

6.Modify filter_16.py so that it produces a stereo signal with a different frequency in left and right channels. Use headphones to verify the stereo effect.

Python code: 6_my.py

```
#16 bit/sample
#y(n) = x(n) -a1 y(n-1) -a2 y(n-2)
from math import cos, pi
import struct
import pyaudio
```

```
Fs = 8000
T = 1
N = T * Fs
f1 = 800
f2 = 100
om1 = 2 * pi * float(f1) / Fs
om2 = 2 * pi * float(f2) / Fs
r = 0.998
#channel-1(with _1)
a0_1 = 1
a1_1 = -2 * r * cos(om1)
a2_1 = r**2
b0_1 = 1
b1_1 = 0
b2_1 = 0
#channel-2(with _2)
a0_2 = 1
a1_2 = -2 * r * cos(om2)
a2_2 = r**2
b0_2 = 1
b1_2 = 0
b2_2 = 0
```

```

y1_1 = 0.0
y2_1 = 0.0
y1_2 = 0.0
y2_2 = 0.0
gain = 10000.0

p = pyaudio.PyAudio()
stream = p.open(format = pyaudio.paInt16, #16 bits
                channels = 2, #stereo
                rate = Fs,
                input = False,
                output = True)

for n in range(0, N):
    if n == 0:
        x0 = 1.0
    else:
        x0 = 0.0
    y0_1 = x0 - a1_1 * y1_1 - a2_1 * y2_1 #channel-1
    y0_2 = x0 - a1_2 * y1_2 - a2_2 * y2_2 #channel-2
    #delays
    y2_1 = y1_1
    y1_1 = y0_1
    y2_2 = y1_2
    y1_2 = y0_2

    output_value_1 = gain * y0_1
    if output_value_1 > 2**15-1:
        output_value_1 = 2**15-1
    elif output_value_1 < -2**15:
        output_value_1 = -2**15

    output_value_2 = gain * y0_2

```

```

if output_value_2 > 2**15-1:
    output_value_2 = 2**15-1
elif output_value_2 < -2**15:
    output_value_2 = -2**15

output_string = struct.pack('h', int(output_value_1))
output_string += struct.pack('h', int(output_value_2))
stream.write(output_string)

print(" * finished * ")

stream.stop_stream()
stream.close()

p.terminate()

```

Comment:

Since we had different frequency in each channel, thus led to different coefficient in the equation. So I wrote these two channels individually. Then put the output value in stream one by one.

Firstly, I used $f_1 = 800$, $f_2 = 400$, and run the code with headphones. However it seemed not too much difference between these two channels. Then I changed the frequency $f_1 = 800$, $f_2 = 100$, it comes with a clear distinguish between the two channels.