assigned_lab_myun7_hli106

March 17, 2019

In [24]:
```
import numpy as np
import matplotlib.pyplot as plt
from scipy.io.wavfile import read, write
from numpy.fft import fft, ifft
from IPython.display import Audio
```

In [25]:
```
FRAME_SIZE = 2048
SKIP = 1024
```

In [26]:
```
# testing file can be either test_audio.wav or helicopter.wav
Fs, data = read('helicopter.wav')
numFrames = int(len(data) / SKIP)
output = np.zeros(len(data))
window_num = 0
noise_spectrum = np.zeros(FRAME_SIZE)
frame = np.zeros(FRAME_SIZE)

residual = np.zeros(FRAME_SIZE)

previous = np.zeros(FRAME_SIZE)
current = np.zeros(FRAME_SIZE)
future = np.zeros(FRAME_SIZE)

c_flag = 0
```

In [27]:
```
for i in range(numFrames):
    frame = data[i * SKIP : (i * SKIP + FRAME_SIZE)]

    if(len(frame) < FRAME_SIZE):
        continue

    #Judging non-speech and speech activity
    energy = np.zeros(frame.shape[0])
    for j in range(frame.shape[0]):
        energy[j] = pow(frame[j], 2)

    if (sum(energy) < 990000000):
        f_flag = 0
```

```
else:
    f_flag = 1

if (f_flag == 0):  #if non-speech get noise spectrum
    curFft = np.abs(np.fft.fft(frame))  #get N

    #calculate residual noise
    for p in range(FRAME_SIZE):
        absolute = np.abs(curFft[p] - noise_spectrum[p]*curFft[p]/np.abs(curFft[p]
        if (absolute > residual[p]):
            residual[p] = absolute

    #calculate noise_spectrum
    noise_spectrum = (noise_spectrum * window_num + curFft)/(window_num + 1)
    window_num = window_num + 1

#start from third future frame, use to update first and second frame
if (i<2):
    continue

windowed = np.zeros(FRAME_SIZE)
temp_ns = np.zeros(FRAME_SIZE)
for k in range(FRAME_SIZE):
    #compute future data
    windowed[k] = frame[k] * (0.5 - 0.5*np.cos(2*np.pi*k/(FRAME_SIZE-1)))
    #compute current data
    temp_ns[k] = data[(i-1) * SKIP +k]* (0.5 - 0.5*np.cos(2*np.pi*k/(FRAME_SIZE-1)

#future fft
curFft = np.fft.fft(windowed)
magnitude = np.abs(curFft)

#current fft
curFft_ns = np.fft.fft(temp_ns)

# spectral subtraction estimator + halfway rectifier
for t in range(FRAME_SIZE):
    if (magnitude[t] < noise_spectrum[t]):
        future[t] = 0
    else:
        future[t] = (magnitude[t] - noise_spectrum[t])*curFft[t]/magnitude[t]


if(c_flag==0):  #handle data for current frame if non-speech
    current= 0.0001*curFft_ns

else:    #handle data for current frame if speech
    for t in range(FRAME_SIZE):
```

```
                    if (np.abs(current[t]) < residual[t]):
                        ada = [np.abs(previous[t]), np.abs(current[t]), np.abs(future[t])]
                        min_value = np.min(ada)
                        if (min_value == 0):
                            current[t] = 0
                        else:
                            current[t] = 2*min_value*current[t]/ada[1]



            temp = np.fft.ifft(previous)
            output[(i-2) * SKIP : (i-2) * SKIP + FRAME_SIZE] = output[(i-2) * SKIP : (i-2) * S

            previous = current
            current = future
            c_flag = f_flag
```

```
/Users/lihongyi/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:54: ComplexWarning
/Users/lihongyi/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:73: ComplexWarning
/Users/lihongyi/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:22: RuntimeWarning
```

