

1. Script 1 – 2.1 Dual chart difference.py

Title: Comparison of Heart Rate Estimation Using `find_peaks` and `neurokit2`

Objective:

This script aims to compare heart rate (HR) values extracted from ECG data using two different peak detection methods:

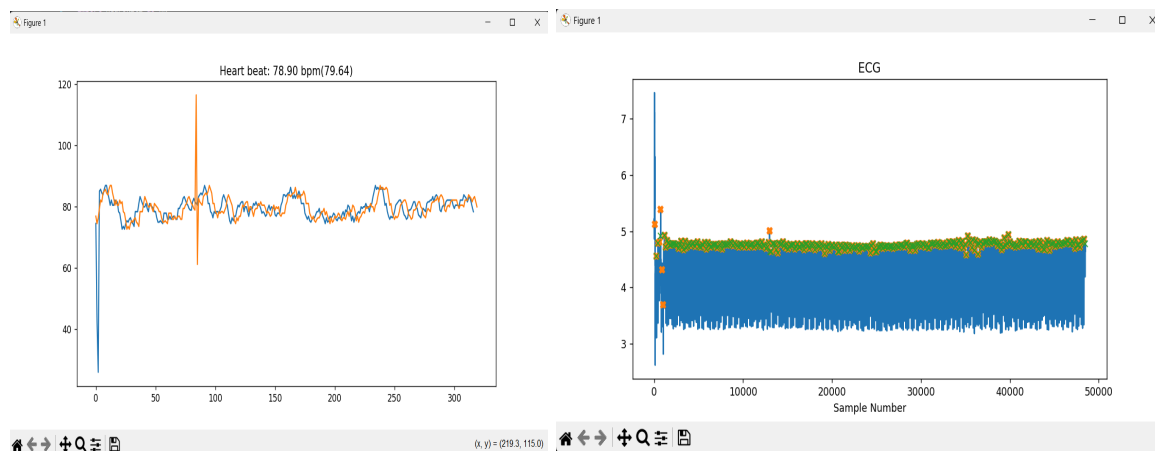
- `scipy.signal.find_peaks`: based on fixed height and distance thresholds
- `neurokit2.ecg_findpeaks`: an adaptive and physiology-based algorithm

Method:

The ECG signal is processed offline. R-peaks are detected separately using both methods.

Results:

- Both HR vectors are plotted for visual comparison.
- The HR signal derived from `neurokit2` tends to be smoother and more physiological.
- In contrast, `find_peaks` may produce false or missed peaks, leading to extreme HR spikes or drops.



2. Script 2 – 2.2 Dual chart difference.py

Title: Improved Comparison with Average Heart Rate Calculation

Objective:

An extension of Script 1, this version enhances the comparison by including the average HR for each method over the full dataset.

Method:

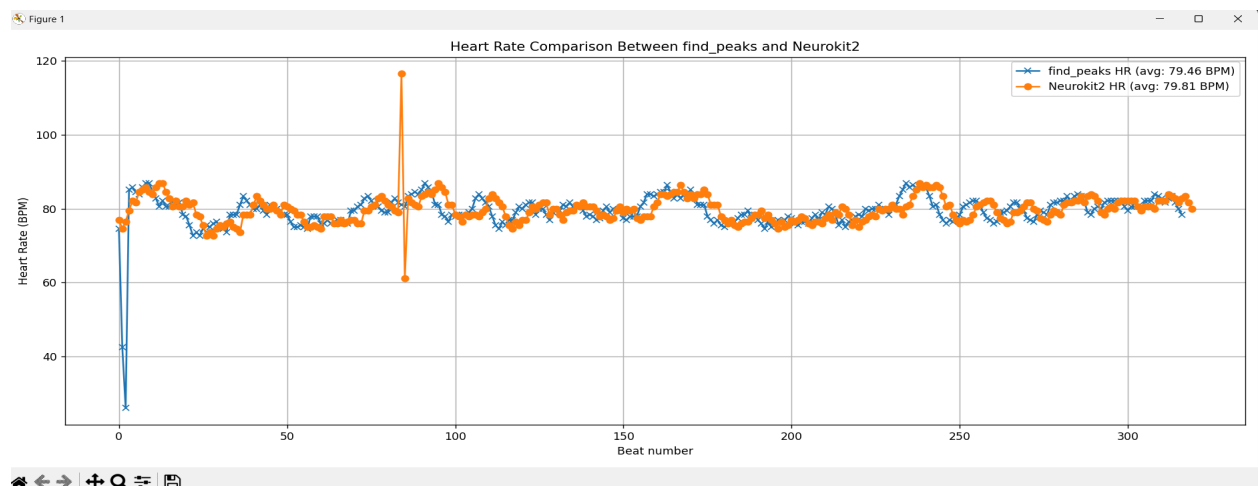
Same as Script 1, using `find_peaks` and `neurokit2` to detect R-peaks and compute RR intervals. HR values are plotted for each beat, and the overall mean HR for each method is displayed in the chart title.

Results:

- Similar beat-to-beat variation patterns are visible.
- The overall average HR for each method helps assess consistency.
- Noise and spikes still exist due to lack of outlier control or temporal smoothing.

Conclusion:

This version is more informative for comparing average HR outcomes, but further improvements are needed to make the HR signal clinically meaningful.



3. Script 3 – 3. Real time hr.py

Title: Real-Time Heart Rate Monitoring Using 2-Second Window

Objective:

To simulate a real-time ECG monitoring system using a 2-second rolling window to detect peaks and calculate heart rate dynamically.

Method:

- ECG signal is streamed in small segments (e.g., 10 samples at a time).
- A 2-second buffer is continuously updated.
- R-peaks are detected in each buffer using `neurokit2`.
- RR intervals are used to compute HR, which is then smoothed using a moving average.
- HR values that deviate sharply from the recent average are filtered out as outliers.
- Two synchronized plots are shown: one for ECG with peaks, and one for real-time HR trend.

Results:

- Provides a visually stable and responsive HR signal
- Eliminates most of the unrealistic spikes seen in offline methods
- The ECG display and HR trend are synchronized in real-time

Unique Feature:

This script uses only **the last 2 seconds of data (not the whole signal)** to make each HR estimation, making it ideal for real-time embedded systems or wearable devices.

Conclusion:

This method achieves real-time HR estimation with good stability, thanks to buffer-based processing, smoothing, and outlier control. It best simulates how HR would appear on a real-time monitor.

