HW 3

r11943131林克帆

1.

(a) S transform

優點是window函數會隨著頻率而調整，進而在特定頻率提升時間解析度或頻率解析度。

(b) 3-parameter atom

藉由調整central time、frequency和scaling facto產生基底。再透過基底的線性組合代替原始訊號。跟Fourier series相比，3-parameter atom可以用更少的terms代替原始訊號。

(c) FrFT

如果訊號和雜訊在time domain 和frequency domain 都不能完全分開。FrFT 能將訊號從time domain 轉換到fractional domain ，就有可能將訊號和雜訊分離。

2.

(a)

time-frequency reassignment會對patch window內的能量做運算，找出新的能量高峰。然後將time-frequency distribution從原本的點移動到新的能量高峰。因此經過time-frequency reassignment運算後能量會更集中，讓time-frequency distribution看起來更清晰。

(b)

原本的WDF具備高清晰度，但是有cross-term 的問題。結合Gabor transform 能有效解決cross-term 的問題。

3.

(a)

$x_1 = x(\frac{t}{2})$

$W_1 = \sqrt{2}W_x(t/2, 2f)$

$x_2 = x_1(t-2) = x(\frac{t-2}{2})$

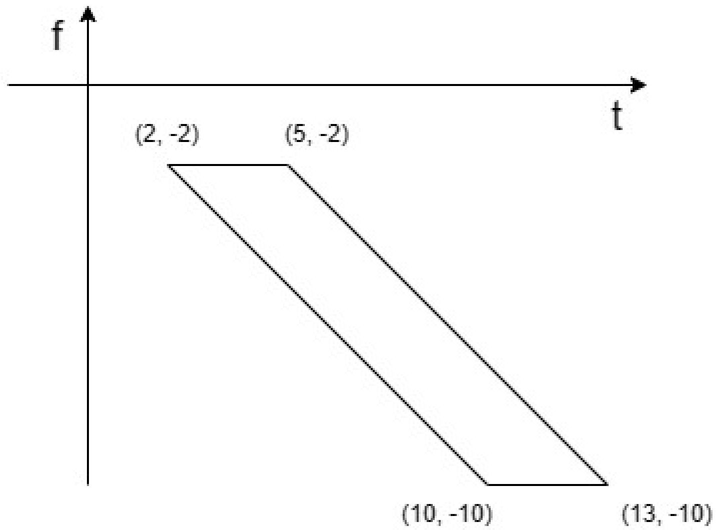
$$W_2 = W_1(t-2, f)$$

$$x_3 = \exp(j\pi t^2)x_2(t)$$

$$W_3 = W_2(t, f-t)$$

$$x_4 = FT(x_3)$$

$$W_4 = W_3(-f, t)$$



(b)

$$W_x(0,6) = W_{x,abcd}(-3,3)$$

$$W_x(4,0) = W_{x,abcd}(3,5)$$

$$\begin{bmatrix} -3 \\ 3 \end{bmatrix} = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} 0 \\ 6 \end{bmatrix} \rightarrow \begin{cases} -3 = 6b \\ 3 = 6d \end{cases} \rightarrow \begin{cases} b = -0.5 \\ d = 0.5 \end{cases}$$

$$\begin{bmatrix} 3 \\ 5 \end{bmatrix} = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} 4 \\ 0 \end{bmatrix} \rightarrow \begin{cases} 3 = 4a \\ 5 = 4c \end{cases} \rightarrow \begin{cases} a = 0.75 \\ c = 1.25 \end{cases}$$

4.

$$x_1 = \sqrt{\tfrac{2}{3}}x(\tfrac{2t}{3})$$

$$x_2 = x_1(t-1) = \sqrt{\tfrac{2}{3}}x(\tfrac{2}{3}(t-1))$$

$$c * 2 * (-2) * (-7) = -1 \rightarrow c = -\tfrac{1}{28}$$

$$polynomial : c(t-1)(t-5)(t-10) \rightarrow (-\frac{1}{28})(t^3 - 16t^2 + 65t - 50)$$

$$\phi(t) = -\frac{1}{28}2\pi(\frac{1}{4}t^4 - \frac{16}{3}t^3 + \frac{65}{2}t^2 - 50t)$$

$$y(t) = e^{j\phi(t)}x_2(t) = e^{j\phi(t)}\sqrt{\frac{2}{3}}x(\frac{2}{3}(t-1))$$

5.

