

Readme Document-M112002105 吳培聖

這份文件會包含以下檔案(程式碼)的使用說明。檔案名稱如下。

1. Mini-max-type2-parameter.py
2. Mini-max-type3-parameter.py
3. Mini-max-type4-parameter.py

////////////////////////////////////

1. Mini-max-type2-parameter.py 使用說明。

設計目的 :為了實現 Minimax 的 type2 的高/低通濾波器，以 Hw1 的 type1 為基礎進行設計。

程式語言 :Python

模擬環境 :Visual Studio Code

使用說明 :參數設定

```
python > ADSP > Mini-max-type2-parameter.py > ...
1  import math
2  import numpy as np
3  from matplotlib import pyplot as plt
4  #-----parameter declaration
5  fs = 6000 # Sampling Frequency
6  Sample_range = fs / 2
7  N = 16 # Point of the filter
8
9  Filter_type = 1 # 0 is for lowpass / 1 is for highpass
10 prcesion = 10
11
12 trans_band_beg = 1200 # Beginning of the transition band
13 trans_band_end = 1500 # End of the transition band
14
15 Weight_low = 1 # Weight of the Hd before the beginning of the transition band
16 Weight_high = 0.6 # Weight of the Hd after the end of the transition band
17
18 Iter_cond = 0.0001 # The condition of the end of iteration
19
```

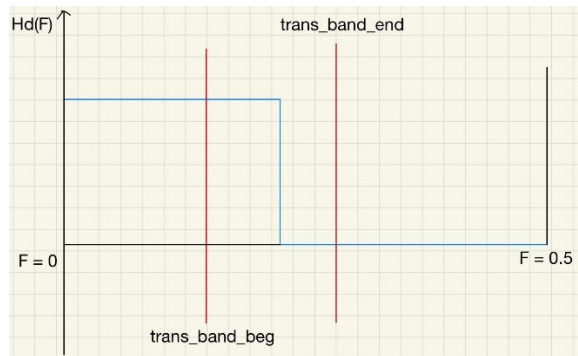
變數 fs 是在設定濾波器的取樣頻率。

變數 N 是在設定濾波器的取樣點數，因為是 type2 所以要設定成偶數。

變數 Filter_type 是在設定此濾波器的模式。設定 0 是低通濾波器，

反之設定 1 是高通濾波器。

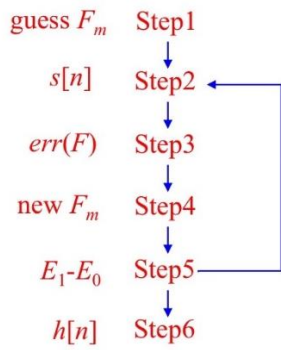
變數 `trans_band_beg` 跟 `trans_band_end` 是在設定 transtion band 的起始位置以及結束位置。下圖以 $f_s = 6000$ 為例，`trans_band_beg` 設定為 1200($F = 1200 / 6000 = 0.2$)，`trans_band_end` 設定為 1500($F = 1500 / 6000 = 0.25$)。因為 $f_s = 6000$ 且 F 的數值是從 0~0.5，所以這兩個變數只能設定小於 $f_s / 2 = 3000$ 、 $F = 0.5$ 的數值。 `trans_band_end` 要大於 `trans_band_beg`。



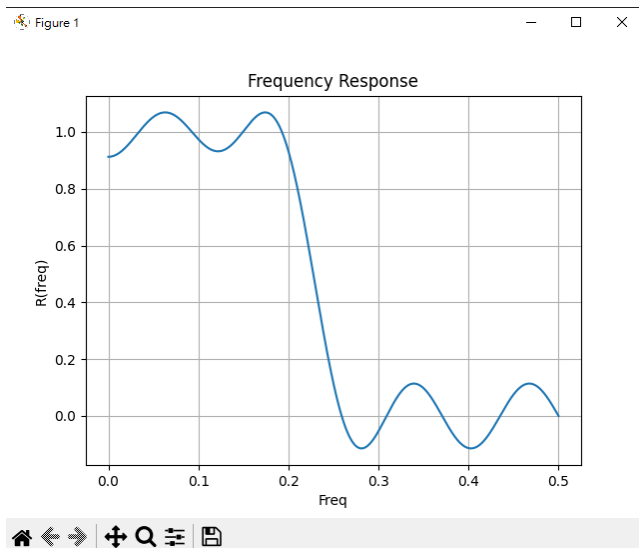
變數 `Weight_low` 是在設定 `trans_band_beg` 前面波型的權重數值(Ex : `Weight_low = 1`)。

變數 `Weight_high` 是在設定 `trans_band_end` 後面波型的權重數值(Ex : `Weight_high = 0.6`)。

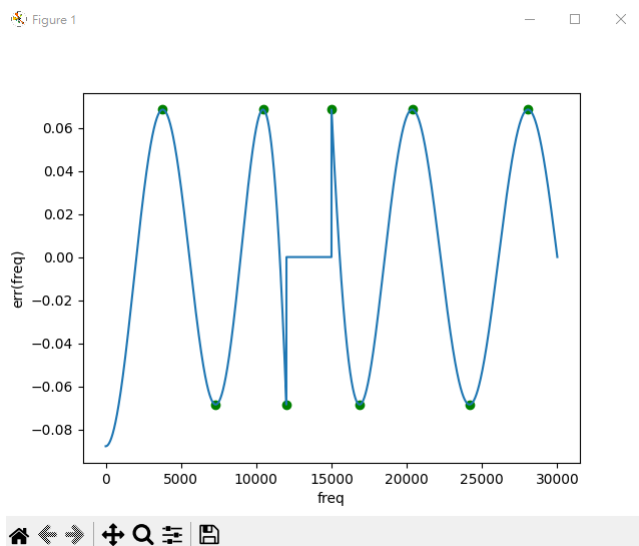
變數 `Iter_cond` 是在設定下圖 Step 2 ~ Step 5 的迭代終止條件。目前設定的為 0.0001。



