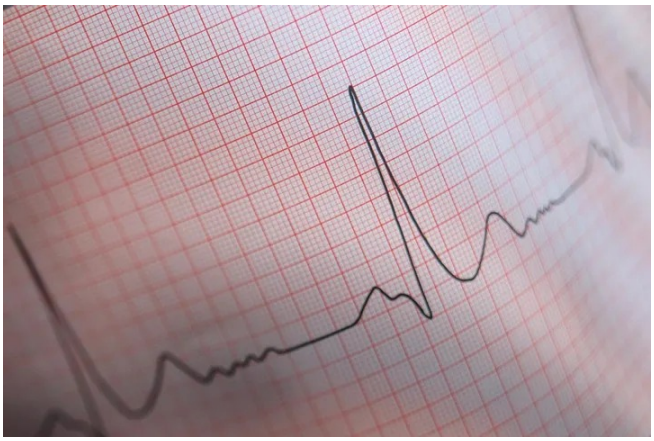
How to analyze an ECG with Python

Alejandro Ena · Follow
4 min read · Nov 16, 2022

I studied chemical engineering, but honestly, I've always liked the health sector. I feel passion for the possibilities that the mix of medicine and technology provide. That's why I studied biomedical engineering later. Why I'm writing that? Just to say to you, reader, that I hope that you enjoy this as I've enjoyed investigating. If you find this useful, let me know!

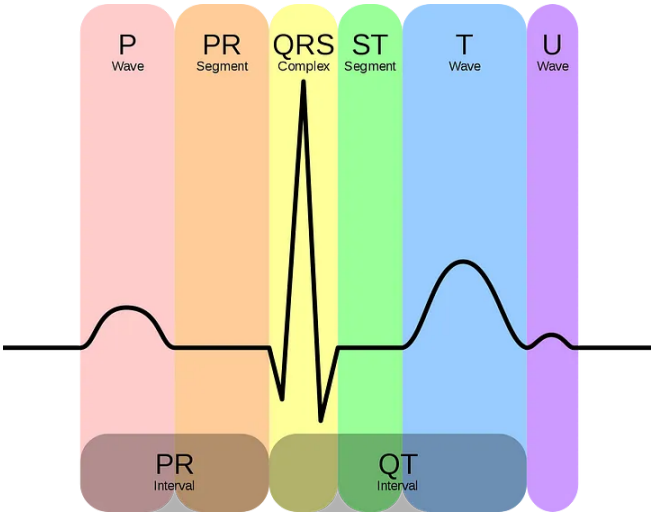


What is an ECG?

A standard electrocardiogram has 12 channels where the 12 electrodes are represented, each electrode is placed in a different place, as follows:

- Inferior leads show electrical activity from the vantage point of the inferior surface (diaphragmatic surface of heart).
- Lateral leads show the electrical activity from the vantage point of the lateral wall of left ventricle.
- Septal leads show the electrical activity from the vantage point of the septal surface of the heart.
- Anterior leads show the electrical activity from the vantage point of the anterior wall of the right and left ventricles

In this post its going to be explained a module that identify them and i will explain my personal approach that I've tried to make it easier. The different waves and intervals are shown below:



Analyze ECGs using Python's library Neurokit2

I was trying to analyze an ECG when I've found this library, and personally I really like it, follow the link to download it.

The installation is easy as every other library, type in the terminal:

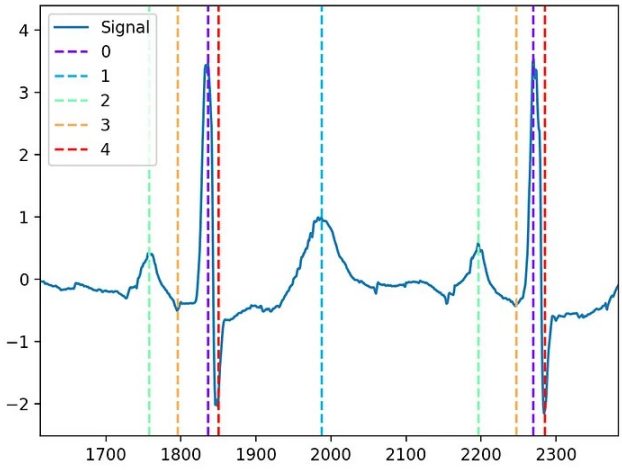
```
pip install neurokit2
```

Now we can play... No ECG library is needed, you can simulate your own ECG signal with the function nk.ecg_simulate()

