

Homework 4 (Due: 7^h Dec.)

- (1) Illustrate the following terms. (a) color noise; (b) vanish moment (about the wavelet transform); (c) the Fresnel transform . (15 scores)
- (2) Suppose that $x(t)$ is a white noise. Which of the following function is also a white noise? Why? (i) $x(2t+3)$); (ii) $x(t)\exp(-\pi t^2)$; (iii) the FT of $x(t)$; (iv) the LCT of $x(t)$ (10 scores)
- (3) What are the disadvantages when using the Hilbert transform to determine the instantaneous frequency? Write at least three disadvantages. (10 scores)
- (4) Among the STFT, the WDF, the Hilbert-Huang transform, and the wavelet transform, which one is better for the applications of (a) video compression, (b) random process analysis, (d) analyzing the variation of temperature, and (d) modulation?
Also illustrate the reasons. (15 scores)

(5) (a) What is the most important advantage of the Haar transform nowadays?

(b) How many entries of the 2^k -point Haar transform are equal to 0, 1, and -1? Express the solutions in term of k . (10 scores)

(6) What are the vanish moments of

(a) $\frac{d^5}{dt^5} e^{-\pi t^2}$

(b) $x(t) = 1 - |t|$ for $-2 < t < 2$, $x(t) = 0$ otherwise. (10 scores)

(Continued)

(7) Write a Matlab or Python program of the Hilbert-Huang transform.

$y = \text{hht}(x, t, \text{thr})$

x: input, y: output (each row of y is one of the IMFs of x), t: samples on the t -axis, thr : the threshold used in Step 7.

In Step 8, the number of non-boundary extremes can be no more than 3.

Just write Steps 1~8 and Step 9 is unnecessary.

The Matlab or Python code should be handed out by NTUCool. (30 scores)

Example: $t = [0: 0.01: 10];$

$x = 0.2*t + \cos(2*\pi*t) + 0.4*\cos(10*\pi*t);$

$\text{thr} = 0.2;$

$y = \text{hht}(x, t, \text{thr});$

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

(ended with 0, 2, 3, 4, 5, 7, 8, 9)