**Plots of noisy signal and original signal**

In Figure 1, the plot of the original signal versus time is plotted. The sampling frequency is 360 Hz, and the the time vector is established based on the sampling frequency, where the interval is equal to the sampling period and time span is 1 0s. Similarly, the plot of the noisy signal versus time is plotted in Figure 2.

图表

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Figure 1: ECG Signal versus time

图表

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Figure 2: Noise versus time

**Heart Rate (Bpm)**

The heart rate is calculated as beats per minute (Bpm). In the ECG signal, the average heart rate can be calculated by dividing the the number of extrema by duration in one minute:

(1)

Where is the number of extrema and is the duration in one minute. The duration in one minute can be calculated by dividing the time span by 60 seconds. As mentioned before, the time span is 10 seconds then is . The extrema can be defined as the local maxima in ECG signal as shown in Figure 3. The final calculated Bpm is approximately 72.

图表

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Figure 3: Number of extrema and calculated

**Original and Noisy signal in frequency domain**

Before designing the low pass filter, the original signal and Noise signal in frequency domain need to be shown so that we can find the frequency where we can find the signal that we do not want. The plot of the ECG signal in frequency time domain is shown in Figure 4.

图表, 直方图

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Figure 4: ECG signal in frequency domain