ECE 366 Honors Project

Jack Hamel

12/6/17

Problem 1 - File: “main1.m”

a) Lines: 1-17
   Each mask blurs the image in a different manner. The Box algorithm appears to have the smallest blurring effect followed by the Gaussian, then the Laplacian algorithm. The Laplacian method is the strangest method of blurring. It looks like it is detecting edges and emphasizing them rather than blurring. Using a 5x5 matrix instead of a 3x3 further blurs the image.
b) Lines: 37-50
   To remove the noise from the image, I plotted the ifft of the image to find the frequency corresponding to the cosine represented as spikes in the spectrum. I then created a band stop filter to only remove the frequency of the cosine and the immediate surrounding frequencies.
c) Lines: 19-36
   The zero-phase image is completely unrecognizable. The zero-magnitude -> ifft -> rescale-magnitude image is even worse. Both images are losing half of the information they contain prior to applying the above methods and are therefore unrecognizable.

Problem 2 - File: “main2.m”

a) Lines: 1-7
b) Lines: 8-23
c) Lines: 24-27
d) Lines: 28-39
   Number x1 is: 4 9 1 5 8 7 7
   Number x2 is: 2 5 3 1 0 0 0
   Lines 35-39 show how I plotted each digit to decipher its frequency components.
e) Lines: 40-43
f) Lines: 44-48

Function Documentation

- surroundings2zero(filter, pnt_x, pnt_y)
  Returns filter with element at (pnt_x,pnt_y) and elements immediately adjacent set to zero.
- separate_digits(signal, space, d_length, d_count)
  Returns a matrix filled with digit tones from a 1D signal of digit tones cluttered with spacings given length of digit tones, amount of digits, and spacing between digits.

- compute_ft(signal_matrix, N)
  Computes the FFT and FFT frequency shift of each individual digit in signal_matrix and returns it in the same format as signal_matrix. N is the FFT sampling rate.
- ttdecode(signal_ft_matrix)
  Deciphers the digits from frequency domain digit signals in the form of the output from compute_ft. Uses a comparison between the known frequencies of each digit and the frequency present in the unknown signal.
- freq2index(freq,N)
  An implementation of the frequency to index of a matrix algorithm used in ttdecode. N is the FFT sampling rate
- separate2ft_digits(signal_unpadded,N)
  More rigorous version of separate_digits and compute_ft in one function. Can analyze a signal with any number of digits of any size and any size of spacing between the digits.
  N is the FFT sampling rate.