模擬結果 : $N = 16$; $fs = 6000$; $trans_band_beg = 1200$; $trans_band_end = 1500$; $Weight_low = 1$; $Weight_high = 0.6$; $Iter_cond = 0.0001$;
 Type2 lowpass filter 的 Frequency Response



Type2 lowpass filter 的 Error Function 以及 Extreme Point ◦

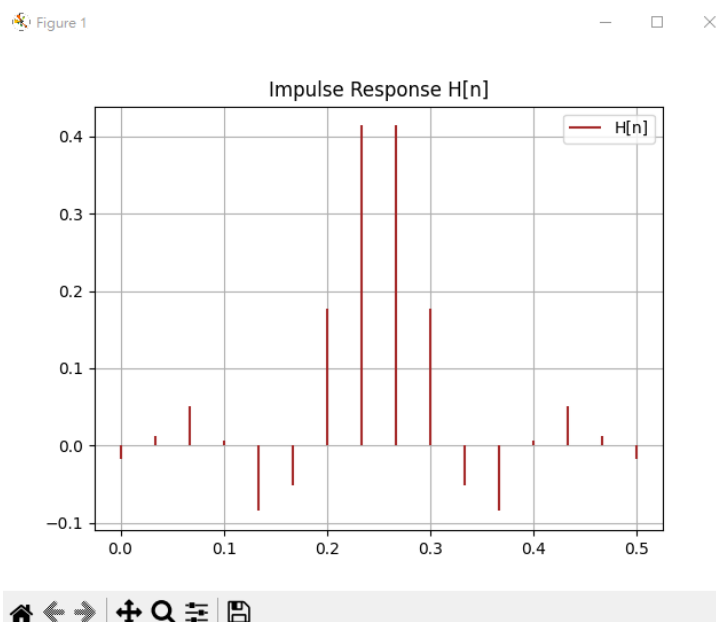


```

Extreme_Point[0] = [0.06305]
Extreme_Point[1] = [0.12176667]
Extreme_Point[2] = [0.17411667]
Extreme_Point[3] = [0.2]
Extreme_Point[4] = [0.25]
Extreme_Point[5] = [0.28113333]
Extreme_Point[6] = [0.3393]
Extreme_Point[7] = [0.40273333]
Extreme_Point[8] = [0.46748333]
MaxIter = 0.08780623775757546
MaxError = 0.08780623775757546
////////////////////////////////////

```

Type2 lowpass filter 的 Impulse Response(Even symmetric)。

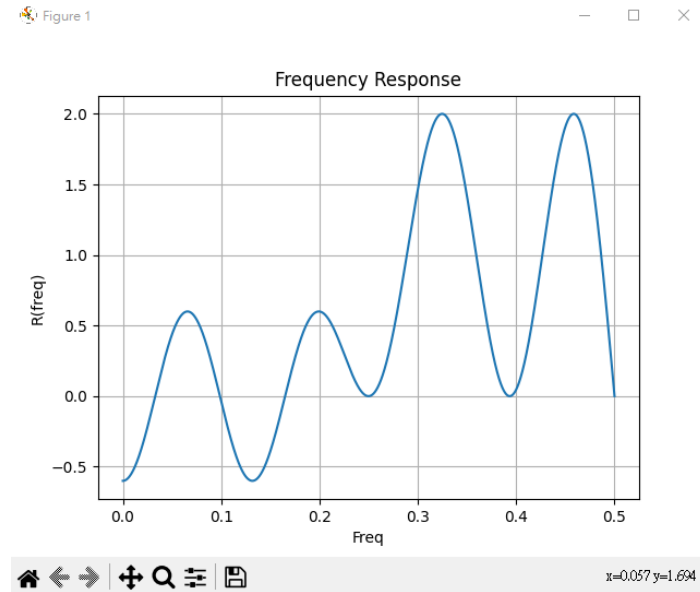


```

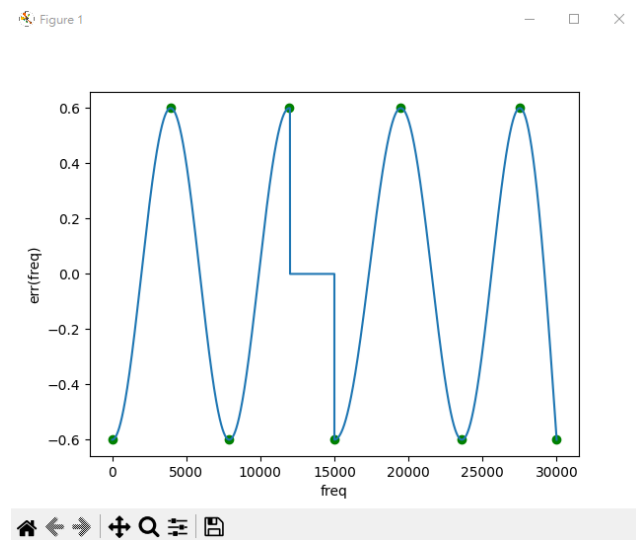
Impulse Response Hd[0] = -0.017113600543607995
Impulse Response Hd[1] = 0.01201405401656154
Impulse Response Hd[2] = 0.050209723050190516
Impulse Response Hd[3] = 0.005772528515372605
Impulse Response Hd[4] = -0.08470726626989353
Impulse Response Hd[5] = -0.05109246398332583
Impulse Response Hd[6] = 0.17657998416083648
Impulse Response Hd[7] = 0.41393355839087487
Impulse Response Hd[8] = 0.41393355839087487
Impulse Response Hd[9] = 0.17657998416083648
Impulse Response Hd[10] = -0.05109246398332583
Impulse Response Hd[11] = -0.08470726626989353
Impulse Response Hd[12] = 0.005772528515372605
Impulse Response Hd[13] = 0.050209723050190516
Impulse Response Hd[14] = 0.01201405401656154
Impulse Response Hd[15] = -0.017113600543607995

