DIGITAL SIGNAL PROCESSING PROJECT

WAVELET-BASED DENOISING OF ECG SIGNAL

PROJECT MENTOR

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PROJECT TEAM

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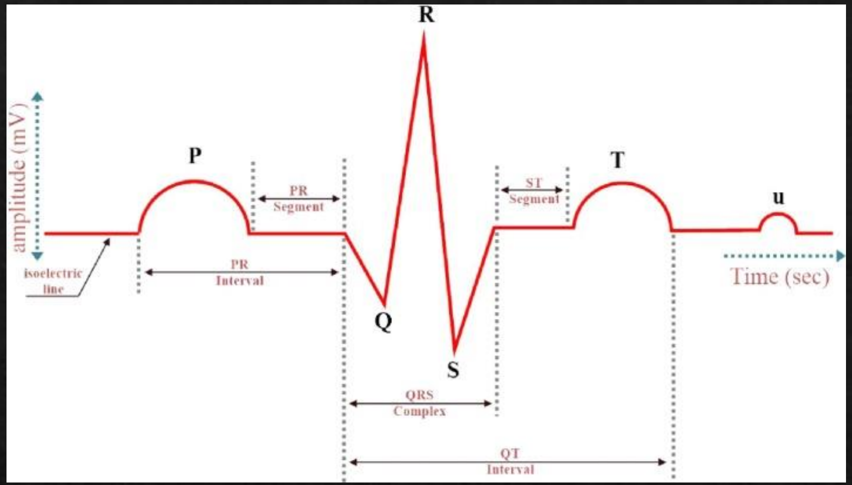
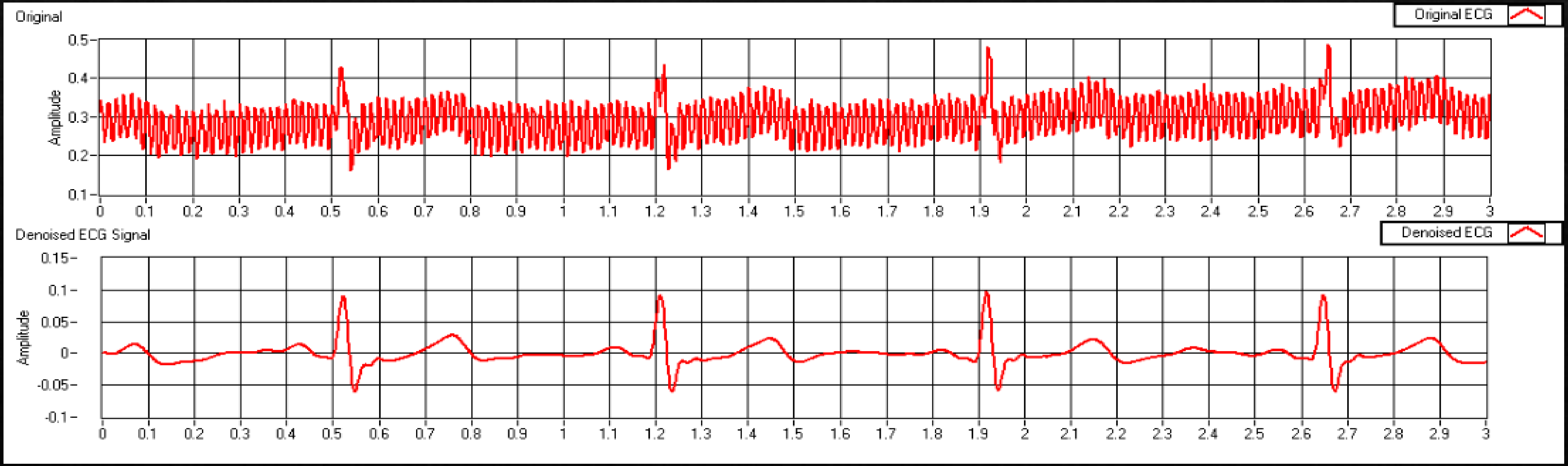
OBJECTIVE OF PROJECT

- ❑ Mainly ECG(Electrocardiogram) signals consists of PR segment, QRS complex, ST segment.
- ❑ Normally, raw ECG signals consists various types of noises.
- ❑ Our main aim of project is to remove those noises and detect QRS complex of ECG signal.

