Time Frequency Analysis and Wavelet Transform Final Project: Code Edition

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1. Function Description

- Function chirpZ_recSTFT(x,t,f,B) in file chirpZ_recSTFT.py: Implement STFT by Chirp-Z Transform Method
 x: input
 t: samples on time-axis
 f: samples on frequency-axis
 B: Bandwidth
- Function *chirpZ_WDF(x,t,f,B)* in file chirpZ_WDF.py: Implement Wigner Distribution Function by Chirp-Z Transform
 x: input t: samples on time-axis f: samples on frequency-axis B: Bandwidth
- Function *plot_transform_result(y,t,f)* in file plot_transform_result.py: Plot the Result of each transform
 y: output result of time-frequency analysis(STFT or WDF) t: samples on time-axis f: samples on frequency-axis

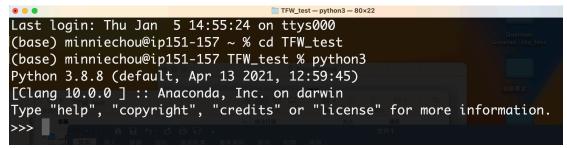
2. Execute Method

STEP1: 將所需的檔案 chirpZ_recSTFT.py / chirpZ_WDF.py /

plot_transform_result.py 全部放在同一個資料夾,並於 cmd 內下指令切換至該資料夾:

< > TFW_test 返回/往前 名稱	田 := □□	✓ ① ○ ○ ✓ 組 分享 編輯標籤 動作 大小 種類	Q 搜尋	
>pycachechirpZ_recSTFT.py	今天下午2:27 今天下午2:17	檔案夾 1 KB 純文字文件		
chirpZ_WDF.py plot_transform_result.py	今天 下午 2:18 今天 下午 2:54	1 KB 純文字文件 769 byte 純文字文件		
Last login: Thu Jan 5 14:55:24 on ttys000				
(base) minniechou@ip151-157 ~ % cd TFW_test (base) minniechou@ip151-157 TFW_test %				

STEP2: 輸入指令 python3 以執行 python 檔案



STEP3: import the functions we need

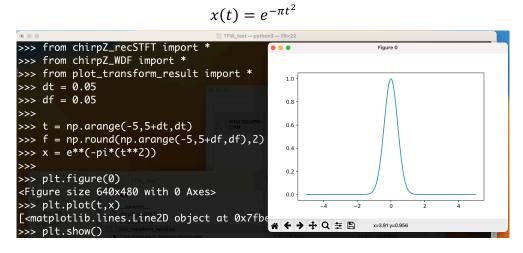
•••	🚞 TFW_test — python3 — 80×22	
Last login: Thu Jan	5 14:55:24 on ttys000	
(base) minniechou@ip1	.51-157 ~ % cd TFW_test	
(base) minniechou@ip1	.51-157 TFW_test % python3	
Python 3.8.8 (default	, Apr 13 2021, 12:59:45)	
[Clang 10.0.0] :: Ar	aconda, Inc. on darwin	
Type "help", "copyrig	ht"yss"credits" or "license"	for more information.
<pre>>>> from chirpZ_recST</pre>	FT import *	
>>> from chirpZ_WDF i	mport *	
<pre>>>> from plot_transfc</pre>	<pre>prm_result import *</pre>	

STEP4: input the signal and sample points on time/frequency to chirpZ_recSTFT and chirpZ_WDF function. (More details in next section)

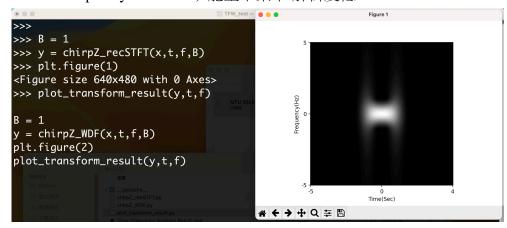
3. Examples

Case 1

1-1 Original Signal on time domain (one component: Gaussian Function)



1-2 Time-Frequency result after doing **recSTFT** by Chirp-Z Transform Method ② Low time/frequency resolution, 能量不集中/解析度低

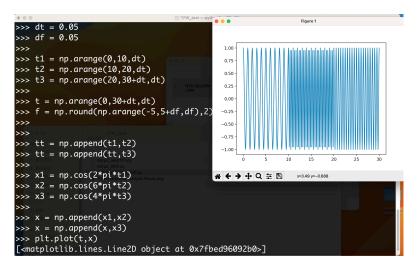


1-3 Time-Frequency result after doing **WDF** by Chirp-Z Transform Method ② High time/frequency resolution, 能量集中/解析度高



Case 2:

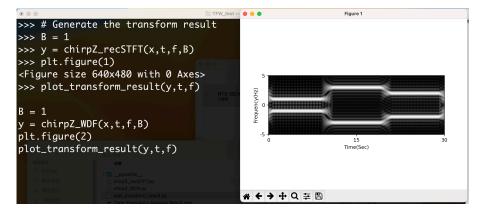
2-1 Original Signal on time domain (multiple components)



2-2 Time-Frequency result after doing **recSTFT** by Chirp-Z Transform Method

 \otimes Low time/frequency resolution

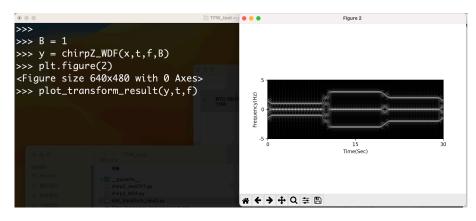
© but there's no cross term in this result



2-3 Time-Frequency result after doing WDF by Chirp-Z Transform Method

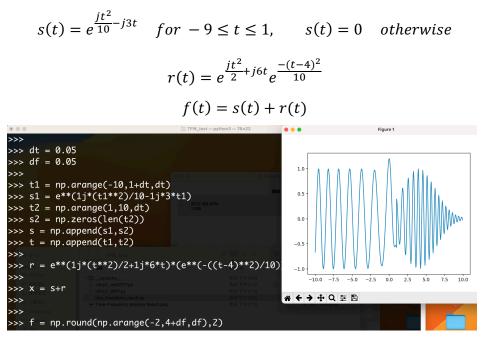
© High time/frequency resolution

B but the cross term exists, caused by multiple components \rightarrow WDF is not suitable for dealing multiple components' signal

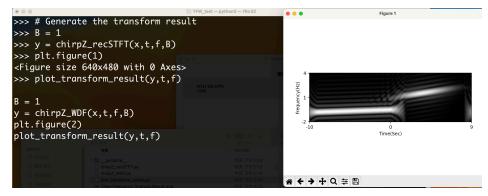


Case 3

3-1 Original Signal on time domain (multiple components)



3-2 Time-Frequency result after doing **recSTFT** by Chirp-Z Transform Method ☺ Low time/frequency resolution→add window might be better (Gabor Transform) ☺ but there's no cross term in this result



3-3 Time-Frequency result after doing WDF by Chirp-Z Transform Method

© Better time/frequency resolution

 \otimes but the cross term exists