for cutoff line 2t+f < 8

$$x_{o0}(t) = O_F^{-\phi}\{O_F^{\phi}[x(t)]H(u)\}$$

$$\phi_0 = arctan(\frac{4}{8}) = arctan(0.5)$$

$$u_0 = \frac{8*4}{\sqrt{8^2+4^2}} = 3.577$$

$$H(u) = \begin{cases} 1, u < 3.577 \\ 0, u > 3.577 \end{cases}$$

for cutoff line -t+2f < 6

$$x_{o1}(t) = O_F^{-\phi}\{O_F^{\phi}[x(t)]H(u)\}$$

$$\phi_1 = arctan(\frac{-6}{3}) = arctan(-2)$$

$$u_1 = \frac{6*3}{\sqrt{6^2+3^2}} = 2.683$$

$$H(u) = \begin{cases} 1, u > 2.683 \\ 0, u < 2.683 \end{cases}$$

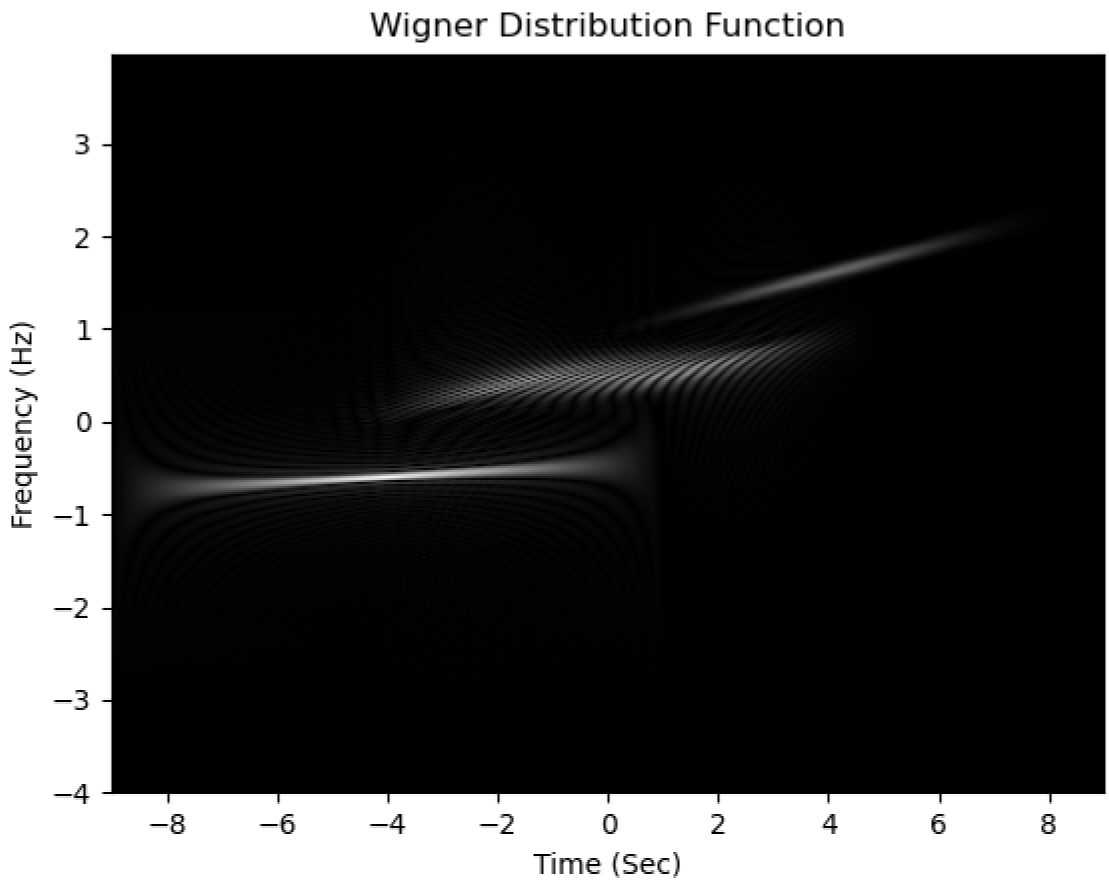
for cutoff line f > 1

$$x_{o2} = IFT\{FT[x(t)]H(u)\}$$

$$H(u) = \begin{cases} 1, u > 1 \\ 0, u < 0 \end{cases}$$

6.

running time: 0.0517(s)



學號尾數1&6

需要兩個FrFT filters