(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 712 544 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
27.03.2019 Bulletin 2019/13

(51) Int Cl.:
A61B 5/00 *(2006.01)* ***A61B 5/1455*** *(2006.01)*

(21) Application number: **13186637.8**

(22) Date of filing: **30.09.2013**

(54) **System and method for spectroscopic measurement of a characteristic of biological tissue**

System und Verfahren zur spektroskopischen Messung einer Eigenschaft eines biologischen Gewebes

Système et procédé pour la mesure spectroscopique d'une caractéristique d'un tissu biologique

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **28.09.2012 US 201261707138 P**

(43) Date of publication of application:
02.04.2014 Bulletin 2014/14

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Printed by Jouve, 75001 PARIS (FR)

Description

[0001] Spectroscopic devices are commonly used to non-invasively measure a characteristic of biological tissue. Spectroscopic devices emit light into biological tissue and detect differences in light absorption to determine the concentration of certain constituents in the biological tissue (e.g., oxygen, hemoglobin, melanin, etc.). The performance of a spectroscopic device is dependent upon its ability to generate sufficient optical power to penetrate the biological tissue of interest and to distinguish against confounding noise (e.g., caused by background light or electrical interference within the environment). Signal-to-noise considerations favor maximizing the optical power of the light emitted into the biological tissue. However, problems can arise when spectroscopic devices output high optical power light for extended periods of time or at fast repetition rates. For example, under certain operation conditions, spectroscopic devices may become undesirably hot. To avoid such problems, spectroscopic devices may be configured to output high optical power light for only short, sequential durations of time. Such spectroscopic devices detect light signals over short, sequential durations of time. The short duration of the detected light signals can make it difficult to use aggressive filtering techniques to remove confounding noise from the detected light signals; e.g., aggressive filtering techniques may add distortion to short duration detected light signals.

[0002] GB 760,729 and US 5,801,826 each disclose spectroscopic devices. US 2010/0049016 discloses a non-invasive transdermal system comprising a reflectometer.

[0003] Aspects of the present invention are directed to systems and methods for spectroscopic measurement of a characteristic of biological tissue which involve output of light having high optical power, short duration, and/or fast repetition rate, which prevent a spectroscopic device from becoming undesirably hot, which involve filtering detected light signals to remove confounding noise, and which account for distortion added to detected light signals during filtering.

[0004] According to an aspect of the present invention, a system for spectroscopic measurement of a characteristic of a biological tissue is provided according to claim 1. The characteristic of the biological tissue may be selected from the group consisting of: oxygen saturation, hemoglobin concentration, and melanin concentration.

[0005] In a set of embodiments the processor includes a detector circuit, the detector circuit comprising: a differentiating amplifier operable to receive the detection signal, and operable to convert the detection signal into the differentiated detection signal; an adjustable gain amplifier operable to receive the differentiated detection signal, and operable to convert the differentiated detection signal into the differentiated and gain-adjusted detection signal; a positive peak detector operable to receive the differentiated and gain-adjusted detection signal, and operable to determine the maximum value of the differentiated and gain-adjusted detection signal; a negative peak detector operable to receive the differentiated and gain-adjusted detection signal, and operable to determine the minimum value of the differentiated and gain-adjusted detection signal; a difference amplifier operable to determine the adjusted peak-to-peak amplitude value using the maximum value received from the positive peak detector and the minimum value received from the negative peak detector; and a sample and hold device operable to receive and hold the adjusted peak-to-peak amplitude value.

[0006] The processor may further be operable to determine the adjusted peak-to-peak amplitude value using the maximum value and the minimum value.

[0007] According to another aspect of the present invention, a method for spectroscopic measurement of a characteristic of a biological tissue is provided according to claim 5. The characteristic of the biological tissue may be selected from the group consisting of: oxygen saturation, hemoglobin concentration, and melanin concentration.

[0008] Furthermore, the step of using the processor to process the detection signal and to determine the adjusted peak-to-peak amplitude value may include determining the adjusted peak-to-peak amplitude value using the maximum value and the minimum value.

[0009] These and other features and advantages of the present invention will become apparent in light of the drawings and detailed description of the present invention provided below.

[0010] Some embodiments of the present invention will now be described, by way of example only, and with reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatic illustration of a spectroscopy system embodiment;
FIG. 2 is a diagrammatic illustration of a sensor assembly embodiment applied to a subject;
FIG. 3 is a diagrammatic illustration of a detection circuit embodiment;
FIG. 4 is a diagrammatic illustration of a differentiating amplifier embodiment;
FIG. 5 is a plot showing a detection signal and its corresponding differentiated detection signal;
FIG. 6 is a plot showing a detection signal and its corresponding differentiated detection signal;
FIG. 7 is a plot showing a detection signal and its corresponding differentiated detection signal;
FIG. 8 is a diagrammatic illustration of an adjustable gain amplifier embodiment;
FIG. 9 is a diagrammatic illustration of a positive peak detector embodiment;
FIG. 10 is a diagrammatic illustration of a negative peak detector embodiment;
FIG. 11 is a diagrammatic illustration of a difference amplifier embodiment;
FIG. 12 is a diagrammatic illustration of a sample

and hold device embodiment; and

FIG. 13 is a timing diagram for the spectroscopy system.

