPRM) that the paper derives. Applying the IPRM to signals $f_1(x)$ and $f_2(x)$ from Figure 2 and Figure 4, respectively, I will recreate Figure 3(a-b) and Figure 5(a-b).

In Section 4.2, the paper describes the computational inefficiency of applying “IPRM on images in a slice-by-slice manner”, as proposed in the referenced Jung article, below. I will forego the approximation procedure described, initially. Instead, I will start with testing the IPRM on built in MatLab functions after preforming a sorting operation according to pixel values. To maintain the original image information, I will create a data structure that contains the original index of the image and the corresponding pixel value, in greyscale. This data structure will convert the original image into a string of values and a string of indices. I also assume that the number of columns or rows will be stored. I will use the following built in MatLab R2020 images to test the algorithm: ‘cameraman.tif’, ‘cell.tif’, ‘mandi.tif’, ‘moon.tif’, and ‘pout.tif’. These images will be processed with and without the addition of gaussian noise at various SNR levels. This will be done following the strategy laid out in section 3.3 of the paper.

Without great delay in the understanding and development of the aforementioned functions, I will set out to implement the more computationally efficient application of the derived algorithm through the use of the adaptation of the “Easy Path Wavelet Transform” approximation and sorting procedure described in section 4.1 of the article. I will test the algorithm on the same images described above and compare the accuracy as well as the computation time. I will compare my results to that of section 5 and 6. Finally, I will attempt to overlay noise that mimics the Gibbs phenomenon on 1D signals described in the paper (eqn. 2-19, in section 2 – addressed as it relates to the solution through Gegenbaurer coeficients) and compare the algorithm efficacy to the success it had on Gaussian noise.

Reference(s):

Dadkhahi et al.: Inverse polynomial reconstruction method in DCT domain. EURASIP Journal on Advances in Signal Processing 2012:133. doi:10.1186/1687-6180-2012-133.

J-H Jung, BD Shizgal, Inverse polynomial reconstruction of two dimensional Fourier images, J. Sci. Comput. **25**(3), 367–399 (2005)