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(54) **Apparatus and method for measuring biosignals**

Vorrichtung und Verfahren zur Messung von Biosignalen

Appareil et procédé pour mesurer des biosignaux

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EP 2 724 666 B1

Description

BACKGROUND

1. Field

[0001] The following description relates to an apparatus and method for measuring biosignals.

2. Description of Related Art

[0002] Various medical systems are typically used and various medical tests are typically performed for conducting a medical diagnosis of a patient. It is often very important to measure electrical biosignals of a patient, including an electrocardiogram (ECG), a brain wave or electroencephalogram (EEG), an electromyogram (EMG), and the like. The measurement of biosignals generally provides greater convenience to a patient during a medical diagnostic process and quicker results of the medical diagnosis. Since biosignals have characteristics of electrical signals, accurately measuring such biosignals without artifacts is important.

[0003] US 2006/0149146 A1 teaches a wearable device comprising motion artifact detection means, which are implemented by a pressure sensor for measuring a normal force component of an external force due to a movement of an individual. A motion artifact correction means processes the signal from the pressure sensor in order to correct the value of a first signal as measured by a set of electrodes arranged on the body of the individual. Whether or not the first signal is processed using the processed signal of the pressure sensor is determined by a control means such that the motion artifact correction means is automatically actuated in case the signal of the pressure sensor exceeds an allowable threshold level.

SUMMARY

[0004] In one general aspect, there is provided an apparatus for measuring a biosignal that may include a motion artifact, the apparatus including: a measuring module configured to measure the biosignal; an obtaining module configured to obtain a replication signal; and a control module configured to generate a control signal, based on the replication signal, for controlling processing of the biosignal.

[0005] The obtaining module may be further configured to measure a change in impedance between electrodes used by the measuring module in measuring the biosignal, or a change in a half cell potential to obtain the replication signal, wherein the replication signal corresponds to the motion artifact.

[0006] The control module may be further configured to determine whether the biosignal is to be processed based on a degree of the motion artifact relating to the replication signal and generate the control signal based on a result of the determining.

[0007] The control module may include an indexing unit configured to index a value based on a degree of the motion artifact relating to the replication signal; a determining unit configured to compare the indexed value to a threshold value; and a generating unit configured to generate the control signal based on a result of the determining.

[0008] The indexed value may be a distribution of the replication signal, a root mean square of the replication signal, or an average magnitude of the replication signal during a predetermined time period.

[0009] The apparatus may further include a signal processing module configured to process the biosignal based on the control signal by filtering the biosignal for reducing the motion artifact.

[0010] The apparatus may further include a signal processing module configured to process the biosignal by filtering the biosignal using the replication signal, or not process the biosignal, based on the control signal.

[0011] By controlling the signal processing module to omit the signal processing for removing the motion artifact when the motion artifact is absent, the measuring apparatus is able to reduce power consumption. That is, the measuring apparatus is able to selectively perform signal processing, such as filtering using an adaptive filter, when the motion artifact is determined to exist.

[0012] In another general aspect, there is provided an apparatus for measuring a biosignal that may include a motion artifact, the apparatus including: a measuring module configured to measure the biosignal; a sensing module configured to sense a motion of the subject; and a control module configured to generate a control signal, based on the sensed motion, for controlling processing of the biosignal.

[0013] The sensing module may use an inertial sensor for sensing the motion, the apparatus may further include a signal processing module configured to process the biosignal based on the control signal, and the control module may include a determining unit configured to determine whether the biosignal is to be processed based on a degree of the motion artifact relating to the sensed motion, and a generating unit configured to generate the control signal based on a result of the determining.

[0014] The control signal may be a first control signal, the generating unit may be a first generating unit, the apparatus may further include an obtaining module configured to obtain a replication signal that corresponds to the motion artifact, and the control module may further include a second generating unit configured to generate a second control signal, based on a result of the determining, for operating the obtaining module.

[0015] The control module may further include an indexing unit configured to index a value based on the degree of the motion artifact, and the determining unit may be configured to compare the indexed value to a threshold value to determine whether the motion artifact is to be processed.

[0016] The indexed value may be a magnitude or a root mean square of an average acceleration of the sensed motion during a predetermined time period.

[0017] In another general aspect, there is provided a method of measuring a biosignal that may include a motion artifact, the method including: measuring the biosignal, obtaining a replication signal, and generating a control signal, based on the replication signal, for controlling processing of the biosignal.

[0018] The obtaining may include measuring a change in impedance between electrodes used by the measuring module in measuring the biosignal, or a change in a half cell potential to obtain the replication signal, and the replication signal may be similar to the motion artifact.

[0019] The generating may include determining whether the biosignal is to be processed based on a degree of the motion artifact relating to the replication signal, and generating the control signal based on a result of the determining.

[0020] The generating may further include indexing a value based on a degree of the motion artifact relating to the replication signal, comparing the indexed value to a threshold value, and generating the control signal based on a result of the determining.

[0021] The indexed value may be a distribution of the replication signal, a root mean square of the replication signal, or an average magnitude of the replication signal during a predetermined time period.

[0022] The method may further include processing the biosignal based on the control signal by filtering the biosignal for reducing the motion artifact.

[0023] The method may further include processing the biosignal by filtering the biosignal using the replication signal, or not processing the biosignal, based on the control signal.

[0024] In another general aspect, there is provided a non-transitory computer-readable storage medium storing a program for controlling a computer to execute the method

[0025] In another general aspect, there is provided a method of measuring a biosignal that may include a motion artifact., the method including: measuring the biosignal; sensing a motion of the subject; and generating a control signal, based on the sensed motion, for controlling processing of the biosignal.

[0026] The sensing module may use an inertial sensor for sensing the motion, the method may further include processing the biosignal based on the control signal, and the generating may include determining whether the biosignal is to be processed based on a degree of the motion artifact relating to the sensed motion, and generating the control signal for controlling processing of the biosignal based on a result of the determining.

[0027] The control signal may be a first control signal, and the method may further include obtaining a replication signal that is similar to the motion artifact, and generating a second control signal, based on a result of the determining, for obtaining the replication signal.

[0028] The generating may further include indexing a value based on the degree of the motion artifact, the determining may include comparing the indexed value to a threshold value to determine whether the motion artifact is to be processed.

[0029] The indexing may include indexing a magnitude or a root mean square of an average acceleration according to the sensed motion during a predetermined time period.

[0030] Thus, the replication signal may be obtained only when the artifact degree of the motion artifact, based on the motion of the subject, is relatively high.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031]

FIG. 1 is a block diagram illustrating an example of an apparatus for measuring a biosignal.

FIG. 2 is a block diagram illustrating an example of a control module of the measuring apparatus of FIG. 1.

FIG. 3 is a block diagram illustrating another example of an apparatus for measuring a biosignal.

FIG. 4 is a block diagram illustrating an example of a control module of the measuring apparatus of FIG. 3.

FIG. 5 is a flowchart illustrating an example of a method of measuring a biosignal.

FIG. 6 is a flowchart illustrating an example of an operation of generating a control signal in a method of measuring a biosignal.

FIG. 7 is a flowchart illustrating another example of a method of measuring a biosignal.

DETAILED DESCRIPTION

[0032] The following detailed description is provided to assist the reader in gaining a comprehensive understanding of the methods, apparatuses, and/or systems described herein. However, various changes, modifications, and equivalents of the systems, apparatuses and/or methods described herein will be apparent to one of ordinary skill in the art. Also, descriptions of functions and constructions that are well known to one of ordinary skill in the art may be omitted for increased clarity and conciseness.

[0033] Throughout the drawings and the detailed description, the same reference numerals refer to the same elements. The drawings may not be to scale, and the relative size, proportions, and depiction of elements in the drawings may be exaggerated for clarity, illustration, and convenience.

[0034] The features described herein may be embodied in different forms, and are not to be construed as being limited to the examples described herein. Rather, the examples described herein have been provided so that this disclosure will be thorough and complete, and will convey the full scope of the disclosure to one of ordinary skill in the art. The invention being defined by the attached claims 1-10.

[0035] FIG. 1 illustrates an example of a measuring apparatus 100 for measuring a biosignal. Referring to FIG. 1, the measuring apparatus 100 includes a measuring module 110, an obtaining module 130, a control module 150, and a signal processing module 170.

