CH 11

Exer 01

阅读并且运行 **chap11.ipynb** 上面的代码示例，听一听示例中的音频。

In [67]:

```
# Get thinkdsp.py

import os

if not os.path.exists('thinkdsp.py'):
    !wget https://github.com/AllenDowney/ThinkDSP/raw/master/code/thinkdsp.py
```

In [68]:

```
import numpy as np
import matplotlib.pyplot as plt

from thinkdsp import decorate
from thinkdsp import read_wave
```

Exer 03

引入鼓聲訊號

In [69]:

```
if not os.path.exists('263868__kevcio__amen-break-a-160-bpm.wav'):
    !wget https://github.com/AllenDowney/ThinkDSP/raw/master/code/263868__kevcio__amen-b
reak-a-160-bpm.wav
```

In [70]:

```
wave = read_wave('263868__kevcio__amen-break-a-160-bpm.wav')
print(wave.framerate)
wave.normalize()
wave.make_audio()
```

```
44100
```

Out[70]:

Your browser does not support the audio element.

對鼓聲做低通濾波，**freq=10000**

In [71]:

```
spectrum_filiter = wave.make_spectrum()
spectrum_filiter.low_pass(10000)
wave_filiter = spectrum_filiter.make_wave()
wave_filiter.make_audio()
```

Out[71]:

Your browser does not support the audio element.

In [72]:

```
from thinkdsp import Wave
```

```
def sample(wave, factor):
    """Simulates sampling of a wave.

    wave: Wave object
    factor: ratio of the new framerate to the original
    """
    ys = np.zeros(len(wave))
    ys[::factor] = wave.ys[::factor]
    return Wave(ys, framerate=wave.framerate)
```

接著進行取樣，取樣率=原來的一半，**44100/2=22050**。並且取樣完再做高低通率波，把過高頻和過低頻訊號去掉。

In [73]:

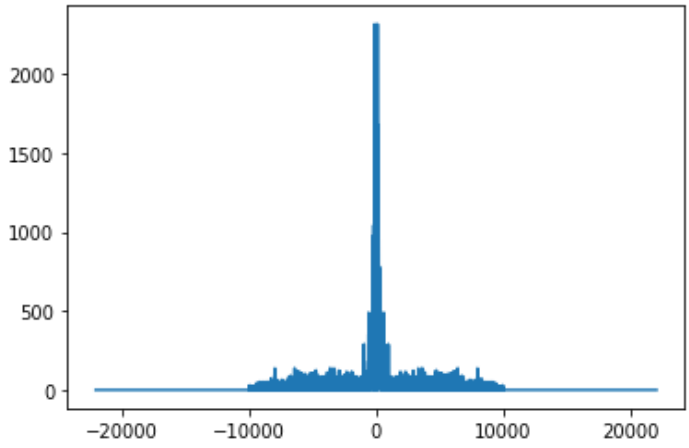
```
wave1 = sample(wave_filiter,2)

spectrum1 = wave1.make_spectrum(full=True)
spectrum1.low_pass(10000)
spectrum1.high_pass(-10000)
wave1 = spectrum1.make_wave()
```

In [74]:

```
wave1.make_spectrum(full=True).plot()
wave1.make_audio()
```

Out[74]:

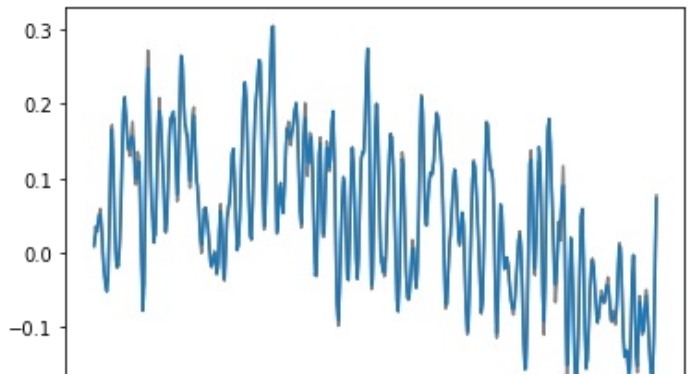
Your browser does not support the audio element.

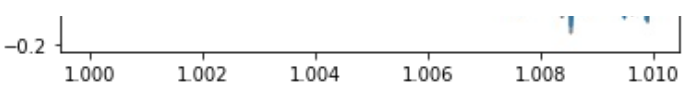


產生的訊號成果很漂亮。

In [76]:

```
def plot_segments(original, filtered):
    start = 1
    duration = 0.01
    original.segment(start=start, duration=duration).plot(color='gray')
    filtered.segment(start=start, duration=duration).plot()

plot_segments(wave,wave_filiter)
```





取樣+濾波的結果 與 **filter**的結果完全一樣。說明只要事先做好取樣率**/2**的低通濾波，在進行取樣，就不會產生雜訊干擾。