```

Type2 highpass filter 的 Frequency Response

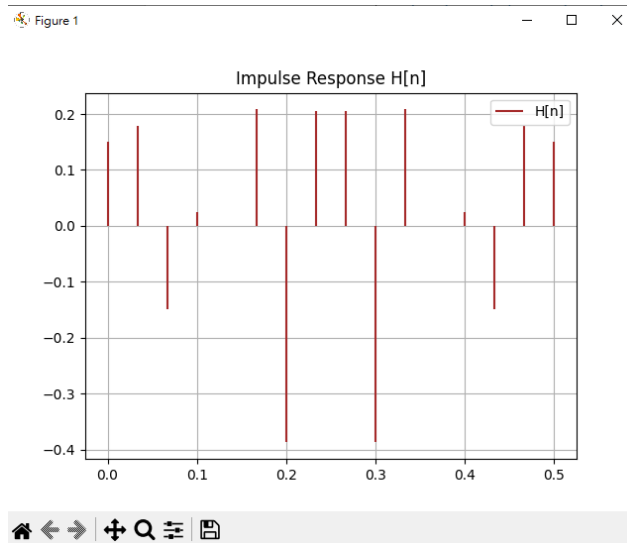


Type2 highpass filter 的 Error Function 以及 Extreme Point



```
Extreme_Point[0] = 0.0
Extreme_Point[1] = 0.0658
Extreme_Point[2] = 0.13176666666666667
Extreme_Point[3] = 0.19928333333333334
Extreme_Point[4] = 0.25
Extreme_Point[5] = 0.32468333333333333
Extreme_Point[6] = 0.39341666666666667
Extreme_Point[7] = 0.45851666666666667
Extreme_Point[8] = 0.5
MaxIter = 0.6000018837845216
MaxError = 0.6000000000000002
////////////////////////////////////
```

Type2 highpass filter 的 Impulse Response(Even symmetric)。



```
Impulse Response Hd[0] = 0.1499999999999977
Impulse Response Hd[1] = 0.1785537727558444
Impulse Response Hd[2] = -0.14954819214530257
Impulse Response Hd[3] = 0.02424714684685858
Impulse Response Hd[4] = -0.0005915893832405539
Impulse Response Hd[5] = 0.20830846480070697
Impulse Response Hd[6] = -0.38731404541124925
Impulse Response Hd[7] = 0.20518499322467743
Impulse Response Hd[8] = 0.20518499322467743
Impulse Response Hd[9] = -0.38731404541124925
Impulse Response Hd[10] = 0.20830846480070697
Impulse Response Hd[11] = -0.0005915893832405539
Impulse Response Hd[12] = 0.02424714684685858
Impulse Response Hd[13] = -0.14954819214530257
Impulse Response Hd[14] = 0.1785537727558444
Impulse Response Hd[15] = 0.1499999999999977
```

2. Mini-max-type3-parameter.py 使用說明。

設計目的 :為了實現 Minimax 的 type3 的高/低通濾波器，以 Hw1 的 type1 為基礎進行設計。

程式語言 :Python

模擬環境 :Visual Studio Code

使用說明 :參數設定

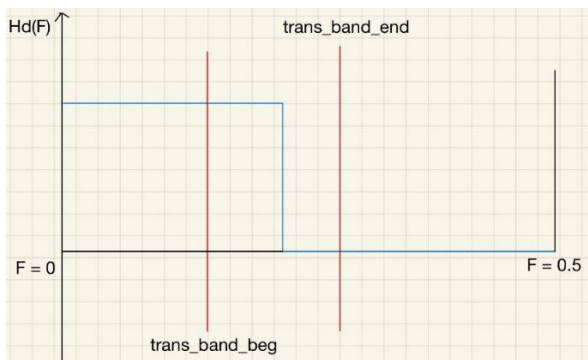
```
python > ADSP > Mini-max-type3-parameter.py > ...
1 import math
2 import numpy as np
3 from matplotlib import pyplot as plt
4 #-----parameter declaration
5 fs = 6000 # Sampling Frequency
6 Sample_range = fs / 2 # 0 ~ 3000
7 N = 17 # Point of the filter
8
9
10 Filter_type = 1 # 0 is for lowpass / 1 is for highpass
11 prcesion = 10
12
13 trans_band_beg = 1200 # Beginning of the transition band
14 trans_band_end = 1500 # End of the transition band
15
16 Weight_low = 1 # Weight of the Hd before the beginning of the transition band
17 Weight_high = 0.6 # Weight of the Hd after the end of the transition band
18
19 Iter_cond = 0.0001 # The condition of the end of iteration
```