[0036] The measuring module 110 may measure a biosignal of a subject, for example, an electrocardiogram (ECG), an electroencephalogram (EEG), an electromyogram (EMG), and the like.

[0037] In an example, the biosignal of the subject may be measured by a potential difference or voltage between a pair of interfaces or electrodes. The biosignal of the subject may be measured by a potential at a single point using a single interface or may be measured by a combination of values detected by more than one interface.

[0038] In this example, the measuring module 110 includes an interface to be in physical contact with a surface of the subject in order to measure the biosignal of the subject. Due to the subject moving continuously, or as a result of the electrode being shifted off a preset measurement point, impedance between the subject and the electrode may inevitably be changed. Such a change in the impedance acts as noise or a motion artifact with respect to a biosignal collected by the measuring module 110. This causes measurement interference or waveform distortion with respect to a measuring result.

[0039] Referring to FIG. 1, the measuring module 110 provides the biosignal of the subject, including the motion artifact, to the signal processing module 170. The obtaining module 130 obtains a replication signal representing the motion artifact. For example, the obtaining module 130 obtains the replication signal using a scheme of measuring a change in impedance between electrodes In another example, the obtaining module 130 obtains the replication signal using a change in a half cell potential.

[0040] An example of a method by which the obtaining module 130 obtains the replication signal using the scheme of measuring the change in impedance is as follows. An electrical cardiac signal having a signal component in a frequency band ranging from about 0.5 Hz to 250 Hz may be differentially measured using a first electrode and a second electrode. Information about a change in impedance between the first electrode and the second electrode may be obtained by passing a sinewave current through the first electrode and the second electrode, differentially measuring a voltage formed at the first electrode and the second electrode, and demodulating the differentially measured voltage into a signal of 2 kHz. The obtained information replicates a motion artifact signal included in the ECG signal.

[0041] An example of a method by which the obtaining module 130 obtains the replication signal using the scheme of measuring a change in the half cell potential is as follows. The obtaining module 130 receives the biosignal of the subject from interfaces A and B, being in contact with the skin of the subject, or from the measuring module 110. The obtaining module 130 also detects a dummy signal from dummy interfaces Ad and Bd having electrical characteristics differing from electrical characteristics of the interfaces A and B. The obtaining module 130 extracts a signal proportional to the motion artifact from the biosignal of the subject and the dummy signal. In this instance, the extracted signal proportional to the artifact is the replication signal.

[0042] In this example, in order to remove the motion artifact included in the biosignal of the subject, the motion artifact is traced using the dummy signal detected by the dummy interfaces Ad and Bd. That is, a change in the dummy signals detected by the dummy interfaces Ad and Bd due to the subject’s motion, should correspond to the change in the signals detected by the interfaces A and B due to the subject’s motion.

[0043] Accordingly, the interface A and the dummy interface Ad are disposed close to one another and within a predetermined distance. This allows for an almost identical external artifact change factor for the interface A and the dummy interface Ad. For example, the predetermined distance may be set to 1 cm or 1 mm.

[0044] Similarly, the interface B and the dummy interface Bd are disposed close to one another. In this example, the interface A and the interface B are disposed a distance apart from each other. This distance is sufficient for detecting the biosignal of the subject, in particular, the voltage between the interface A and the interface B.

[0045] When the interface A and the dummy interface Ad are disposed close to each other, motions of electrodes of the interface A and the dummy interface Ad resulting from the motion of the subject are almost identical. Accordingly, a change in the electrical characteristic of the interface A and a change in the electrical characteristic of the dummy interface Ad caused by an external factor, such as the motion of the subject, have similar aspects.

[0046] In this example, the obtaining module 130 uses the similarity in the change of the electrical characteristic between the interface A and the dummy interface Ad and the similarity in the change of the electrical characteristic between the interface B and the dummy interface Bd. Accordingly, the obtaining module 130 extracts an artifact signal proportional to the motion artifact included in the biosignal of the subject using the signals detected by the interface A, the interface B, the dummy interface Ad, and the dummy interface Bd.

[0047] For example, the obtaining module 130 extracts the replication signal using a similarity in a voltage change between voltage sources in an equivalent circuit of each of the interface A and the dummy interface Ad and a similarity in a voltage change between voltages sources in an equivalent circuit of each of the interface B and the dummy interface Bd.

[0048] Referring to FIG. 1, the replication signal obtained by the obtaining module 130, which is similar to the motion artifact, is provided to the control module 150 and the signal processing module 170.

[0049] In this example, the control module 150 generates a control signal for processing the motion artifact, based on the degree of the motion artifact as expressed in the replication signal. The control module 150 determines whether the biosignal is to be processed, based on the degree of the motion artifact relating to the replication signal provided from the obtaining module 130, and may generate a control signal for processing the biosignal based on a result of the determining.

[0050] For example, the control module 150 indexes a motion artifact signal using the degree of the motion artifact relating to the replication signal. When it is determined that the indexed motion artifact signal exceeds a predetermined threshold, the control module 150 generates a control signal for controlling the signal processing module 170 to perform signal processing with respect to the motion artifact. When it is determined that the motion artifact is absent or the artifact degree is modest since the indexed motion artifact signal does not exceed the predetermined threshold, the control module 150 controls the signal processing module 170 to omit the signal processing task for removing the motion artifact. In this example, the signal processing module 170 processes the motion artifact included in the biosignal of the subject, based on the control signal generated by the control module 150. The signal processing module 170 performs filtering for reducing the motion artifact included in the biosignal of the subject based on the control signal.

[0051] For example, the signal processing module 170 reduces the motion artifact included in the biosignal of the subject using an adaptive filter. An adaptive filter includes a digital filter capable of adjusting filter coefficients based on values fed back to the filter. In this example, the signal processing module 170 removes the motion artifact from the biosignal by adjusting filter coefficients based on the replication signal obtained by the obtaining module 130. The biosignal, corresponding to a voltage waveform between the interface A and the interface B, is filtered using the adjusted filter coefficients.

[0052] For example, the signal processing module 170 may perform signal processing, as initiated by the control signal, by filtering out the motion artifact from the biosignal. When the signal processing module 170 performs signal processing a result of the signal processing is output by the signal processing module 170. On the other hand, when the control signal disallows the processing of the motion artifact, the signal processing module 170 omits the signal processing task.

[0053] By controlling the signal processing module 170 to omit the signal processing for removing the motion artifact when the motion artifact is absent, the measuring apparatus 100 is able to reduce power consumption. That is, the measuring apparatus is able to selectively perform signal processing, such as filtering using an adaptive filter, when the motion artifact is determined to exist.

[0054] For example, a difference in power consumption between a case in which the adaptive filter performs the operation and a case in which the adaptive filter omits the operation may correspond to 100 μA of required electric current. In addition, when an ECG sensor as an example of the measuring apparatus is worn, a frequency of occurrence of an inoperative state to an operational state of the signal processing module 170 may correspond to a ratio of about 9:1. In this example, an average current consumption for the operation of the adaptive filter in the signal processing module 170 may be reduced from 100 μA to 10 μA.

[0055] FIG. 2 illustrates an example of a control module 200 of the measuring apparatus 100 of FIG. 1. Referring to FIG. 2, the control module 200 includes an indexing unit 210, a determining unit 230, and a generating unit 250.

[0056] In this example, the indexing unit 210 indexes an artifact degree of a motion artifact included in a biosignal, based on the replication signal provided by the obtaining module 130. The indexing unit 210 indexes a distribution, a root mean square (rms), or an average size of the replication signal during a predetermined time period as the artifact degree. For example, the predetermined period of time may be one second.

[0057] In this example, the control module 200 also includes a determining unit 230. The determining unit 230 compares a value indexed by the indexing unit 210 to a predetermined threshold value to determine whether the biosignal is to be processed. For example, the determining unit 230 determines that filtering for removing the motion artifact is necessary when the indexed value exceeds the predetermined threshold value. In addition, the determining unit 230 determines to omit the filtering when it is determined that the indexed value does not exceed the predetermined threshold value and a motion artifact to be removed is absent. Accordingly, when a motion artifact to be removed is absent, the filtering is omitted and power consumption is reduced.

[0058] In this example, the control module 200 also includes a generating unit 250. The generating unit 250 generates a control signal for operating the signal processing module 170 based on a result of the determining performed by the determining unit 230.

