Homework 2 (Due: 27th Oct.)

(1) What are the main advantages and the disadvantages of the recursive method for implementing the STFT? (10 scores)

(2) Calculate the WDF of $\sin(4\pi(t+1))$ (10 scores)

(3) For which of the following functions the WDFs may have the cross term problem? Why? (a) $\exp(-\pi t^2)$; (b) $\cos(-\pi t^2)$; (c) $\exp(-\pi t^3)$; (d) $\exp(j\pi t^4)$; (e) A typical music signal. (15 scores)

(4) Why (a) Cohen's class distribution, (b) the polynomial WDF, and (c) the Gabor-Wigner transform can avoid the cross term problem in some cases? (15 scores)

(5) (a) Compared to the original WDF, what is the advantage of the windowed WDF? (b) What is the constraint for the window $w(\tau)$ to make the output of the windowed WDF a real function? (c) Is the windowed WDF a one-to-one operation? Why? (15 scores)

(6) Write a Matlab or Python program for the rectangular STFT. (35 scores)

(the window is $w(t) = 1$ if $|t| < B$, $w(t) = 0$ otherwise).

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

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

(i) The code (*.m or *.py) should be handed out by NTUCool

(ii) Choose an input x. Plot the output y.

(iii) Use tic and toc to determine the running time

(iv) Write by the **FFT-based method.**

Example：

```
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)];
tic
y=recSTFT(x, t, f , B);
toc
```

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

(ended with 0, 1, 2, 4, 5, 6, 7, 9)