變數 fs 是在設定濾波器的取樣頻率。

變數 N 是在設定濾波器的取樣點數，因為是 `type3` 所以要設定成奇數。

變數 `Filter_type` 是在設定此濾波器的模式。設定 `0` 是低通濾波器，反之，設定 `1` 是高通濾波器。

變數 `trans_band_beg` 跟 `trans_band_end` 是在設定 transtion band 的起始位置以及結束位置。下圖以 $fs = 6000$ 為例，`trans_band_beg` 設定為 $1200(F = 1200 / 6000 = 0.2)$ ，`trans_band_end` 設定為 $1500(F = 1500 / 6000 = 0.25)$ 。因為 $fs = 6000$ 且 F 的數值是從 $0 \sim 0.5$ ，所以這兩個變數只能設定小於 $fs / 2 = 3000$ 、 $F = 0.5$ 的數值。`trans_band_end` 要大於 `trans_band_beg`。



變數 $Weight_low$ 是在設定 $trans_band_beg$ 前面波型的權重數值(Ex :

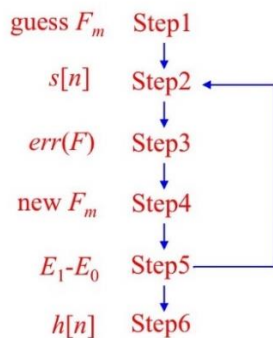
$Weight_low = 1$)。

變數 $Weight_high$ 是在設定 $trans_band_end$ 後面波型的權重數值(Ex :

$Weight_high = 0.6$)。

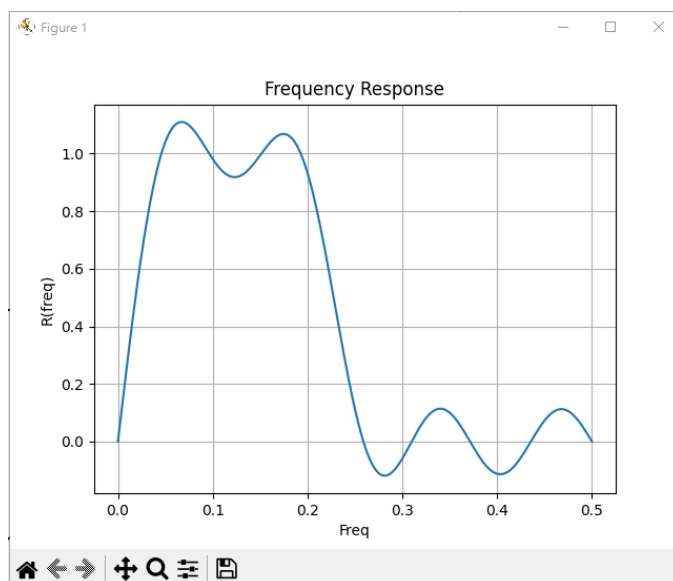
變數 $Iter_cond$ 是在設定下圖 Step 2 ~ Step 5 的迭代終止條件。目前

設定的為 0.0001。

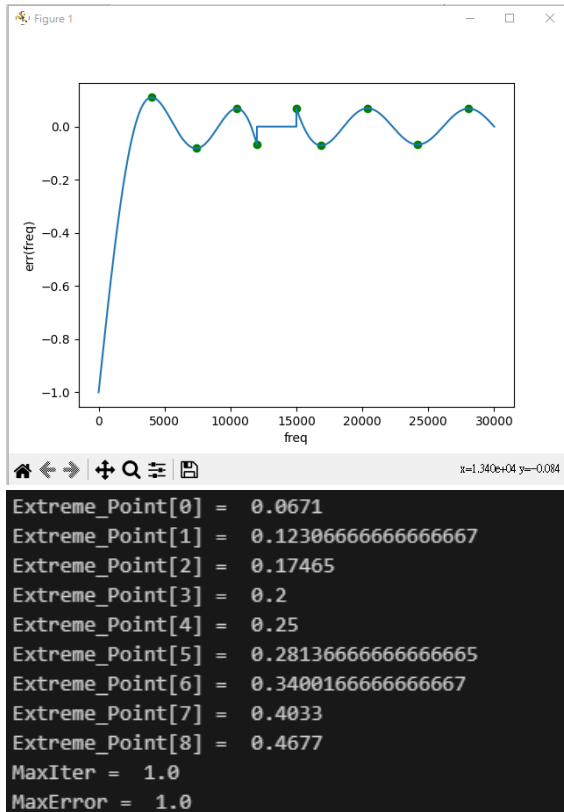


模擬結果 : $N = 17$; $fs = 6000$; $trans_band_beg = 1200$; $trans_band_end = 1500$; $Weight_low = 1$; $Weight_high = 0.6$; $Iter_cond = 0.0001$;