We already have one signal to analyze, there the R peaks can be extracted:

```
_, rpeaks = nk.ecg_peaks(signal, sampling_rate=500)
_, waves_peak = nk.ecg_delineate(signal, rpeaks, sampling_rate=500, method="peak
```

With those 2 functions every peak can be extracted as can be seen:

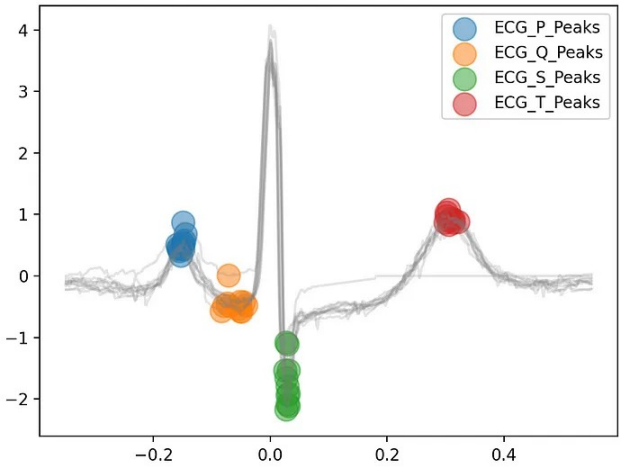


Signal 0 is the ECG, signal 10 is the R peak, signal 1 is the T peak, signal 2 is the P peak, signal 3 is the Q peak, signal 4 is the S peak

Also, there are functions that let the user to analyze all the heartbeats in just one plot:

```
signal_dwt, waves_dwt = nk.ecg_delineate(signal,
                                         rpeaks,
```

```
                                    sampling_rate=500,
                                    method="dwt",
                                    show=True,
                                    show_type='peaks')
```



The heartbeats can be easily calculated knowing the number of beats in the signal and the length of it. I recommend this library if you want to start analyzing ECG signals.

There are many more functions that you can check in the web linked above to play with!

My personal method

For a raw signal, the way I segmented every phase is the following:

```
signal= signal-np.mean(signal) #To center the signal in 0
outlier_indices = hampel(pd.Series(signal), window_size=100, n=3)

peaks = [list(map(itemgetter(1), g)) for k, g in groupby(enumerate(outlier_indic
peaks_max_vals = [peaks[i][np.argmax(abs(signal[peaks[i]]))] for i in range(len(
peaks_sign = np.sign(signal[peaks_max_vals])
diffs_max = np.where((np.diff(peaks_max_vals)<40))[0]
zipped_list = list(zip(signal[peaks_max_vals],peaks_sign,peaks_max_vals))

counter = 0

for i in diffs_max:
    a = i + 1
    if zipped_list[i][0] > zipped_list[a][0] and zipped_list[i][1]==zipped_list[
        peaks_max_vals.pop(a-counter)
        counter += 1
    if zipped_list[i][0] < zipped_list[a][0] and zipped_list[i][1]==zipped_list[
        peaks_max_vals.pop(i-counter)
        counter +=1
    else:
        pass
```

With the Hampel Filter I could extract the P,R,S,T peaks. Only the Q peaks didn't appear. But to find them, the minimum value between P and R peaks have to be found, so is not difficult to do.

To compare the heartbeats between them I should use Dynamic Time Warping method, but that work is under progress.

I hope this brief post has helped you in your investigations, see you soon!

Ecg Signal Processing Signal

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