m03_ex1_ecg_50_hz_complete

October 3, 2024

The objective of this exercise is to study the influence of the parameterization of the Welch spectral estimator in order to highlight a 50 Hz perturbation in an ECG signal.

[2]:
```
import numpy as np
import pylab as py
py.ion()
py.close('all')
import scipy.signal as sp
```

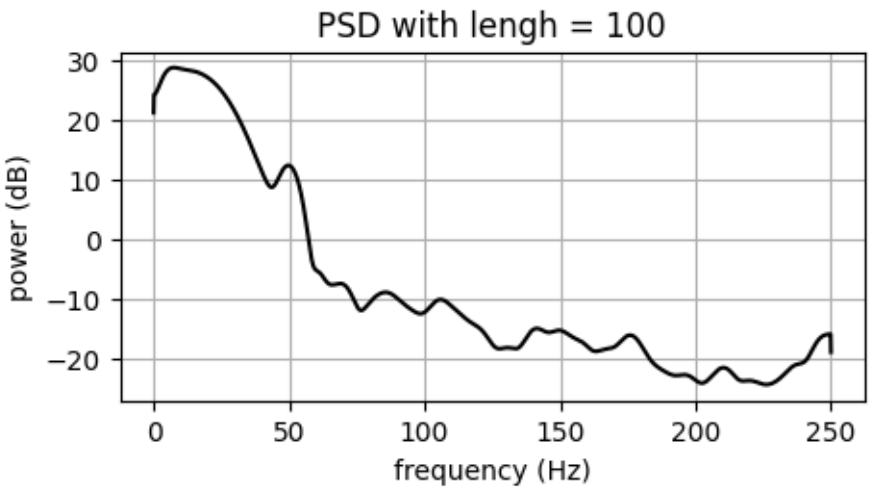
[3]:
```
x = np.genfromtxt('ecg.dat')
fs = 500
```

Objective: Compare spectral estimation for different window lengths using welch estimation. Plot the log spectrum of the signal using windows of 100, 500, 2000. Q: Comment the results. Q: Which windows length is the most suitable for the observation of 50 Hz? Q: Why?

[4]:
```
f,X_100 = sp.welch(x, nperseg=100, nfft=4096, fs=fs)
f,X_500 = sp.welch(x, nperseg=500, nfft=4096, fs=fs)
f,X_2000 = sp.welch(x, nperseg=2000, nfft=4096, fs=fs)
```

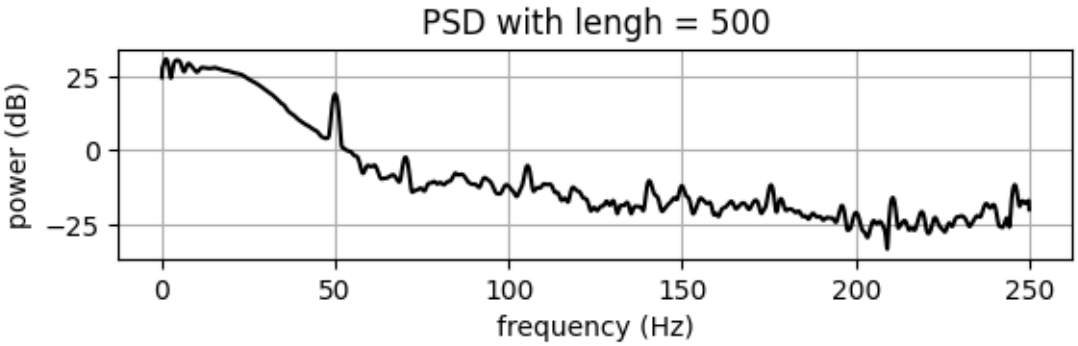
[5]:
```
py.figure(1, figsize=[5,8])
py.clf()
py.subplot(3,1,1)
py.plot(f, 10*np.log10(X_100), 'k')
py.grid()
py.xlabel('frequency (Hz)')
py.ylabel('power (dB)')
py.title('PSD with lengh = 100')
```

[5]:
```
Text(0.5, 1.0, 'PSD with lengh = 100')
```



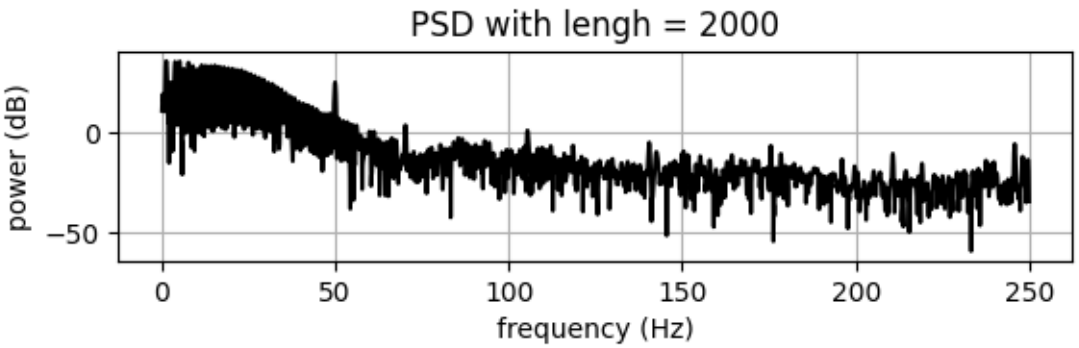
[6]:
```
py.subplot(3,1,2)
py.plot(f, 10*np.log10(X_500), 'k')
py.grid()
py.xlabel('frequency (Hz)')
py.ylabel('power (dB)')
py.title('PSD with lengh = 500')
```

[6]: Text(0.5, 1.0, 'PSD with lengh = 500')



[7]:
```
py.subplot(3,1,3)
py.plot(f, 10*np.log10(X_2000), 'k')
py.grid()
py.xlabel('frequency (Hz)')
py.ylabel('power (dB)')
py.title('PSD with lengh = 2000')
```

[7]: `Text(0.5, 1.0, 'PSD with lengh = 2000')`



0.0.1 Answer

From the three figures above, it is clear that using a window length of 2000 introduced a lot of noise. The frequency located at 50Hz, which is the interesting frequency is not clearly highlighted.

Concerning the two remaining sizes, we can say that regarding the first one, the curve lacks of details and therefore the peak at 50Hz is too much attenuated compared to the rest of the signal. This can be explained by the fact that taking a length of 100 will cut some important part of the signal.

Finally, a length of 500 is a good compromise, discarding the noise, while keeping the relevant part of the signal. The peak at 50Hz is distinct from the other frequencies.