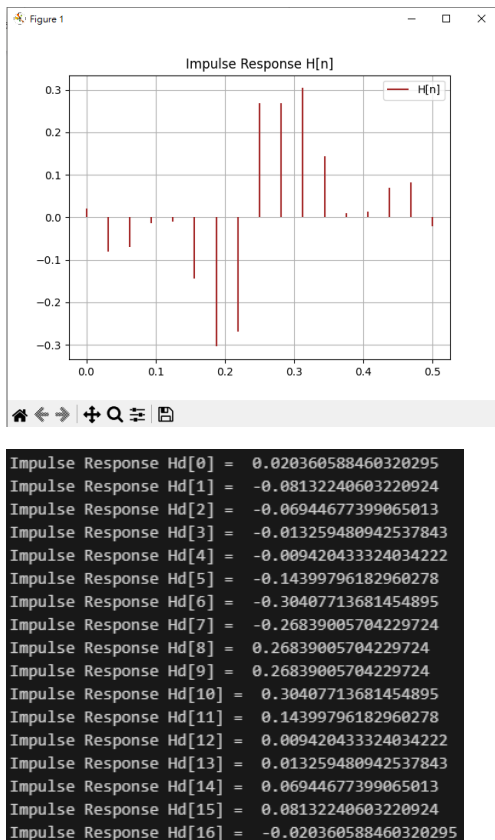
Type3 lowpass filter 的 Frequency Response



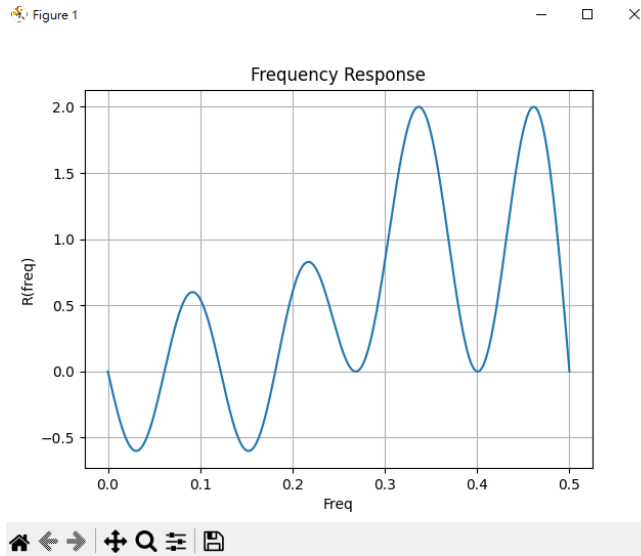
Type3 lowpass filter 的 Error Function 以及 Extreme Point ◦



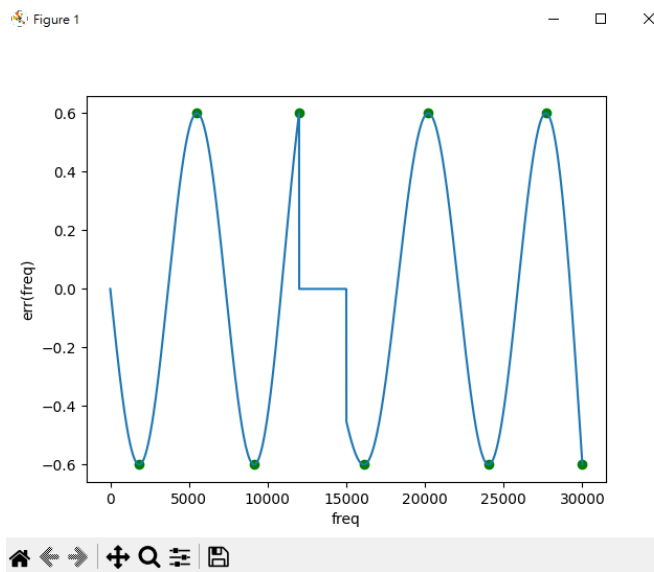
Type3 lowpass filter 的 Impulse Response(Odd symmetric) ◦



Type3 highpass filter 的 Frequency Response

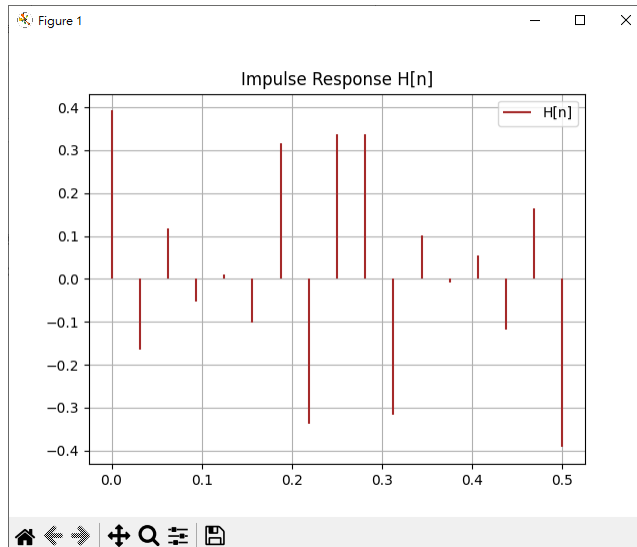


Type3 highpass filter 的 Error Function 以及 Extreme Point



```
Extreme_Point[0] = 0.030633333333333332
Extreme_Point[1] = 0.09178333333333333
Extreme_Point[2] = 0.15231666666666666
Extreme_Point[3] = 0.2
Extreme_Point[4] = 0.26848333333333335
Extreme_Point[5] = 0.33671666666666666
Extreme_Point[6] = 0.40058333333333335
Extreme_Point[7] = 0.4612833333333333
Extreme_Point[8] = 0.5
MaxIter = 0.6000000296362873
MaxError = 0.6000000000000005
////////////////////////////////////
```

