

A Method For Measuring Cardiac Timing From A Ballistocardiogram

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SUMMARY

UCLA researchers have developed an algorithm to directly measure the cardiac timing from Ballistocardiogram (BCG) to help cleaning the BCG from the Electroencephalogram (EEG) recording.

BACKGROUND

Electroencephalography (EEG) is the recording of electrical activity from the scalp. In the clinic, EEG plays an important role in sleep medicine, epilepsy, brain tumors, anesthesia monitoring, coma, and other serious medical conditions.

Ballistocardiography (BCG) refers to contaminate signals in an EEG that arise from movement of the body, blood and electrical charge across blood vessels due to heart pulsation within a magnetic field, particularly during concurrent magnetic resonance imaging (MRI).

Electrocardiography (EKG or ECG) is a measure of the heart's electrical activity. Electrodes attached to the surface of the skin pick up electrical impulses generated by the polarization and depolarization of cardiac tissue, and the signal is translated into a waveform. The waveform is used to measure the rate and regularity of heartbeats.

Under a variety of circumstances, particularly when EEG signals are acquired during MRI, the BCG (and at times the ECG) can contaminate the desired EEG signals. Several methods exist to remove these contaminations, but this depends on accurate timing information for the cardiac-related BCG and ECG signals. There have been attempts to extract cardiac timing from the BCG. The current state of the art is to infer the timing based upon the timing of the R-wave complexes of a simultaneously recorded ECG. However, since the ECG is electrical in nature and the BCG is mechanical and hydrodynamic, this method often leads to poor artifact rejection and degraded EEG.

INNOVATION

UCLA researchers have developed an algorithm that can extract the cardiac timing from BCG directly, thus eliminating the most important sources of error that stem from the ECG recording. The EEG data is passed in the algorithm and processed by two separate pipelines. The first pipeline provides a robust signal with regards to the BCG. The second pipeline provides a signal with respect to the ECG. The time points from the two pipelines are then combined and discrepancies between them are resolved. These can then be fed into the artifact correction algorithm of choice to correct EEG signal.

APPLICATIONS

The primary application of this invention is to remove BCG contaminations from EEG signals, especially in the MRI environment.

ADVANTAGES

This invention will allow more accurate cardiac timing measurement by eliminating the most important sources of error that stem from the ECG recording. Thus, it improves the ability of current algorithms to clean the BCG from the EEG recording.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,729,344	08/04/2020	2014-234

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OTHER INFORMATION

KEYWORDS

Ballistocardiogram (BCG), cardiac timing, Electroencephalography (EEG), Electrocardiography (ECG), MRI

CATEGORIZED AS

- ▶ Imaging
 - ▶ Medical
- ▶ Medical
 - ▶ Imaging
 - ▶ Software

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