

Digital Filters for Real-Time ECG Signal Processing

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Abstract/Aim of project

Implementation of real time digital filtering algorithms as an alternative to analog filtering methods to conduct signal conditioning of ECG(electrocardiogram) signals

Importance of digital filtering:

- 1) Digital filters can conduct filtering processing which might be impossible in an analog domain
- 2) Reduced computation time
- 3) Increase flexibility of filtering processes(since you just have to change the code and not the circuit)

Challenges or motivation of work

Challenges of analog filters:

- 1) Analog filters are affected by environmental noise
- 2) Analog filters are often bulky and not easily portable due to circuit components
- 3) Rigid and cannot be easily modified without change of hardware.

Motivations for designing digital filters:

- 1) Not affected by environmental noise
- 2) Easily portable as only transfer of code is needed
- 3) Can easily be modified with change of code.
- 4) Can perform processes which are difficult to implement using analog filters

References

- [1] B. Widrow, J. R. Glover, Jr., J. M. McCool, J. Kaunitz, C. S. Williams, R. H. Hearn, J. R. Zeidler, E. Dong, Jr., and R. C. Goodlin, "Adaptive noise cancelling: Principles and applications," Proc. IEEE, vol. 63, pp. 1692-1716, 1975.
- [2] Muzaffar Saba Anjum and Dr. Monisha Chakraborty, ECG Data Compression using Turning PointAlgorithm, International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences, Volume 2, page 42, Issue 3, December 2014

Method /Algorithms/ important concepts

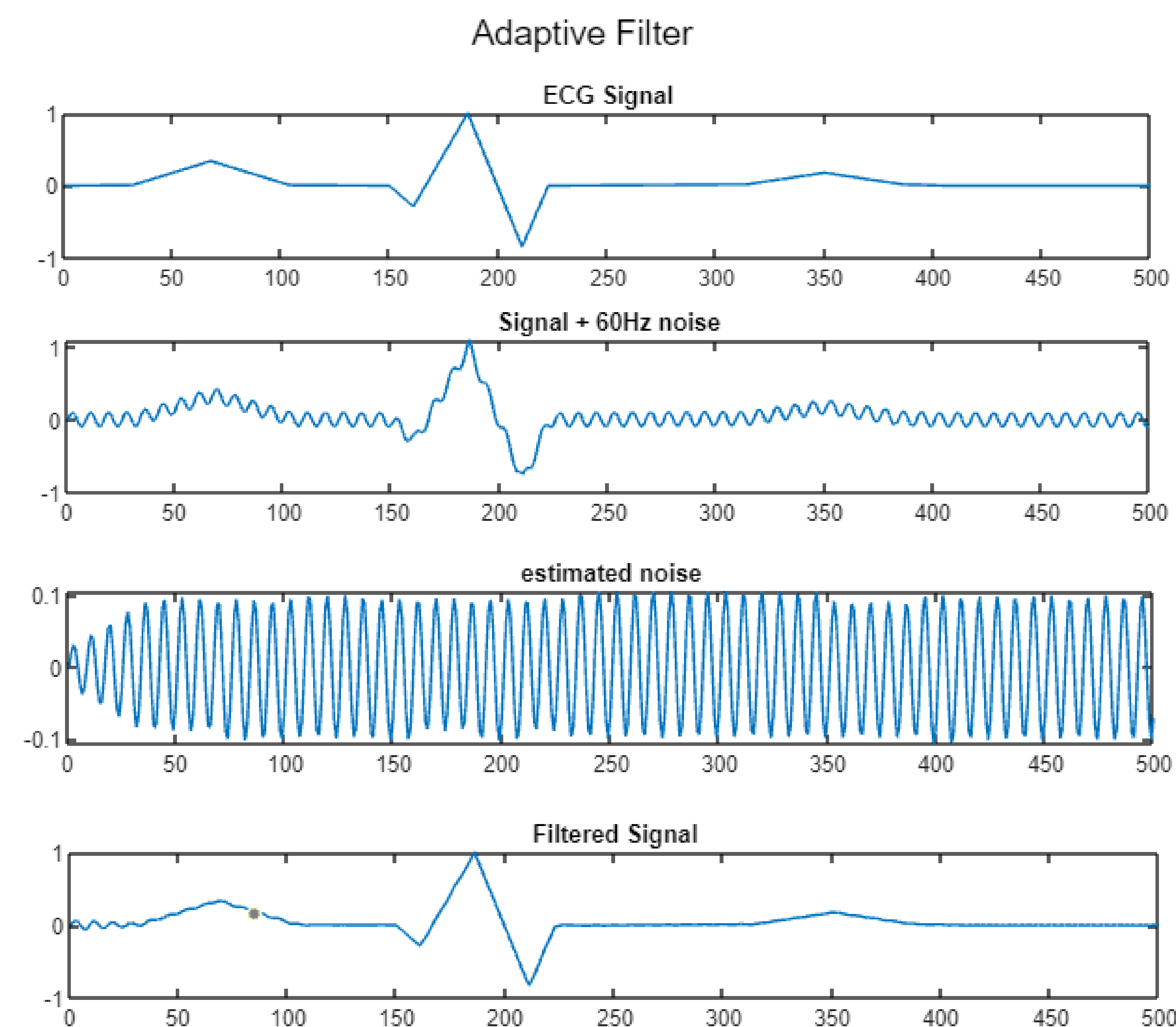
You can explain the method/algorithm using texts, figures, formulas, block diagram.

- **Adaptive 60 Hz filter** – Removes 60 Hz noise without removing 60 Hz components of the signal
- **Hanning filter** - low-pass filter which uses a weighted moving-average algorithm to smoothen out signals and suppress noise.
- **Low pass filter** – Used to remove high frequency component of the signal
- **Elimination of Offset** - in order to eliminate constant offset a high pass filter is used since offset is near constant and thus has zero frequency
- **Turning point data reduction** – conducts data reduction by determining and retaining key points which are necessary to retain in order to prevent loss of amplitude.
- **Band Pass filter for QRS detection** - When passed through band pass filters QRS complexes give high ringing output. We use this property of band pass filters to detect QRS region.

Relevant Discussion

In most filters, we use the transfer functions appropriate for a filter in order to conduct filtering by passing the numerator and denominator coefficients into the code. For filters where the transfer function hasn't been provided we shall use the discrete time equations related to the filters to obtain the output.

Example Result



Conclusion

It is practical to replace many of the ECG filtering processes that typically require circuits with digital filtering algorithms which can accomplish many of the filtering tasks required in an electrocardiograph instrument more efficiently.