[0059] FIG. 3 illustrates another example of an apparatus 300 for measuring a biosignal. Referring to FIG. 3, the measuring apparatus 300 includes a measuring module 310, a sensing module 330, a control module 350, a signal processing module 370, and an obtaining module 390.

[0060] The measuring module 310 measures a biosignal of a subject including a motion artifact occurring in an interface when the biosignal is measured. The sensing module 330 senses a motion of the subject using an inertial sensor such as an accelerometer, a gyroscope, or the like. For example, to determine an artifact degree using the accelerometer, the sensing module 330 uses the magnitude of acceleration in all directions or axes, and extracts and uses information on a direction perpendicular to the subject. The sensing module 330 provides information related to the sensed motion of the subject to the control module 350.

[0061] The control module 350 generates a control signal for controlling the processing of the motion artifact. In an example, the control module 350 generates a first control signal based on the artifact degree received from the sensing module 330. A configuration and an operation of the control module 350 will be described in detail with reference to FIG. 4.

[0062] The signal processing module 370 processes the motion artifact included in the biosignal of the subject based on the first control signal generated by the control module 350. In this example, the signal processing module 370 processes the motion artifact using a replication signal obtained by the obtaining module 390. The description provided with reference to FIG. 1 may be referred to with respect to a method by which the signal processing module 370 may process the motion artifact using the replication signal.

[0063] The obtaining module 390 is operated based on a second control signal that is generated by the control module 350 based on an artifact degree. In order to reduce a power consumption of the obtaining module 390, the measuring apparatus 300 controls the operation of the obtaining module 390. The obtaining module 390 may be signaled to operate only when the artifact degree of the motion artifact, based on the motion of the subject, is relatively high.

[0064] FIG. 4 illustrates an example of a control module 400 of the measuring apparatus 300 of FIG. 3. Referring to FIG. 4, the control module 400 includes an indexing unit 410, a determining unit 430, a first generating unit 450, and a second generating unit 470.

[0065] The indexing unit 410 indexes an artifact degree of a motion artifact based on a motion of a subject. The indexing unit 410 indexes the artifact degree based on the magnitude of average acceleration for a predetermined time period or a root mean square (rms) magnitude of the average acceleration according to the motion of the subject.

[0066] In this example, the control module also includes a determining unit 430. The determining unit 430 determines whether the motion artifact is to be processed based on the artifact degree relating to the motion of the subject. The determining unit 430 compares the indexed value, which represents the artifact degree, to a predetermined threshold value to determine whether the biosignal is to be processed.

[0067] In this example, the control module also includes a first generating unit 450. The first generating unit 450 generates a first control signal for controlling the signal processing module 370 based on a result of the determining performed by the determining unit 430. In addition, the second generating unit 470 generates a second control signal for operating the obtaining module 390 based on the result of the determining performed by the determining unit 430.

[0068] FIG. 5 illustrates an example of a method of measuring a biosignal.

[0069] Referring to FIG. 5, in operation 510, a measuring apparatus measures a biosignal of a subject including the undesired motion artifact occurring in an interface when the biosignal is measured.

[0070] In operation 520, the measuring apparatus obtains a replication signal corresponding to the motion artifact. For example, the measuring apparatus may measure a change in impedance between electrodes measuring the biosignal or measure a change in a half cell potential to obtain the replication signal. The measuring apparatus generates a control signal for processing the biosignal based on an artifact degree obtained in operation 520.

[0071] In operation 530, the measuring apparatus determines whether the biosignal is to be processed based on the artifact degree. In operation 540, the measuring apparatus generates the control signal based on a result of the determining in operation 530.

[0072] In this example, the measuring apparatus processes the motion artifact included in the biosignal of the subject based on the control signal generated in operation 540. The measuring apparatus may perform filtering for reducing the motion artifact included in the biosignal of the subject.

[0073] In operation 550, the measuring apparatus determines whether the control signal allows processing of the biosignal. If processing is allowed, the measuring apparatus filters the motion artifact using the replication signal and outputs a result of the filtering in operation 560.

[0074] On the other hand, if processing is disallowed, the measuring apparatus omits the signal processing for removing the motion artifact from the biosignal of the subject in operation 570.

[0075] FIG. 6 illustrates an example of an operation of generating a control signal in a method of measuring a biosignal.

[0076] Referring to FIG. 6, in operation 610, a control module of a measuring apparatus indexes an artifact degree of a motion artifact based on a replication signal. The control module compares the indexed value to a predetermined threshold value. In operation 620, the control module determines whether the indexed value, that represents the artifact degree, is greater than the predetermined threshold value.

[0077] When it is determined that the indexed artifact degree is greater than the predetermined threshold, the control module determines to process the biosignal in operation 630, and generates a control signal for processing of the biosignal in operation 640. On the other hand, when it is determined that the indexed artifact degree of the motion artifact is less than or equal to the predetermined threshold value, the control module determines to omit processing of the biosignal in operation 650, and generates a control signal for omitting the processing of the biosignal in operation 660.

[0078] The method of measuring the biosignal described with reference to FIGS. 5 and 6 may consist of operations to be processed chronologically by the measuring apparatus of FIGS. 1 and 2. Accordingly, the description provided with reference to FIGS. 1 and 2 may be applied to the method described with reference to FIGS. 5 and 6.

[0079] FIG. 7 illustrates another example of a method of measuring a biosignal.

[0080] Referring to FIG. 7, a measuring apparatus may measure a biosignal of a subject including the undesired motion artifact occurring in an interface when the biosignal is measured. In operation 710, the measuring apparatus senses a motion of the subject using an inertial sensor such as an accelerometer, a gyroscope, or the like. In operation 710, the measuring of the biosignal of the subject and the sensing of the motion of the subject may be performed simultaneously or may be performed sequentially.

[0081] In this example, the measuring apparatus generates a control signal for processing the biosignal based on the artifact degree relating to the sensed motion of the subject. In operation 720, the measuring apparatus determines whether the biosignal is to be processed based on the artifact degree. In operation 730, the measuring apparatus generates a first control signal based on a result of the determining performed in operation 720.

[0082] In an example, the measuring apparatus generates the control signal based on an indexed artifact degree. The measuring apparatus indexes the artifact degree of the motion artifact based on the sensed motion of the subject. For example, the measuring apparatus indexes the artifact degree based on a magnitude of an average acceleration during a predetermined time period. The measuring apparatus compares the indexed value to a predetermined threshold value to determine whether the biosignal is to be processed. For example, when the indexed value is greater than the predetermined threshold value, the measuring apparatus may determine to perform filtering for removing the motion artifact. The measuring apparatus generates a control signal for processing the biosignal based on a result of the determining as to whether the biosignal is to be processed.

[0083] In operation 740, the measuring apparatus generates a second control signal for obtaining a replication signal corresponding to the motion artifact based on a result of the determining performed in operation 720. This may be performed after generating the first control signal or simultaneously. In operation 750, the measuring apparatus obtains the replication signal based on the second control signal generated in operation 740. In operation 760, the measuring apparatus processes the motion artifact included in the biosignal of the subject, using the replication signal, based on the control signal generated in operation 730.

[0084] The method of measuring the biosignal described with reference to FIG. 7 may consist of operations to be processed chronologically by the measuring apparatus of FIGS. 3 and 4. Accordingly, the description provided with reference to FIGS. 3 and 4 may be applied to the method described with reference to FIG. 7.

[0085] The measuring modules, obtaining modules, control modules, signal processing modules, and sensing modules described above may be implemented using one or more hardware components, or a combination of one or more hardware components and one or more software components. A hardware component may be, for example, a physical device that physically performs one or more operations, but is not limited thereto. Examples of hardware components include controllers, microphones, amplifiers, low-pass filters, highpass filters, band-pass filters, analog-to-digital converters, digital-to-analog converters, and processing devices.

[0086] A processing device may be implemented using one or more general-purpose or special-purpose computers, such as, for example, a processor, a controller and an arithmetic logic unit, a digital signal processor, a microcomputer, a field-programmable array, a programmable logic unit, a microprocessor, or any other device capable of running software or executing instructions. The processing device may run an operating system (OS), and may run one or more software applications that operate under the OS. The processing device may access, store, manipulate, process, and create data when running the software or executing the instructions. For simplicity, the singular term "processing device" may be used in the description, but one of ordinary skill in the art will appreciate that a processing device may include multiple processing elements and multiple types of processing elements. For example, a processing device may include one or more processors, or one or more processors and one or more controllers. In addition, different processing configurations are possible, such as parallel processors or multi-core processors.