In [28]:
```
# Play out the original audio
Audio(data, rate=Fs)
```

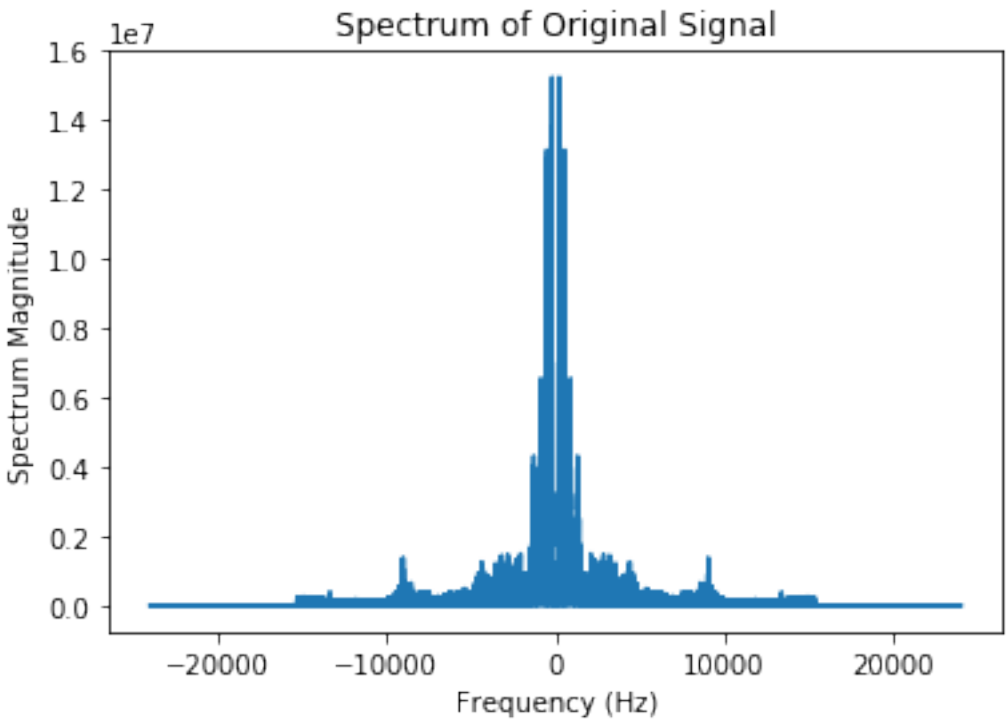
Out[28]:
```
<IPython.lib.display.Audio object>
```

In [29]:
```
# Play out the output audio
Audio(output, rate=Fs)
```

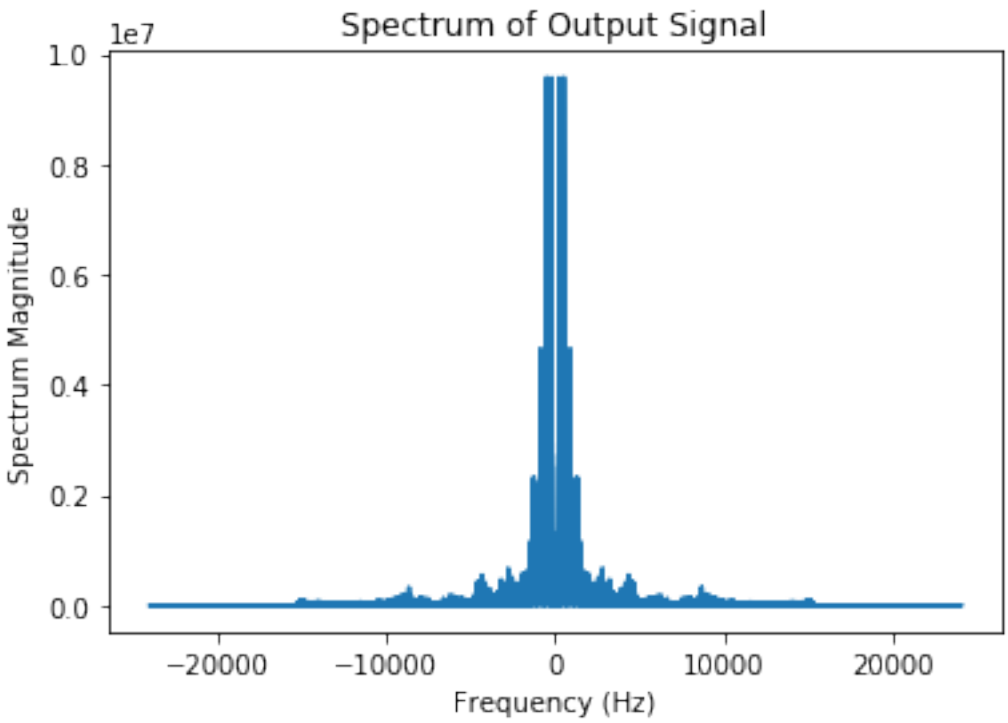
Out[29]:
```
<IPython.lib.display.Audio object>
```

In [30]:
```
DFT = np.fft.fft(data)

#Generate the frequency values in horizontal axis
freq = np.fft.fftfreq(data.size, 1/Fs)
plt.plot(freq,abs(DFT))
plt.xlabel('Frequency (Hz)')
plt.ylabel('Spectrum Magnitude')
plt.title('Spectrum of Original Signal')
plt.show()
```




```
In [31]: DFT = np.fft.fft(output)
         #Generate the frequency values in horizontal axis
         freq = np.fft.fftfreq(output.size, 1/Fs)
         plt.plot(freq,abs(DFT))
         plt.xlabel('Frequency (Hz)')
         plt.ylabel('Spectrum Magnitude')
         plt.title('Spectrum of Output Signal')
         plt.show()
```



In [32]:
```
# Print out sampling frequency
print(Fs)
```

```
48000
```