TFW HW1. 2021/10/21 P10942A05 鄭閔軒

1-(a) Time frequency analysis advantage：可判斷信號出現之先後順序

disadvantage：因增加對時間維度的分析，所以計算速度會下降

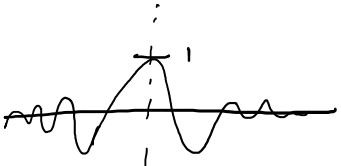
1-(b) wavelet transform advantage：運算量小，運算速度快 input=N output ≈ N points

disadvantage：因 wavelet 會將信號高頻低頻做分離，相對中頻信號解析度會較差

2-(a) 當 rectangular function 對自己做無限次 convolution 後會成為 Gaussian function

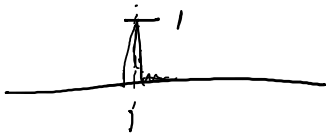
2-(b) 因 rectangular function 做 Fourier Trans for 會成為 sinc function

$$F(x(t)\,w(t-\tau)) = X(f) * \underbrace{F(w(t-\tau))}_{\text{sinc}}$$



但因 Gaussian 是無限次 rectangular function 做 convolution

又因 $\text{sinc} = \frac{\sin \pi t}{\pi t}$ $\quad \text{sinc}^{\infty} \Rightarrow$



3.

$x(t)$, $\exp(j2\pi(at+b))\,x(ct+d)$

$x(ct+d)$ compare with $x(t)$ $x(ct+d)$ due to time shift not impact sampling rate, we only concern $x(ct) \xrightarrow[\text{F.T.}]{} \frac{1}{|c|} X\left(\frac{f}{c}\right)$ $\frac{1}{|c|}$ times in time length, c times in frequency

compare $x(t)$, $\exp(j2\pi(at+b))\,x(t)$ we can know from $e^{j\omega_0 t}x(t) \overset{FT}{\leftrightarrow} X(j\omega-\omega_0)$ shift in frequency axis

$x(t)$ and $\exp(j2\pi(at+b))\,x(ct+d)$ have same sampling points

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4

一、注音符號二、四聲

二、Doppler effect

三 radar system

5.

(a) the window width B ↑ time resolution ↓ frequency resolution ↑

B ↓ time resolution ↑ frequency resolution ↓

(b) people can use asymmetric window in real-time analysis, due to use less future point in signal analysis.

(c) rec-STFT of cos(2πt) we can see spectrogram response in ± 1 Hz and with sidelobe problem

人耳對什麼頻率聲音最敏感（上課問題）

3000 Hz 左右