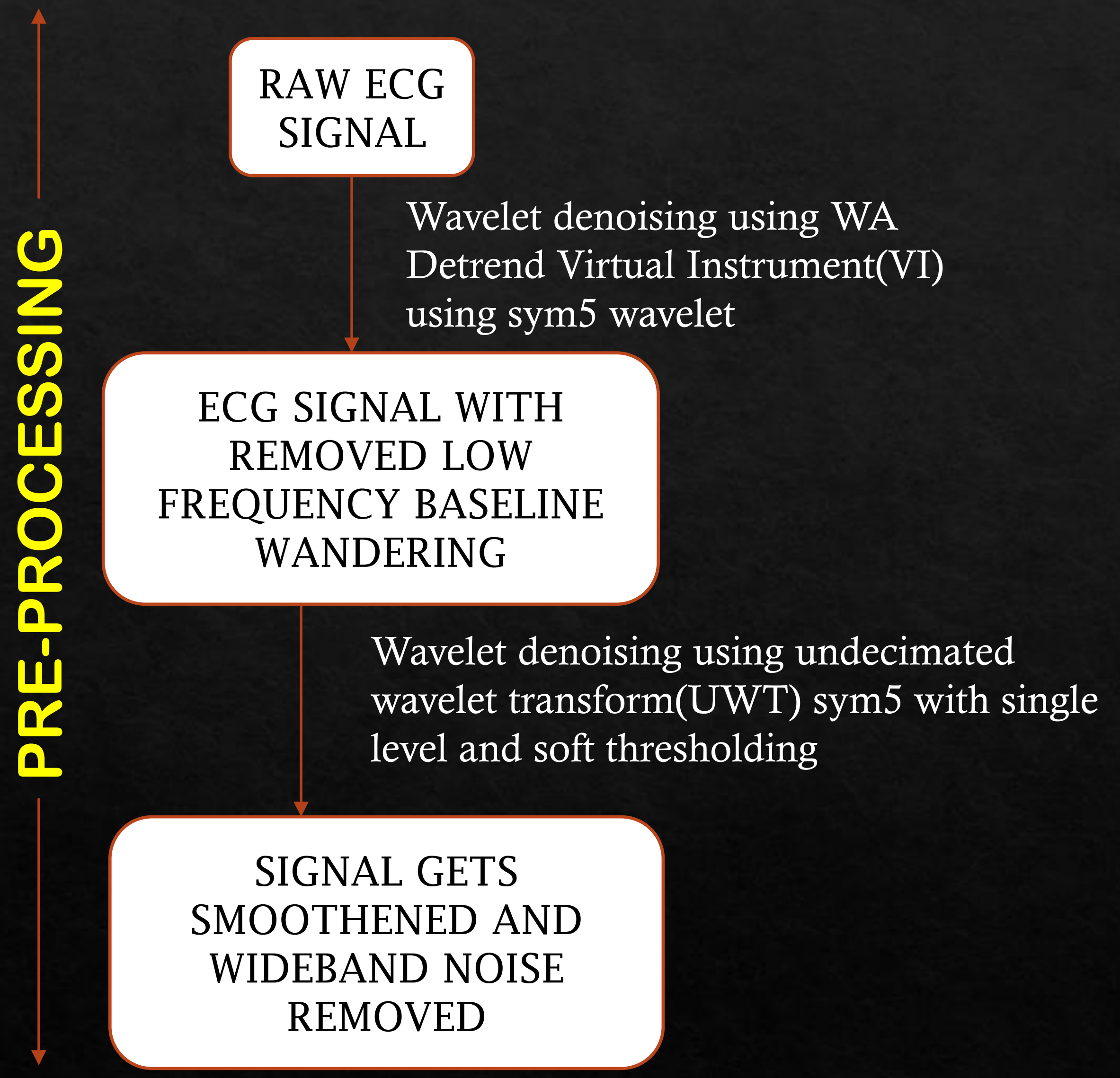


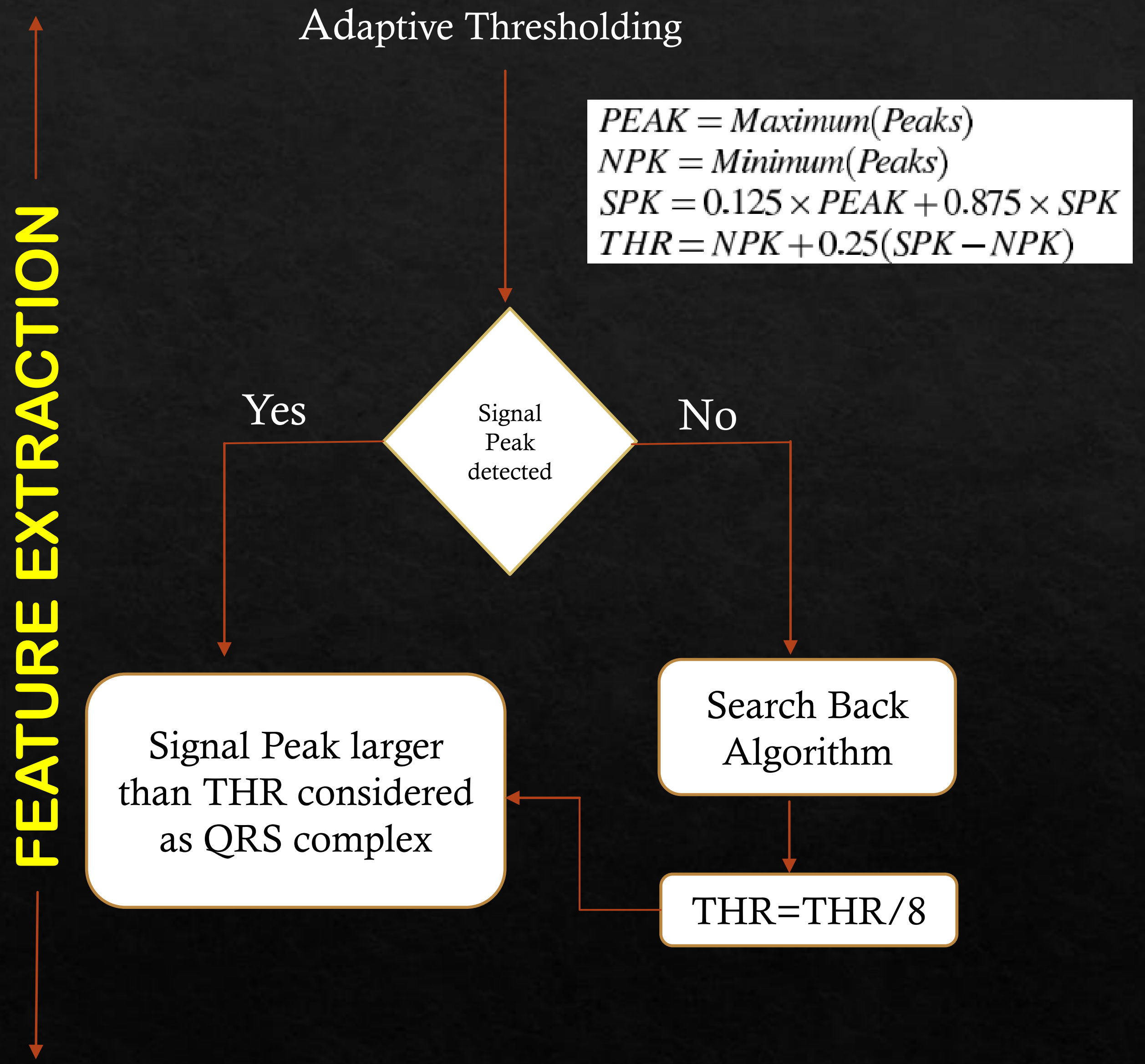


PROJECT OVERVIEW

- Design and implementation of an automatic ECG beat detection system.
- This project is a modified version of Pan-Tompkins algorithm which detects QRS complexes in ECG signals.
- During recording process of ECG signals noise effect the signal heavily which include baseline wandering ,EMG noise ,motion artifact, power line interference and electrode pop or contact noise.
- The denoising part is done using wavelet-based tools.
- This method performs much better in case of non-stationary ECG signal and would result in SNR gain when using wavelet denoising method.
- Probability of detection of fiducial points which are QRS complexes is more here compared to Pan-Tompkins algorithm.
- In Fourier Transform we usual get a range of values for the instantaneous frequency at a given point of time . This can be overcome by approximating the original signal to wavelets. This increases the resolution of the signal.