[0087] Software or instructions for controlling a processing device, such as those described in FIGS. 5-7, to implement a software component may include a computer program, a piece of code, an instruction, or some combination thereof, for independently or collectively instructing or configuring the processing device to perform one or more desired operations. The software or instructions may include machine code that may be directly executed by the processing device, such as machine code produced by a compiler, and/or higher-level code that may be executed by the processing device using an interpreter. The software or instructions and any associated data, data files, and data structures may be embodied permanently or temporarily in any type of machine, component, physical or virtual equipment, computer storage medium or device, or a propagated signal wave capable of providing instructions or data to or being interpreted by the processing device. The software or instructions and any associated data, data files, and data structures also may be distributed over network-coupled computer systems so that the software or instructions and any associated data, data files, and data structures are stored and executed in a distributed fashion.

[0088] For example, the software or instructions and any associated data, data files, and data structures may be recorded, stored, or fixed in one or more non-transitory computer-readable storage media. A non-transitory computer-readable storage medium may be any data storage device that is capable of storing the software or instructions and any associated data, data files, and data structures so that they can be read by a computer system or processing device. Examples of a non-transitory computer-readable storage medium include read-only memory (ROM), random-access memory (RAM), flash memory, CD-ROMs, CD-Rs, CD+Rs, CD-RWs, CD+RWs, DVD-ROMs, DVD-Rs, DVD+Rs, DVD-RWs, DVD+RWs, DVD-RAMs, BD-ROMs, BD-Rs, BD-R LTHs, BD-REs, magnetic tapes, floppy disks, magnetooptical data storage devices, optical data storage devices, hard disks, solid-state disks, or any other non-transitory computer-readable storage medium known to one of ordinary skill in the art.

[0089] Functional programs, codes, and code segments for implementing the examples disclosed herein can be easily constructed by a programmer skilled in the art to which the examples pertain based on the drawings and their corresponding descriptions as provided herein.

[0090] The examples described herein are to be considered in a descriptive sense only and not for purposes of limitation. Descriptions of features or aspects in each example are to be considered as being applicable to similar features or aspects in other examples. Suitable results may be achieved if the described techniques are performed in a different order and/or if components in a described system, architecture, device, or circuit are combined in a different manner and/or replaced or supplemented by other components or their equivalents. The invention is defined by the attached claims 1-10.

Claims

1. An apparatus for measuring a biosignal of a subject that may include a motion artifact, the apparatus comprising:

   a measuring module (310) configured to measure the biosignal;
   an obtaining module (390) configured to obtain a replication signal corresponding to the motion artifact;
   a sensing module (330) different from the obtaining module (390) configured to sense a motion of the subject;
   a control module (350) configured to generate a first control signal for controlling processing of the biosignal;
   wherein the control module (350) is further configured to determine whether the biosignal is to be processed or not based on a degree of the motion artifact relating to the sensed motion, such that processing is performed if the degree of the motion artifact is above a predetermined threshold, and to generate the first control signal based on a result of the determining and further comprises a second generating unit configured to generate a second control signal, based on the result of the determining, for operating the obtaining module (390); and
   a signal processing module (370) configured to process or not process the biosignal by filtering the biosignal using the replication signal, based on the first control signal.

2. The apparatus of claim 1, wherein the obtaining module (390) is further configured to measure a change in impedance between electrodes used by the measuring module (310) in measuring the biosignal or a change in a half cell potential to obtain the replication signal.

3. The apparatus of claim 1 or 2, wherein the sensing module (330) uses an inertial sensor.

4. The apparatus of one of claims 1 to 3, wherein the control module (350) comprises:

   an indexing unit (210) configured to index a value based on the degree of the motion artifact relating to the sensed motion of the subject;
   a determining unit (230) configured to compare the indexed value to a threshold value;
   and
   a first generating unit (250) configured to generate the first control signal based on a result of the comparison.

5. The apparatus of claim 4, wherein the indexed value is a magnitude or a root mean square of an average acceleration of the sensed motion during a predetermined time period.

6. A method of measuring a biosignal of a subject that may include a motion artifact, the method comprising:

   measuring (710) the biosignal;
   obtaining a replication signal corresponding to the motion artifact using an obtaining module (390);
   sensing a motion of the subject using a sensing module (330) different from the obtaining module (390);
   generating (730) a first control signal for controlling processing of the biosignal; processing (760) or not processing the biosignal by filtering the biosignal using the replication signal based on the first control signals
   wherein the generating comprises: determining

(720) whether the biosignal is to be processed based on a degree of the motion artifact relating to the sensed motion of the subject; and
generating (730) the first control signal based on a result of the determining;
wherein the replication signal is obtained based on a second control signal, which is generated (740) based on the result of the determining;
wherein the processing (760) is performed if the degree of the motion artifact is above a predetermined threshold.

7. The method of claim 6, wherein the obtaining comprises measuring a change in impedance between electrodes used in measuring the biosignal or a change in a half cell potential to obtain the replication signal.

8. The method of claim 6 or 7, wherein the motion of the subject is sensed by using an inertial sensor.

9. The method of one of claims 6 to 8, wherein:

the generating further comprises indexing (610) a value based on a degree of the motion artifact relating to the sensed motion of the subject; and
the determining comprises comparing (620) the indexed value to a threshold value to determine whether the biosignal is to be processed.

10. The method of claim 9, wherein the indexed value is a magnitude or a root mean square of an average acceleration of the sensed motion during a predetermined time period.

Patentansprüche

1. Vorrichtung zur Messung eines Biosignals eines Subjekts, das einen Bewegungsartefakt einschließen kann, wobei die Vorrichtung umfasst:

ein Messmodul (310), gestaltet, um das Biosignal zu messen;
ein Erlangungsmodul (390), gestaltet, um ein Replikationssignal zu erlangen, das dem Bewegungsartefakt entspricht;
ein Erfassungsmodul (330), das von dem Erlangungsmodul (390) verschieden ist, gestaltet, um die Bewegung des Subjekts zu erfassen;
ein Steuermodul (350), gestaltet, um ein erstes Steuersignal zur Steuerung der Verarbeitung des Biosignals zu erzeugen;
wobei das Steuermodul (350) des Weiteren gestaltet ist, basierend auf dem Grad des Bewegungsartefakts in Bezug auf die erfasste Bewegung zu ermitteln, ob das Biosignal verarbeitet werden soll oder nicht, dergestalt, dass eine Verarbeitung erfolgt, wenn der Grad des Bewegungsartefakts über einem vorgegebenen Schwellenwert liegt, und basierend auf dem Ergebnis der Ermittlung das erste Steuersignal zu erzeugen, und des Weiteren eine zweite Erzeugungseinheit umfasst, gestaltet, um basierend auf dem Ergebnis der Ermittlung ein zweites Steuersignal zum Betreiben des Erlangungsmoduls (390) zu erzeugen; und
ein Signalverarbeitungsmodul (370), gestaltet, um das Biosignal durch Filterung des Biosignals unter Anwendung des Replikationssignals basierend auf dem ersten Steuersignal zu verarbeiten oder nicht zu verarbeiten.

2. Vorrichtung nach Anspruch 1, wobei das Erlangungsmodul (390) des Weiteren gestaltet ist, eine Änderung der Impedanz zwischen den durch das Messmodul (310) verwendeten Elektroden bei der Messung des Biosignals oder eine Änderung des Halbzellenpotentials zu messen, um das Replikationssignal zu erlangen.

3. Vorrichtung nach Anspruch 1 oder 2, wobei das Erfassungsmodul (330) einen Inertialsensor verwendet.

4. Vorrichtung nach einem der Ansprüche 1 bis 3, wobei das Steuermodul (350) umfasst:

eine Indizierungseinheit (210), gestaltet, um einen Wert basierend auf dem Grad des Bewegungsartefakts in Bezug auf die erfasste Bewegung des Subjekts zu indizieren;
eine Ermittlungseinheit (230), gestaltet, um den indizierten Wert mit einem Schwellenwert zu vergleichen; und
eine erste Erzeugungseinheit (250), gestaltet, um ein erstes Steuersignal basierend auf dem Ergebnis des Vergleichs zu erzeugen.