Type3 highpass filter 的 Impulse Response(Odd symmetric)。



```
Impulse Response Hd[0] = 0.3924309995758129
Impulse Response Hd[1] = -0.16532127396123447
Impulse Response Hd[2] = 0.11759029733124798
Impulse Response Hd[3] = -0.053620881284053956
Impulse Response Hd[4] = 0.009337287566462682
Impulse Response Hd[5] = -0.10119486315852422
Impulse Response Hd[6] = 0.3156530199913241
Impulse Response Hd[7] = -0.3366079746128919
Impulse Response Hd[8] = 0.3366079746128919
Impulse Response Hd[9] = 0.3366079746128919
Impulse Response Hd[10] = -0.3156530199913241
Impulse Response Hd[11] = 0.10119486315852422
Impulse Response Hd[12] = -0.009337287566462682
Impulse Response Hd[13] = 0.053620881284053956
Impulse Response Hd[14] = -0.11759029733124798
Impulse Response Hd[15] = 0.16532127396123447
Impulse Response Hd[16] = -0.3924309995758129
```

3. Mini-max-type4-parameter.py 使用說明。

設計目的 :為了實現 Minimax 的 type4 的高/低通濾波器，以 Hw1 的 type1 為基礎進行設計。

程式語言 :Python

模擬環境 :Visual Studio Code

使用說明 :參數設定

```

python > ADSP > Mini-max-type4-parameter.py > ...
1  import math
2  import numpy as np
3  from matplotlib import pyplot as plt
4  #-----parameter declaration
5  fs = 6000 # Sampling Frequency
6  Sample_range = fs / 2 # 0 ~ 3000
7  N = 16 # Point of the filter
8
9  prcesion = 10
10 Filter_type = 0 # 0 is for lowpass / 1 is for highpass
11
12 trans_band_beg = 1200 # Beginning of the transition band
13 trans_band_end = 1500 # End of the transition band
14
15 Weight_low = 1 # Weight of the Hd before the beginning of the transition band
16 Weight_high = 0.6 # Weight of the Hd after the end of the transition band
17
18 Iter_cond = 0.0001 # The condition of the end of iteration

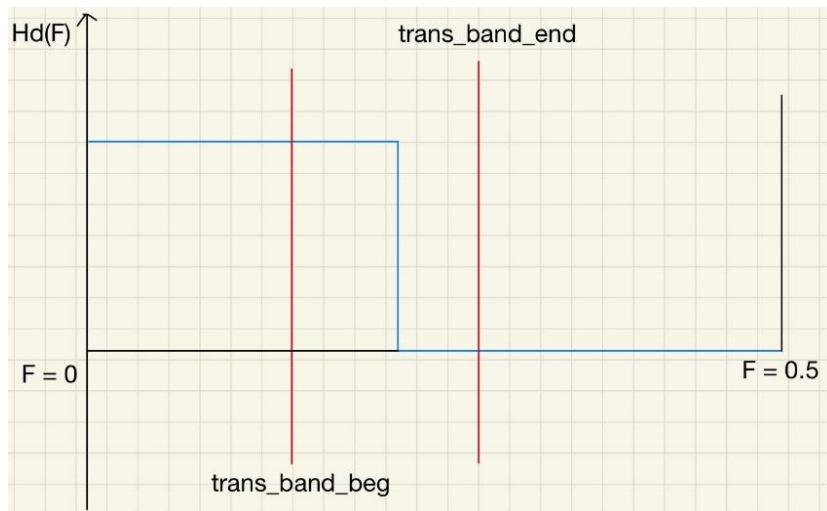
```

變數 `fs` 是在設定濾波器的取樣頻率。

變數 `N` 是在設定濾波器的取樣點數，因為是 `type4` 所以要設定成偶數。

變數 `Filter_type` 是在設定此濾波器的模式。設定 `0` 是低通濾波器，反之，設定 `1` 是高通濾波器。

變數 `trans_band_beg` 跟 `trans_band_end` 是在設定 transtion band 的起始位置以及結束位置。下圖以 `fs = 6000` 為例，`trans_band_beg` 設定為 `1200`($F = 1200 / 6000 = 0.2$)，`trans_band_end` 設定為 `1500`($F = 1500 / 6000 = 0.25$)。因為 `fs = 6000` 且 `F` 的數值是從 `0~0.5`，所以這兩個變數只能設定小於 `fs / 2 = 3000`、`F = 0.5` 的數值。`trans_band_end` 要大於 `trans_band_beg`。



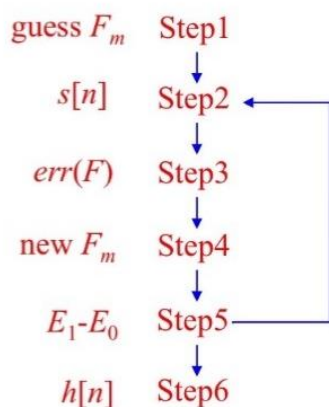
變數 `Weight_low` 是在設定 `trans_band_beg` 前面波型的權重數值(Ex :