WORKING





The VI first decomposes the ECG signal into several sub-bands by applying wavelet transform and then modifies each wavelet coefficient by applying a threshold or shrinkage function and finally reconstructs the denoised signal. $\mathbf{C(\mathit{scale, coefficients})} = \int_{-\infty}^{\infty} f(t)\varphi(scale, position, t)\,dt$

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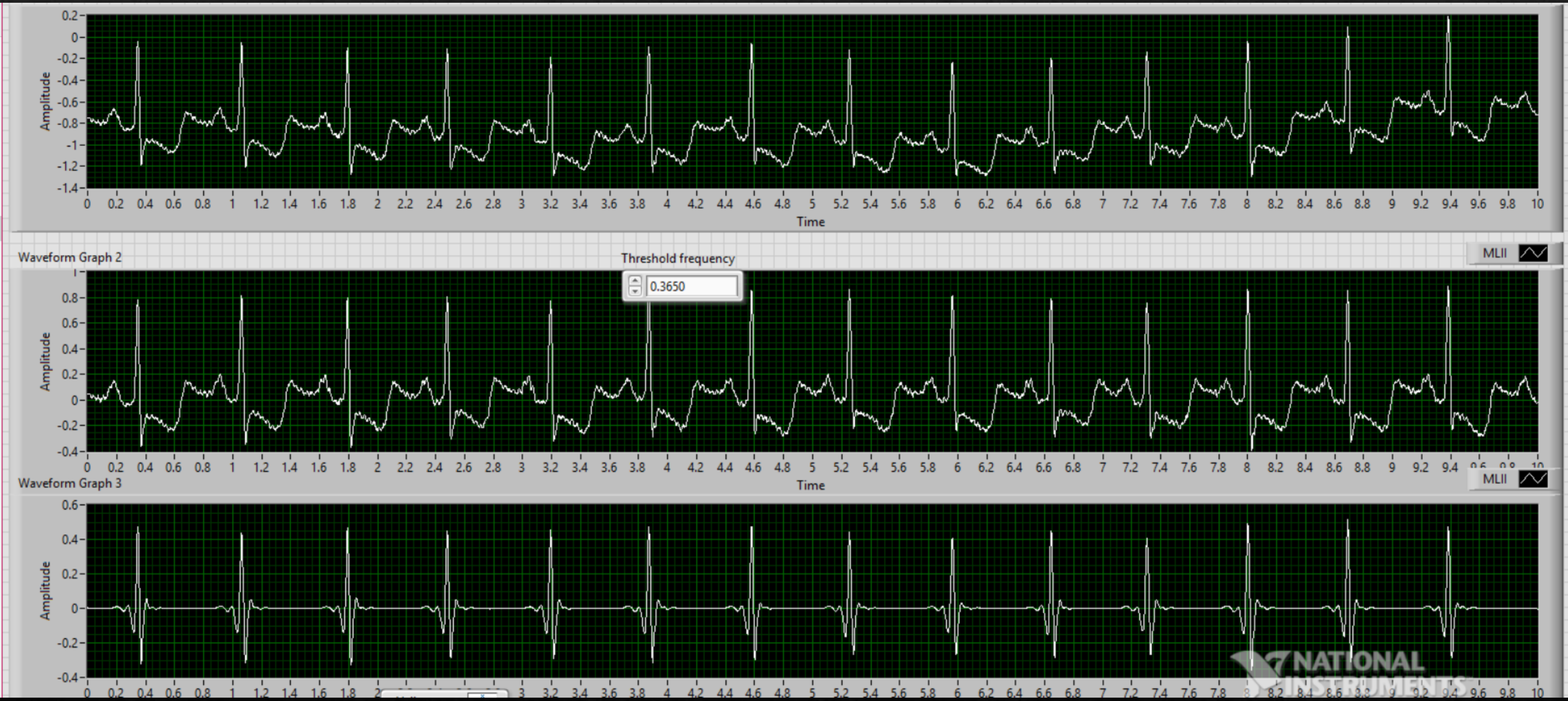
RESULTS

