A Simple, Area-Efficient Ripple-Rejection Technique for Chopped Bio-Signal Amplifiers

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SUMMARY

The Markovic group at UCLA has designed a chopping amplification technique with passive ripple-rejection that improves on the state-of-the-art in monitoring electrophysiological signals.

BACKGROUND

Monitoring electrophysiological signals in relation to health and disease has been instrumental to the understanding of biological systems and patient healthcare. These measurements are especially critical in the fields of neurological and cardiac science. Because so many bioelectrical readings of interest from the brain and heart are generally low in intensity, signal amplification is necessary prior to digitization and output. However, input amplification inherently generates additional sources of noise which makes accurate interpretation of bioelectrical signals with low frequency bands and amplitudes challenging. Therefore, advances in detection sensitivity and accuracy typically coincide with technological advances in signal amplifiers that minimize extraneous background noise.

INNOVATION

The Markovic group at UCLA has developed a chopped bio-signal amplification technique with reduced output noise compared to current technologies. This technology is relevant to measuring biologically relevant neuro and cardiac signals, many of which span a narrow frequency band between 1- 100 Hz with relatively low signal intensities. The challenge with signal amplification is the minimization of flicker and thermal noise that may obscure the original input signal. Chopping in amplifiers is commonly used to reduce amplification associated noise but creates a large noise ripple at output. Active methods to reduce this ripple have traditionally employed the use of active stages and switching circuitry resulting in unwanted phase delay, power consumption, and increased device size. The Markovic group improves upon these areas with a simple design using passive components that has been shown in simulation to attenuate the output ripple by as much as 78 dB without affecting signal gain, performance, or device size.

APPLICATIONS

- Amplifiers in electroencephalograms (EEGs) used to measure brain activity.
- Amplifiers in electrocardiograms to test electrical activity of the heart.

ADVANTAGES

- Saves chip area to allow/maintain device miniaturization.
- Ripple-rejection technology consumes no additional power by utilizing a passive design.
- Design is considerably simpler than current state-of-the-art devices.

STATE OF DEVELOPMENT

Design has been successfully tested in simulations.

PATENT STATUS

Country	Type	Number	Dated	Case

CONTACT

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INVENTORS

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OTHER INFORMATION

KEYWORDS

ripple-rejection, ripple reduction, bio-signal amplifier, amplifier, chopping, flicker noise, EEG, ECG, biosensor, low noise

CATEGORIZED AS

- **Imaging**
  - Medical
- **Medical**
  - Devices
  - Imaging
- **Sensors & Instrumentation**
  - Biosensors
  - Medical
- **Engineering**
  - Other

RELATED CASES

2015-164-0

United States Of America	Issued Patent	10,778,165	09/15/2020	2015-164

RELATED MATERIALS

- Hariprasad Chandrakumar, Dejan Markovic: A Simple Area-Efficient Ripple-Rejection Technique for Chopped Biosignal Amplifiers. IEEE Trans. on Circuits and Systems (2015)

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Scalable Parameterized VLSI Architecture for Compressive Sensing Sparse Approximation
- Autonomous Thermoelectric Energy-Harvesting Platform for Biomedical Sensors
- Saturation-Tolerant Electrophysiological Recording Interface
- A Distance-Immune Low-Power Inductively-Coupled Bidirectional Data Link

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