5. Vorrichtung nach Anspruch 4, wobei der indizierte Wert eine Größenordnung oder ein quadratischer Mittelwert einer Durchschnittsbeschleunigung der erfassten Bewegung während eines vorgegebenen Zeitraums ist.

6. Verfahren zur Messung eines Biosignals eines Subjekts, das einen Bewegungsartefakt einschließen kann, wobei das Verfahren umfasst:

Messen (710) des Biosignals;
Erlangung eines Replikationssignals, das dem Bewegungsartefakt entspricht, unter Nutzung eines Erlangungsmoduls (390);
Erfassen einer Bewegung eines Subjekts unter Nutzung eines Erfassungsmoduls (330), das sich von dem Erlangungsmodul (390) unter-

scheidet;
Erzeugung (730) eines ersten Steuersignals zur Steuerung der Verarbeitung des Biosignals;
Verarbeitung (760) oder keine Verarbeitung des Biosignals durch Filterung des Biosignals unter Nutzung des Replikationssignals basierend auf dem ersten Steuersignal;
wobei die Erzeugung umfasst: Ermittlung (720), ob das Biosignal verarbeitet werden soll, basierend auf dem Grad des Bewegungsartefakts in Bezug auf die erfasste Bewegung des Subjekts; und
Erzeugung (730) des ersten Steuersignals basierend auf dem Ergebnis der Ermittlung;
wobei das Replikationssignal basierend auf einem zweiten Steuersignal erlangt wird, das basierend auf dem Ergebnis der Ermittlung erzeugt (740) wird;
wobei die Verarbeitung (760) durchgeführt wird, wenn der Grad des Bewegungsartefakts über einem vorgegebenen Schwellenwert liegt.

7. Verfahren nach Anspruch 6, wobei die Erlangung das Messen einer Änderung der Impedanz zwischen den bei der Messung des Biosignals verwendeten Elektroden oder eine Änderung des Halbzellenpotentials umfasst, um das Replikationssignal zu erlangen.

8. Verfahren nach Anspruch 6 oder 7, wobei die Bewegung des Subjekts unter Nutzung eines Inertialsensors erfasst wird.

9. Verfahren nach einem der Ansprüche 6 bis 8, wobei:

die Erzeugung des Weiteren die Indizierung (610) eines Wertes basierend auf dem Grad des Bewegungsartefaktes in Bezug auf die erfasste Bewegung des Subjekts umfasst:

und
die Ermittlung das Vergleichen (620) des indizierten Wertes mit einem Schwellenwert, um zu ermitteln, ob das Biosignal verarbeitet werden soll, umfasst.

10. Verfahren nach Anspruch 9, wobei der indizierte Wert eine Größenordnung oder ein quadratischer Mittelwert einer Durchschnittsbeschleunigung der erfassten Bewegung während eines vorgegebenen Zeitraums ist.

Revendications

1. Appareil permettant de mesurer un bio-signal provenant d'un sujet qui peut inclure un artefact de mouvement, l'appareil comprenant :

un module de mesure (310) configuré pour mesurer le bio-signal,
un module de récupération (390) configuré pour obtenir un signal de réplication correspondant à l'artefact de mouvement,
un module de détection (330), différent du module de récupération (390), configuré pour détecter un mouvement du sujet,
un module de commande (350) configuré pour générer un premier signal de commande permettant de commander le traitement du bio-signal,
dans lequel le module de commande (350) est en outre configuré pour déterminer si le bio-signal doit être traité ou non sur la base du degré de l'artefact de mouvement se rapportant au mouvement détecté de sorte à ce que le traitement soit effectué si le degré de l'artefact de mouvement est au-dessus d'un seuil prédéterminé, et pour générer le premier signal de commande sur la base du résultat de la détermination ; et comprend en outre une seconde unité de génération configurée pour générer un second signal de commande, sur la base du résultat de la détermination, permettant de mettre en oeuvre le module de récupération (390), et
un module de traitement du signal (370) configuré pour traiter ou non le bio-signal en filtrant le bio-signal grâce à l'utilisation du signal de réplication, sur la base du premier signal de commande.

2. Appareil selon la revendication 1, dans lequel le module de récupération (390) est en outre configuré pour mesurer un changement d'impédance entre des électrodes utilisées par le module de mesure (310) lors de la mesure du bio-signal ou bien un changement de potentiel de demi-cellule pour obtenir le signal de réplication.

3. Appareil selon la revendication 1 ou la revendication 2, dans lequel le module de détection (330) utilise un capteur inertiel.

4. Appareil selon l'une des revendications 1 à 3, dans lequel le module de commande (350) comprend :

une unité d'indexation (210) configurée pour indexer une valeur sur la base du degré de l'artefact de mouvement se rapportant au mouvement détecté du sujet,
une unité de détermination (230) configurée pour comparer la valeur indexée à une valeur de seuil, et
une première unité de génération (250) configurée pour générer le premier signal de commande sur la base du résultat de la comparaison.

5. Appareil selon la revendication 4, dans lequel la valeur indexée représente une amplitude ou la racine carrée d'une accélération moyenne du mouvement détecté pendant un intervalle de temps prédéterminé.

6. Procédé de mesure d'un bio-signal d'un sujet qui peut inclure un artefact de mouvement, le procédé comprenant :

la mesure (710) du bio-signal,
la récupération d'un signal de réplication correspondant à l'artefact de mouvement en utilisant un module de récupération (390),
la détection d'un mouvement du sujet en utilisant un module de détection (330) différent du module de récupération (390),
la génération (730) d'un premier signal de commande destiné à commander le traitement du bio-signal ; le traitement (760) ou non du bio-signal en filtrant le bio-signal grâce à l'utilisation du signal de réplication sur la base du premier signal de commande,
dans lequel la génération comprend : la détermination (720) de ce que le bio-signal doit être traité sur la base d'un degré de l'artefact de mouvement se rapportant au second mouvement détecté du sujet, et
la génération (730) du premier signal de commande sur la base du résultat de la détermination,
dans lequel le signal de réplication est obtenu sur la base d'un second signal de commande qui est généré (740) sur la base du résultat de la détermination,
dans lequel le traitement (760) est effectué si le degré de l'artefact de mouvement est au-dessus d'un seuil prédéterminé.

7. Procédé selon la revendication 6, dans lequel la récupération comprend la mesure d'un changement d'impédance entre des électrodes utilisées dans la mesure du bio-signal ou d'un changement de potentiel de demi-cellule pour obtenir le signal de réplication.

8. Procédé selon la revendication 6 ou la revendication 7, dans lequel le mouvement du sujet est détecté en utilisant un capteur inertiel.

9. Procédé selon l'une des revendications 6 à 8, dans lequel :

la génération comprend en outre l'indexation (610) d'une valeur fondée sur un degré de l'artefact de mouvement se rapportant au mouvement détecté du sujet, et
la détermination comprend la comparaison (120) de la valeur indexée à une valeur de seuil pour déterminer si le bio-signal doit être traité.

10. Procédé selon la revendication 9, dans lequel la valeur indexée représente une amplitude ou la racine carrée d'une accélération moyenne du mouvement détecté pendant un intervalle de temps prédéterminé.