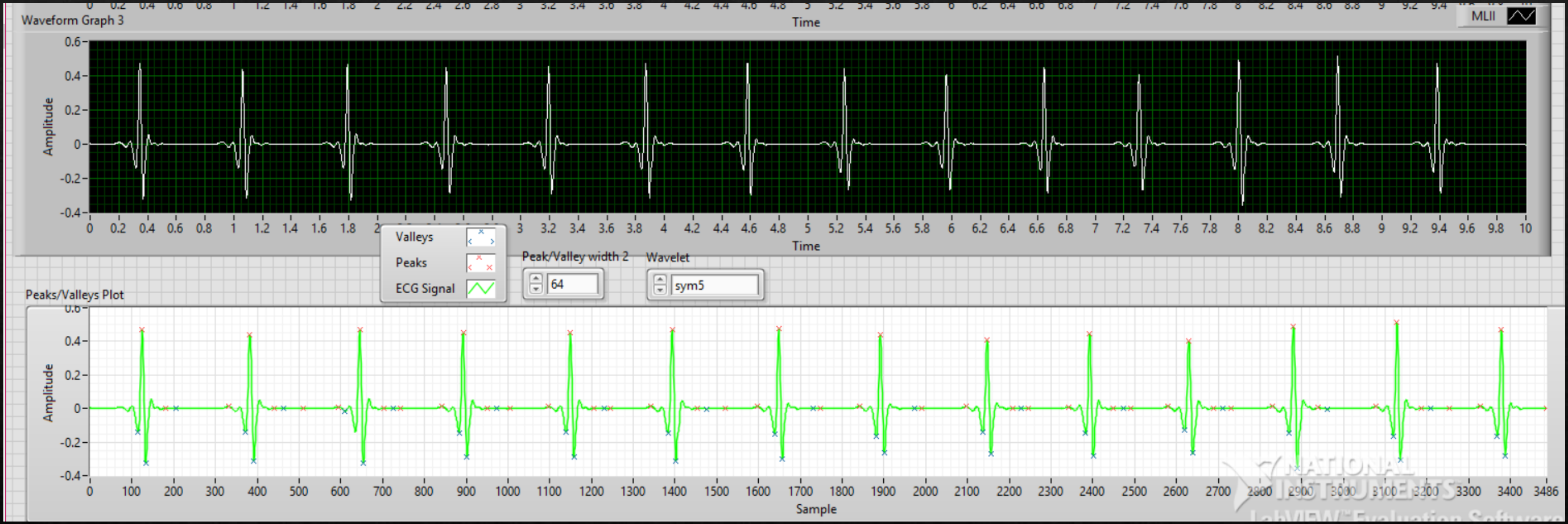


First waveform : Input ECG Signal

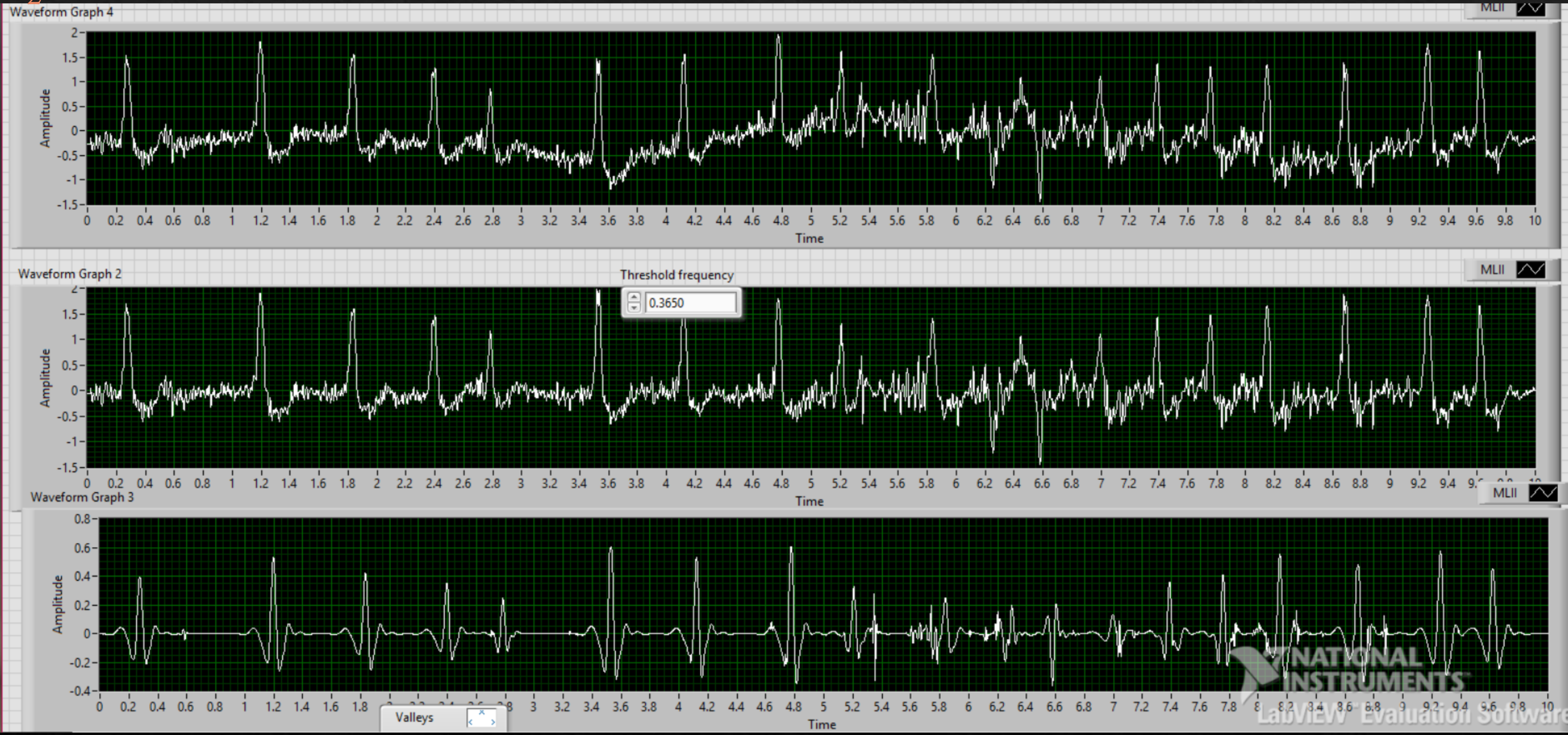
Second waveform: ECG signal after baseline wandering

