Note: Do not forget the extra question.

Homework 1 (Due: 21st Oct.)

(1) (a) What are the advantage and the disadvantage of the time-frequency analysis when compared with the Fourier transform? (b) What are the advantage and the disadvantage of the wavelet transform when compared with the STFT?

(20 scores)

(2) (a) What is the relation between the rectangular function and the Gaussian function? (b) Why the STFT with a Gaussian window can achieve better performance than the STFT with the rectangular window? (10 scores)

(3) Does $x(t)$ and $\exp(j2\pi(at + b))x(ct + d)$ require the same numbers of sampling points? Why? (10 scores)

(4) Write at least three conditions where the chirp signal may be generated.

(10 scores)

(5) (a) How does the window width B affect the resolution of the rec-STFT? (b) What is the advantage of the STFT with an asymmetric window? (c) Determine the rec-STFT of $\cos(2\pi t)$. (15 scores)

(6) Write a program for the rectangular short time Fourier transform .

y = recSTFT(x, t, f, B) (35 scores)

x: input, *t*: samples on *t*-axis, *f*: samples on *f*-axis,

[-B, B]: interval of integration, y: output

(i) 要交本題的程式碼 (*.m 檔或 *.py檔，可用 Matlab 或 Python寫)，

(iii) 自己選一個 input x, 用你們的程式將 output y 算出來並畫出來

(iv) 計算程式的 computation time

(v) 不可以用 direct implementation 的方法

例子：

```
dt=0.05;
df=0.05;
t1=[0:dt:10-dt]; t2=[10:dt:20-dt]; t3=[20:dt:30];
t=[0:dt:30];
f=[-5:df:5];
x=[cos(2*pi*t1),cos(6*pi*t2),cos(4*pi*t3)];
B=1;
tic
y=recSTFT(x,t,f,B);
toc
```

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

(ended with 0, 1, 2, 3, 5, 6, 7, 8)