Department of Electrical and Computer Engineering
The Johns Hopkins University
520.646 Wavelets and Filter Banks – Fall 2018

Problem Set V

Go to the course website and download the wavelet software package. You should find in the package Matlab codes for the 1D as well as the 2D wavelet transform.

1. Let $p_0[n] = \frac{1}{2048}[\ -5\ \ 0\ \ 49\ \ 0\ \ -245\ \ 0\ \ 1225\ \ 2048\ \ 1225\ \ 0\ \ -245\ \ 0\ \ 49\ \ 0\ \ -5\ ]$.

   (a) Distribute the zeros of $P_0(z)$ such that $H_0(z)$ is real, linear-phase, and of length 6, whereas $F_0(z)$ is real, linear-phase, and of length 10. Find all possible solutions.

   (b) For each solution above, plot the time and frequency responses of all 4 filters. Verify perfect reconstruction.

   (c) For each of your solution, compute the 4-level discrete wavelet transform of the *Boat* image. Reconstruct the image from only 10 % largest coefficients (the rest is set to zero). Compare the reconstructed image quality and the peak signal-to-noise ratio (PSNR) with respect to the original image.

   (d) Now factor the same filter $P_0(z)$ into odd-length real linear phase filters $H_0(z)$ and $F_0(z)$. Find all possible solutions that yield 9/7 taps.

   Repeat Part (b) and (c) above with your new odd/odd systems.

Due date: **Friday Oct. 19** in class