Third waveform: ECG signal after smoothening and removal of wide band noise

Threshold Frequency= $\log_2(2 * 10)/ \log_2(3600)$



Peaks /Valleys plot shows us the detection of peaks and valleys from the denoised ECG signal and number of peaks and valleys depends on peak/valley width.



First waveform : Input ECG Signal

Third waveform: ECG signal after smoothening and removal of wide band noise

Second waveform: ECG signal after baseline wandering

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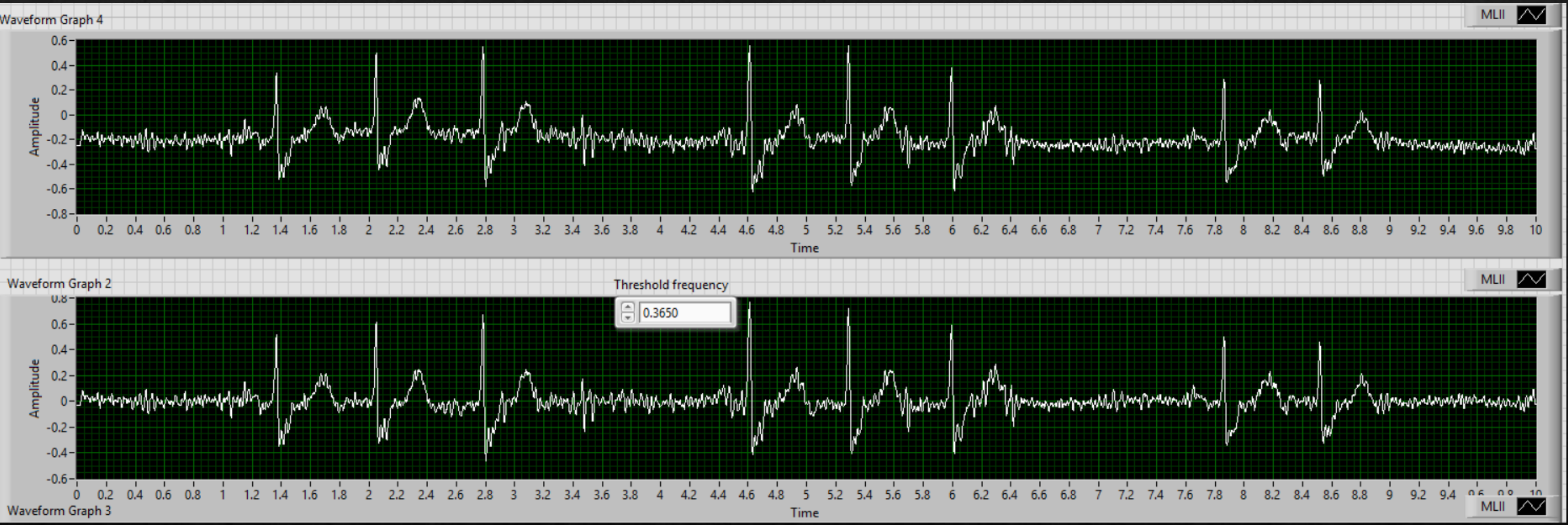

First waveform : Input ECG Signal

Second waveform: ECG signal after baseline wandering

Threshold Frequency= $\log_2(2 * 10) / \log_2(3600)$

First Waveform: After Wide band noise removal from ECG signal.
Peaks /Valleys plot shows us the detection of peaks and valleys from the denoised ECG signal and number of peaks and valleys depends on peak/valley width