`Weight_low = 1`)。

變數 `Weight_high` 是在設定 `trans_band_end` 後面波型的權重數值(Ex :

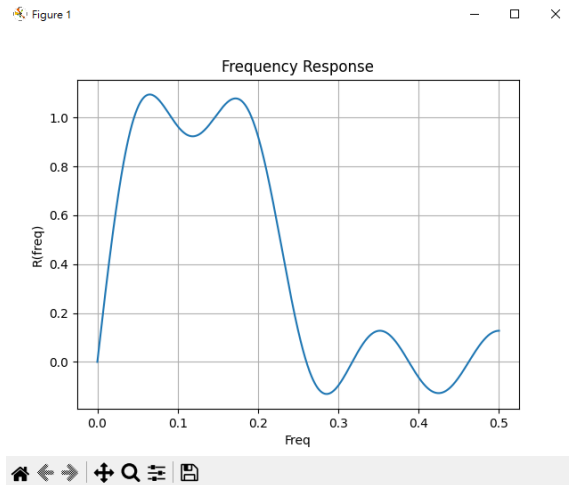
`Weight_high = 0.6`)。

變數 `Iter_cond` 是在設定下圖 Step 2 ~ Step 5 的迭代終止條件。目前設定的為 0.0001。

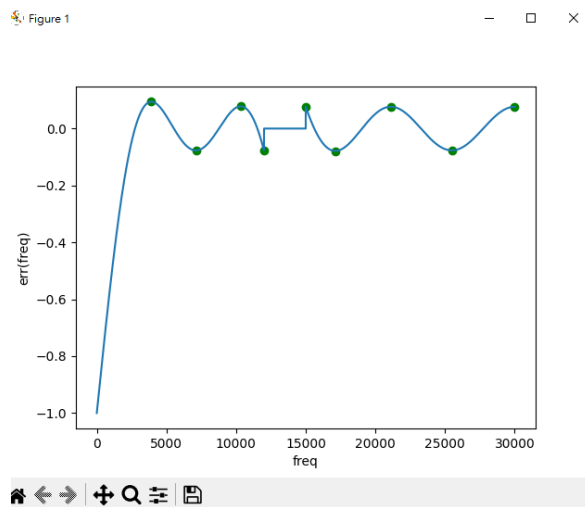


模擬結果 : $N = 16$; $fs = 6000$; $trans_band_beg = 1200$; $trans_band_end = 1500$; $Weight_low = 1$; $Weight_high = 0.6$; $Iter_cond = 0.0001$;

Type4 lowpass filter 的 Frequency Response

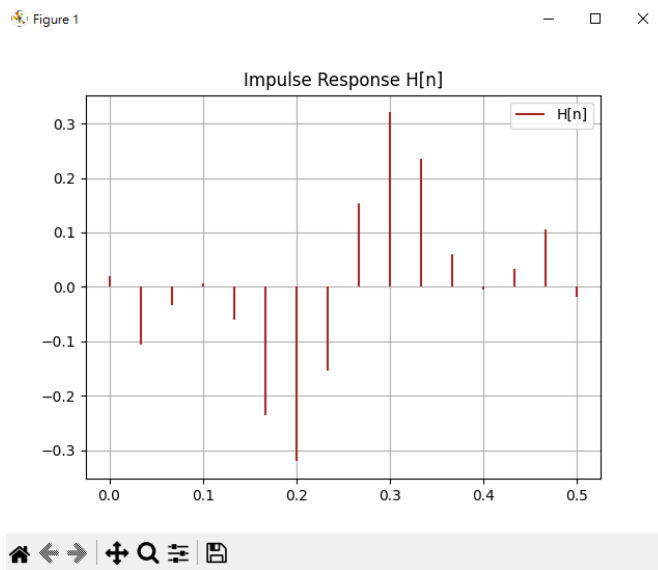


Type4 lowpass filter 的 Error Function 以及 Extreme Point ◦



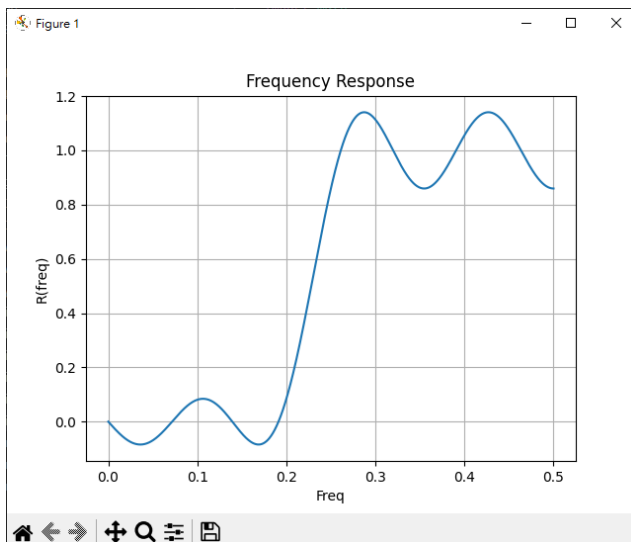
```
Extreme_Point[0] = 0.06525
Extreme_Point[1] = 0.11868333333333334
Extreme_Point[2] = 0.17205
Extreme_Point[3] = 0.2
Extreme_Point[4] = 0.25
Extreme_Point[5] = 0.2854
Extreme_Point[6] = 0.35176666666666667
Extreme_Point[7] = 0.42476666666666667
Extreme_Point[8] = 0.5
MaxIter = 1.0
MaxError = 1.0
```