FIG. 1

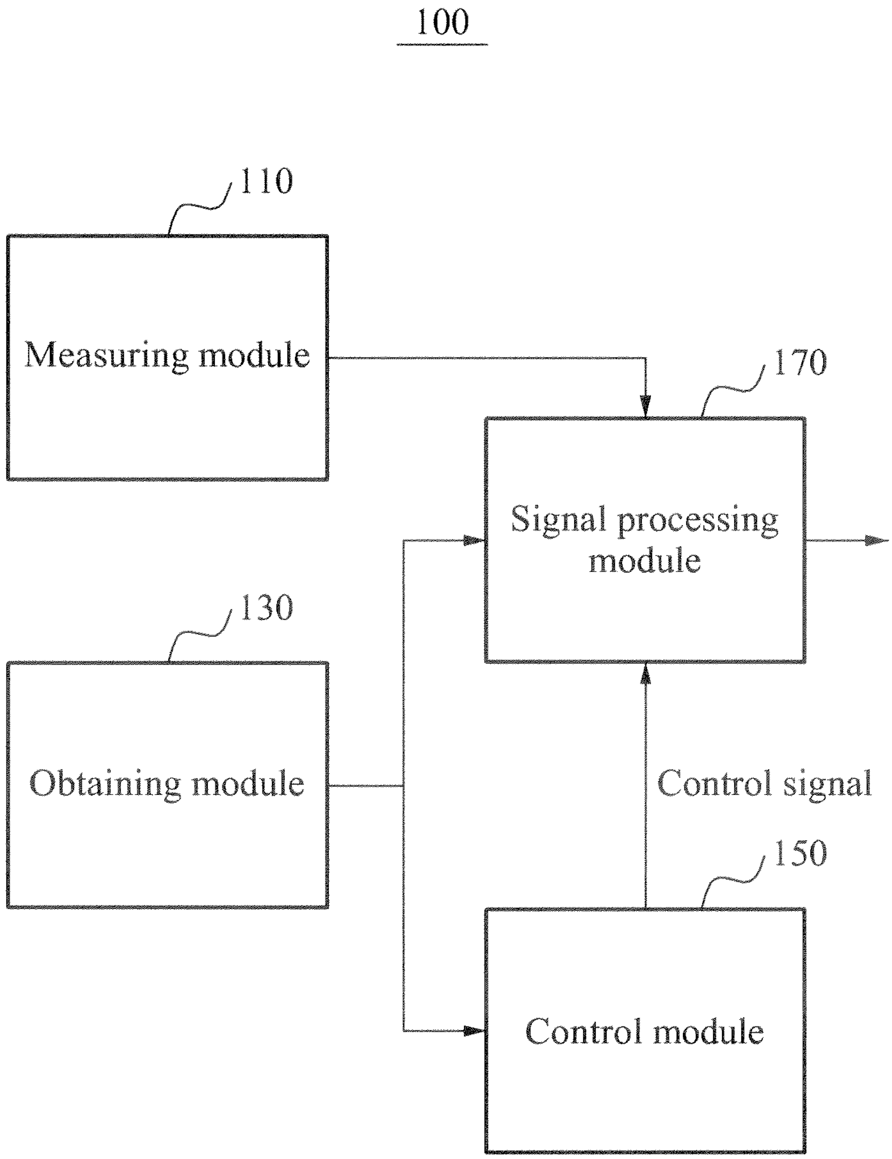

100
110
Measuring module
170
Signal processing module
130
Obtaining module
Control signal
150
Control module

FIG. 2

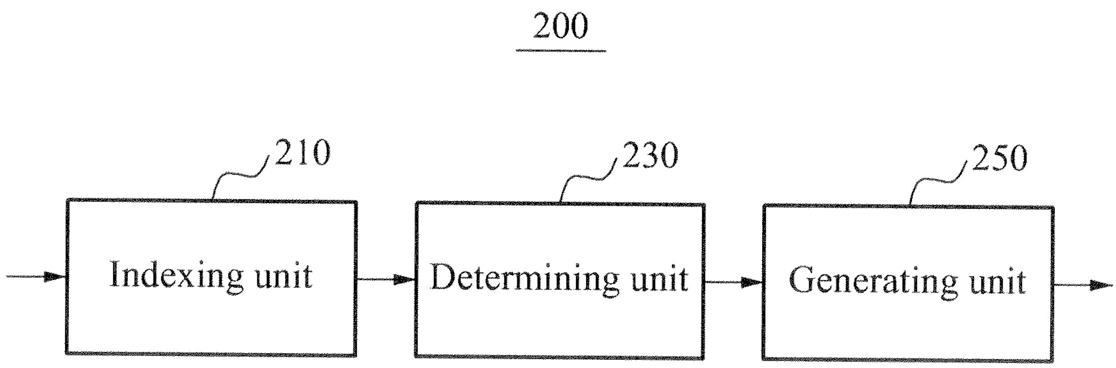

200
210
230
250
Indexing unit
Determining unit
Generating unit

FIG. 3

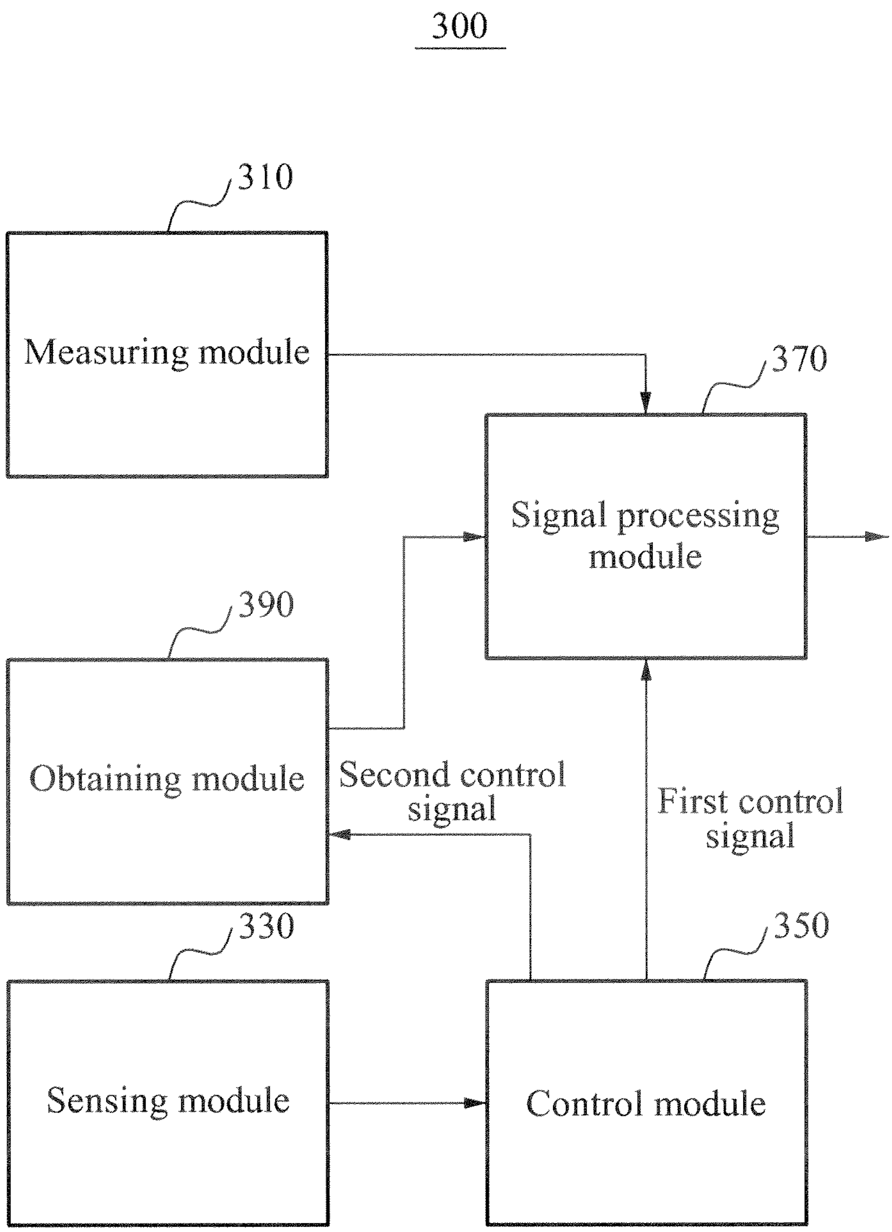

300
310
Measuring module
370
Signal processing module
390
Obtaining module
Second control signal
First control signal
330
350
Sensing module
Control module

