

A Comparison of IIR and Wavelet Filtering for Noise Reduction of the ECG

Jens Stampe Soerensen*, Lars Johannesen, Ulrik Silvanus Lerkevang Grove, Kasper Lundhus, Jean-Philippe Couderc and Claus Graff

Health Science and Technology, Aalborg University, Aalborg, Denmark

Baseline wander and powerline noise both have confined power spectra making the use of narrowband linear time-invariant filters (IIR) ideal. For transient ECG noise, wavelet filtering has been proposed as a potential filtering alternative to IIR filtering. This study compares the ability to preserve information and reduce noise contaminants for five wavelet filters and three IIR filters. Two 3-lead Holter ECGs from healthy subjects were obtained from the Telemetric and Holter ECG Warehouse. A one minute noise-free segment was identified from lead X of the first ECG and replicated to 24 h duration. White Gaussian noise (15 dB SNR) was added to the noise free ECG in increments of 10% coverage. The second ECG was a 2.5 minute segment with alternating muscle transients (70% total) and noise-free segments (30% total) of approximately 10 s durations. Computation times and improvements in SNR for different noise coverages were calculated for all filters and compared. RMS errors were calculated from noise-free segments on the ECG with transient muscle noise. Wavelet filters improved SNR more than IIR filters when the signal was covered by more than 50 % noise. In contrast, the computation times were shorter for IIR filters (6 s) than for wavelet filters (88 s). There was no difference between wavelet and IIR filtering with respect to RMS errors on the ECG with transient muscle noise. In a clinical setting where the amount of noise is unknown, we recommend using IIR filters over wavelet filtering for consistent performance and low computation time.