Homework 5 (Due: 7/2)

(1) Write a Matlab or Python program to compute the FFT of two N-point real signals x and y using only one N-point FFT.

$[Fx, Fy]$ =fftreal(x, y)

The code should be handed out by ceiba. (20 scores)

(2) What are the two main advantages of the sectioned DFT convolution?

(10 scores)

① Optimal section length is independent of N.

② If M is fixed constant, then the complexity is linear with N. ($O(N)$)

(3) How many entries of (a) the *N*-point Walsh transform and (b) the *N*-point Haar transform that are equal to 0, 1, and -1? (10 scores)

(a) the N-point Walsh transform :

N must be a power of 2^k (for $k = 1, 2, \cdots, \infty$)

1 的數量為 : $\frac{N}{2}(N+1)$

-1 的數量為 : $\frac{N}{2}(N-1)$

0 的數量為 : 0

(b) the N-point Haar transform :

N must be $2^k \Rightarrow k = \log_2 N$

0 的數量為 : $N(N-k-1)$

1 的數量為 : $(k+2)\frac{N}{2}$

-1 的數量為 : $k \cdot \frac{N}{2}$

(4) What are the most important applications of (a) the Walsh transform and (b) the Haar transform nowadays? (10 scores)

(a) Walsh transform :

CDMA (code division multiple access), Speech Recognition

(b) Haar transform :

localized spectrum analysis, edge detection

(Extra): Answer the questions according to your student ID number.

(ended with 2, 3, 4, 7, 8, 9)