FIG. 4

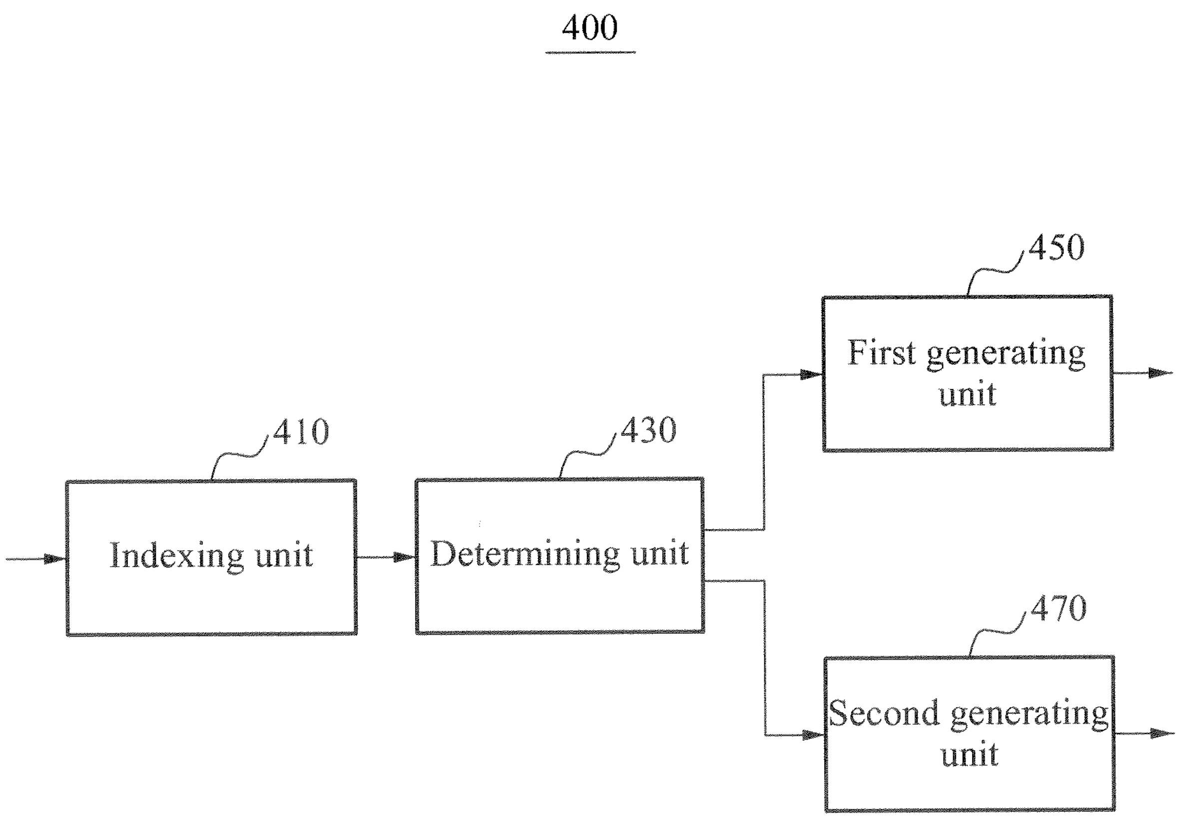

400
450
First generating unit
410
430
Indexing unit
Determining unit
470
Second generating unit

FIG. 5

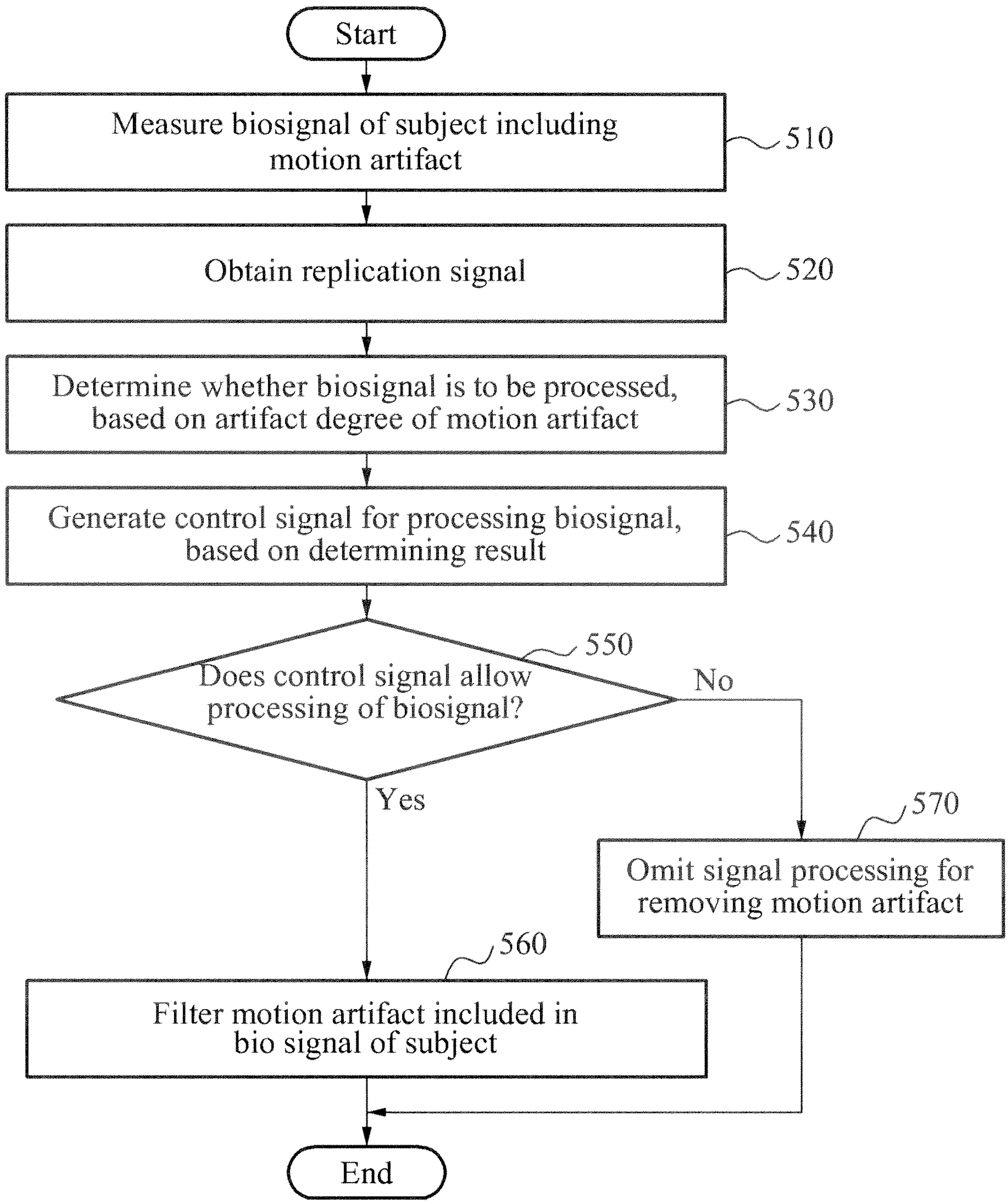

Start
Measure biosignal of subject including motion artifact
510
Obtain replication signal
520
Determine whether biosignal is to be processed, based on artifact degree of motion artifact
530
Generate control signal for processing biosignal, based on determining result
540
Does control signal allow processing of biosignal?
550
No
Yes
570
Omit signal processing for removing motion artifact
560
Filter motion artifact included in bio signal of subject
End