Type4 lowpass filter 的 Impulse Response(Odd symmetric) ◦

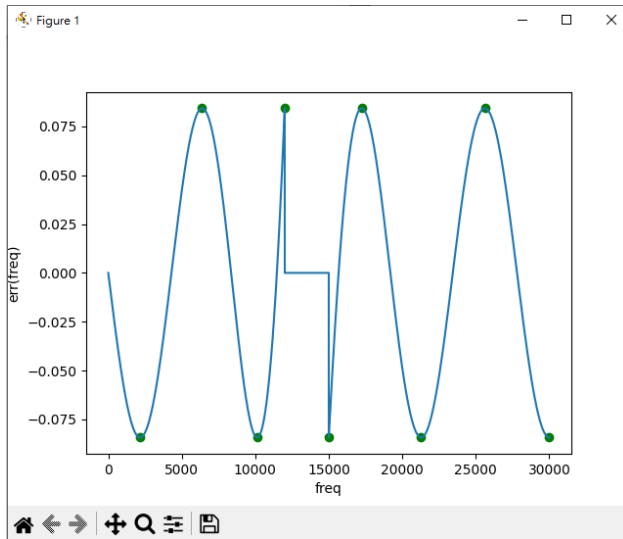


```
Impulse Response Hd[0] = 0.01913062969588635
Impulse Response Hd[1] = -0.10593182070249224
Impulse Response Hd[2] = -0.034061027485681544
Impulse Response Hd[3] = 0.005640589291456222
Impulse Response Hd[4] = -0.06012449144707968
Impulse Response Hd[5] = -0.23539652981208928
Impulse Response Hd[6] = -0.3204742668235227
Impulse Response Hd[7] = -0.15319917720526732
Impulse Response Hd[8] = 0.15319917720526732
Impulse Response Hd[9] = 0.3204742668235227
Impulse Response Hd[10] = 0.23539652981208928
Impulse Response Hd[11] = 0.06012449144707968
Impulse Response Hd[12] = -0.005640589291456222
Impulse Response Hd[13] = 0.034061027485681544
Impulse Response Hd[14] = 0.10593182070249224
Impulse Response Hd[15] = -0.01913062969588635
```

Type4 highpass filter 的 Frequency Response



Type4 highpass filter 的 Error Function 以及 Extreme Point ◦

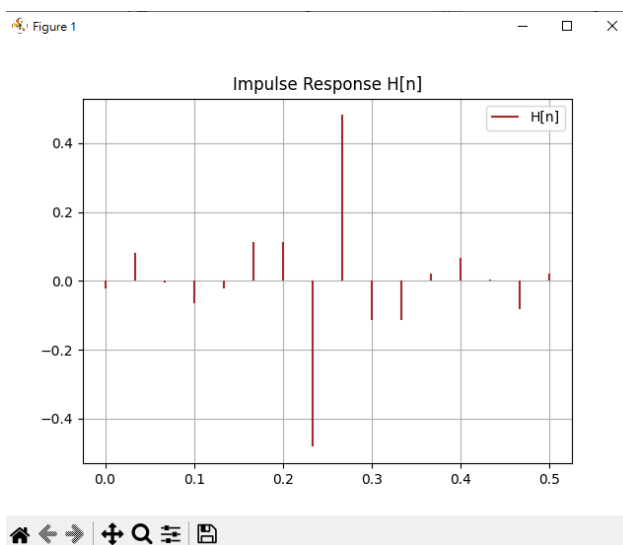


```

Extreme_Point[0] = [0.03603333]
Extreme_Point[1] = [0.10636667]
Extreme_Point[2] = [0.16878333]
Extreme_Point[3] = [0.2]
Extreme_Point[4] = [0.25]
Extreme_Point[5] = [0.28733333]
Extreme_Point[6] = [0.35471667]
Extreme_Point[7] = [0.4269]
Extreme_Point[8] = [0.5]
MaxIter = 0.08436222960078478
MaxError = 0.08433591774799337
////////////////////////////////////

```

Type4 highpass filter 的 Impulse Response(Odd symmetric) ◦




```
Impulse Response Hd[0] = -0.0210839794369983
Impulse Response Hd[1] = 0.08192864626517818
Impulse Response Hd[2] = -0.0053589831732368115
Impulse Response Hd[3] = -0.06567782903478316
Impulse Response Hd[4] = -0.022071325723125056
Impulse Response Hd[5] = 0.11386440389509772
Impulse Response Hd[6] = 0.11215409312623931
Impulse Response Hd[7] = -0.48180388662877577
Impulse Response Hd[8] = 0.48180388662877577
Impulse Response Hd[9] = -0.11215409312623931
Impulse Response Hd[10] = -0.11386440389509772
Impulse Response Hd[11] = 0.022071325723125056
Impulse Response Hd[12] = 0.06567782903478316
Impulse Response Hd[13] = 0.0053589831732368115
Impulse Response Hd[14] = -0.08192864626517818
Impulse Response Hd[15] = 0.0210839794369983
```