FIG. 6

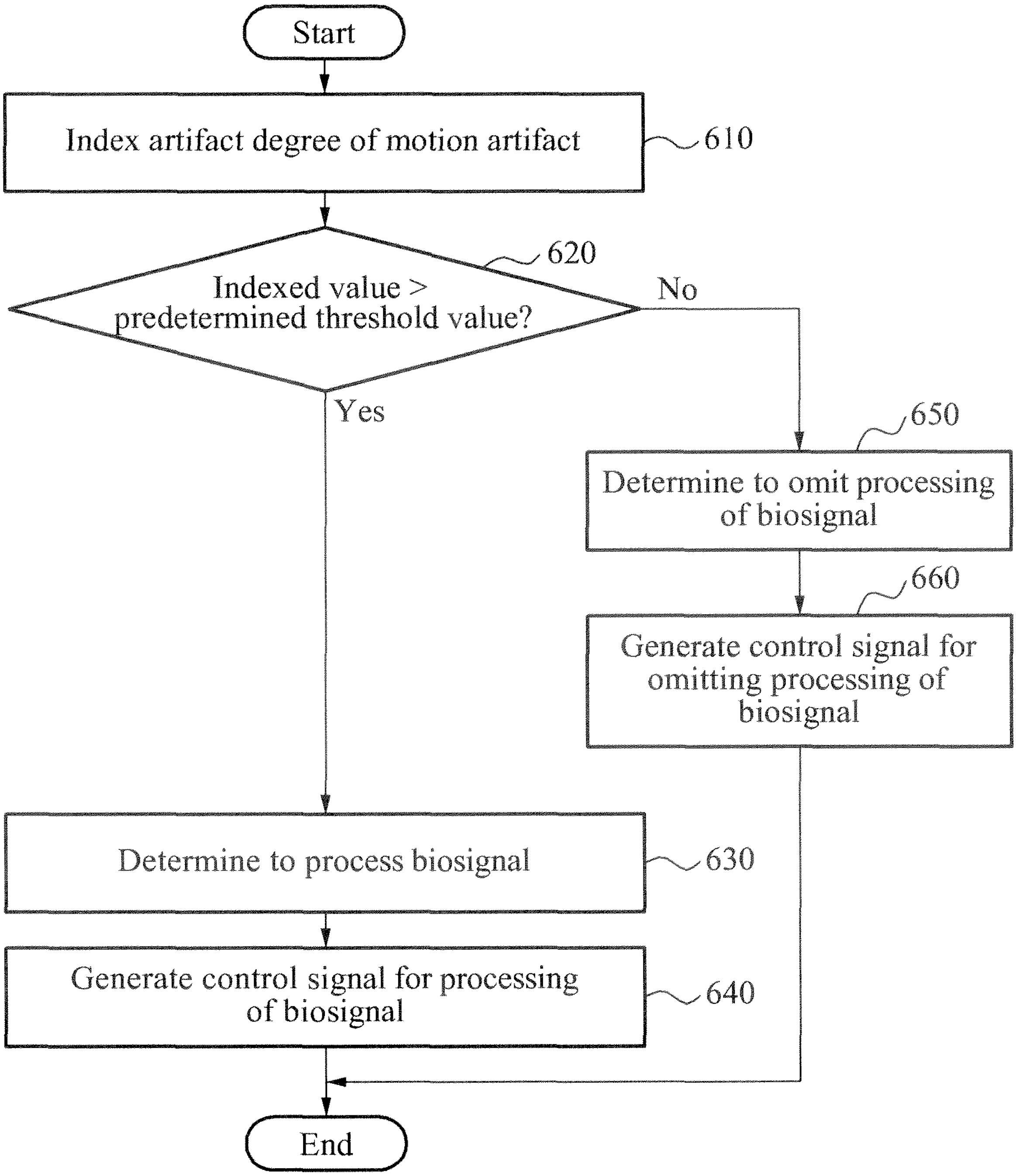
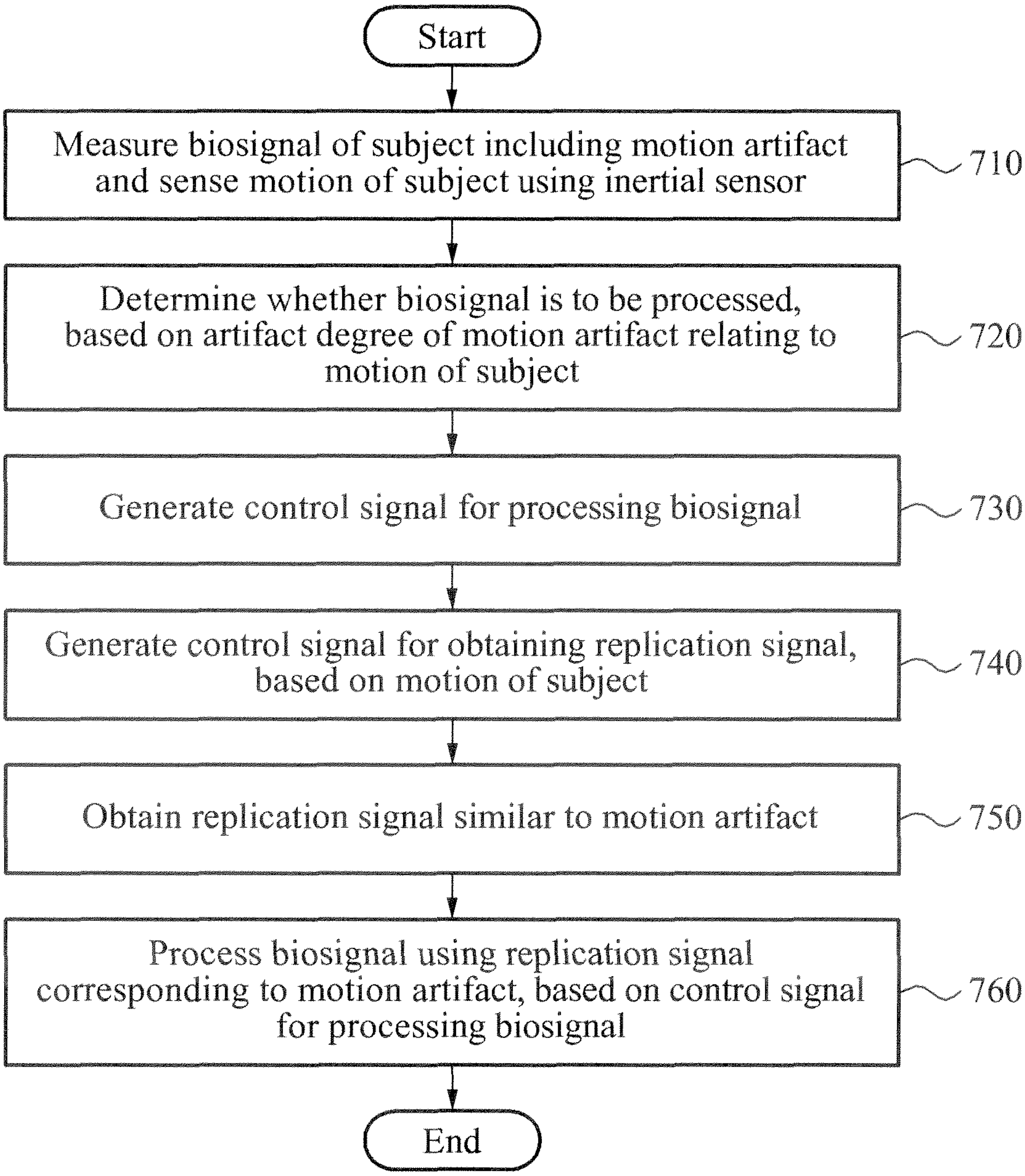

Start
Index artifact degree of motion artifact
610
Indexed value > predetermined threshold value?
620
No
Yes
650
Determine to omit processing of biosignal
660
Generate control signal for omitting processing of biosignal
Determine to process biosignal
630
Generate control signal for processing of biosignal
640
End

FIG. 7


Start
Measure biosignal of subject including motion artifact and sense motion of subject using inertial sensor
710
Determine whether biosignal is to be processed, based on artifact degree of motion artifact relating to motion of subject
720
Generate control signal for processing biosignal
730
Generate control signal for obtaining replication signal, based on motion of subject
740
Obtain replication signal similar to motion artifact
750
Process biosignal using replication signal corresponding to motion artifact, based on control signal for processing biosignal
760
End

REFERENCES CITED IN THE DESCRIPTION

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专利名称(译)	用于测量生物信号的装置和方法		
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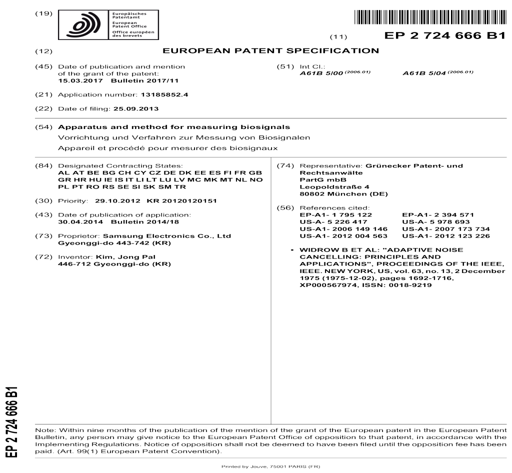
摘要(译)

一种用于测量生物信号的装置和方法，包括基于获得的复制信号或感测到的受试者的运动产生用于处理生物信号的控制信号。



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(54) **Apparatus and method for measuring biosignals**
Vorrichtung und Verfahren zur Messung von Biosignalen
Appareil et procédé pour mesurer des biosignaux

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EP 2 724 666 B1

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