[0011] Referring to FIG. 1, an embodiment of the present spectroscopy system 10 includes at least one sensor assembly 12 connected to a base unit 14. In FIG. 1, the sensor assembly 12 is applied to a subject. The base unit 14 includes a display 16, operator controls 18, and a processor 20 for providing signals to and/or receiving signals from the sensor assembly 12. The processor 20 is configured to selectively perform the functions necessary to operate the sensor assembly 12. For ease of description, the functionality of the processor 20 will be described herein as being implemented at least in part using hardware-specifically, a detection circuit 22, discussed in detail below. A person skilled in the art will recognize that the functionality of the processor 20 might alternatively be implemented using other hardware, software, firmware, or a combination thereof.

[0012] FIG. 2 illustrates a sensor assembly 12 embodiment applied to a subject. The sensor assembly 12 includes a pad 24, a light source 26, and a light detector 28. The light source 26 and the light detector 28 are mounted to the pad 24. The light source 26 may be any device operable to emit light; e.g., the light source 26 may be a laser, a light emitting diode (LED), or another device. The light source 26 may emit light at one or more wavelengths. The light detector 28 may be any device operable to detect light emitted by the light source 26; e.g., the light detector 28 may be a photodiode, or another device. Although the system 10 illustrated in FIG. 1 includes only one light source 26 and one light detector 28, in some embodiments the system 10 may include more than one light source 26 and/or more than one light detector 28.

[0013] Referring to FIG. 2, the sensor assembly 12 may be applied to a user so that the light source 26 emits input light 30 that penetrates a biological tissue of interest 32. In FIG. 2, the biological tissue of interest 32 is the brain. In alternative embodiments, the biological tissue of interest 32 may be tissue of the human finger, tissue of the human abdomen, or some other biological tissue. The input light 30 travels through the tissue 32 where it is attenuated, and subsequently exits the tissue as output light 34, and is detected by the light detector 28. The light detector 28 converts the detected output light 34 into a detection signal 36 (see FIG. 3). The detection signal 36 may include an unwanted noise component that results, for example, from background light detected by the light detector 28. As shown in FIG. 3, the detection signal 36 is input to the detection circuit 22. As will be discussed in detail below, the detection circuit 22 outputs an adjusted peak-to-peak amplitude value 38 that is representative of the amplitude of the detection signal 36 adjusted for an unwanted noise component that may be included in the detection signal 36. The adjusted peak-to-peak amplitude value 38 thus provides an accurate measurement of a characteristic of the biological tissue of interest 32 (e.g., oxygen concentration, hemoglobin concentration, melanin concentration, etc.).

[0014] Referring to FIGS. 3-12, an embodiment of the detection circuit 22 includes a differentiating amplifier 40, an adjustable gain amplifier 42, a positive peak detector 44, a negative peak detector 46, a difference amplifier 48, and a sample and hold device 50.

[0015] Referring to FIGS. 3 and 4, the differentiating amplifier 40 receives the detection signal 36 and outputs a differentiated detection signal 52. The differentiated detection signal 52 is the first derivative of the detection signal 36. Whereas the detection signal 36 is a unipolar waveform, the differentiated detection signal 52 is a bipolar waveform. The differentiating amplifier 40 functions like a high-pass filter, removing some or all of the low frequency components of the detection signal 36, which low frequency components may correspond to an unwanted noise component that may be included in the detection signal 36. FIGS. 5-7 each illustrate a plot of a detection signal 36 and its corresponding differentiated detection signal 52. In FIGS. 5-7, the x-axes represent time and the y-axes represent voltage. The differentiated detection signal 52 includes a peak-to-peak amplitude 54. FIGS. 5-7 each illustrate the peak-to-peak amplitude 54 of the respective differentiated detection signals 52. The peak-to-peak amplitude 54 of the differentiated detection signal 52 is representative of the detection signal 36, but may include an unwanted distortion component added by the differentiating amplifier 40. Other components of the detection circuit 22 (e.g., the adjustable gain amplifier 42, the positive peak detector 44, the negative peak detector 46, the difference amplifier 48, etc.) work together to determine the adjusted peak-to-peak amplitude value 38. The adjusted peak-to-peak amplitude value 38 accounts for an unwanted distortion component that may be added by the differentiating amplifier 40. Also, as indicated above, the adjusted peak-to-peak amplitude value 38 is representative of the amplitude of the detection signal 36 adjusted for an unwanted noise component that may be included in the detection signal 36. The differentiating amplifier 40 is not limited to the embodiment illustrated in FIG. 4.

[0016] Referring to FIGS. 3 and 8, the adjustable gain amplifier 42 receives the differentiated detection signal 52 and outputs the differentiated and gain-adjusted detection signal 56. The adjustable gain amplifier 42 multiplies the differentiated detection signal 52 by a multiplication factor to produce the differentiated and gain-adjusted detection signal 56. The multiplication factor is selected to optimize the system 10 and to enable the system 10 to achieve a maximum dynamic range under most operational conditions. The adjustable gain amplifier 42 is not limited to the embodiment illustrated in FIG. 8.

[0017] Referring to FIGS. 3 and 9, the positive peak detector 44 receives the differentiated and gain-adjusted detection signal 56. At an appropriate time period relating to a transition of the differentiated and gain-adjusted de-

tection signal 56, the positive peak detector 44 captures, holds, and ultimately outputs the maximum value of the differentiated and gain-adjusted detection signal 56 (hereinafter referred to as the "positive peak 58" of the differentiated and gain-adjusted detection signal 56). The positive peak detector 44 may capture and hold the positive peak 58, for example, by charging a capacitor. Referring to FIG. 5, the appropriate time period for detecting the positive peak 58 is identified by reference element "60". Timing control of the positive peak detector 44 can be implemented, for example, using a microcontroller or programmable logic. In the embodiment illustrated in FIG. 9, inputs 62, 64 received from a microcontroller are operable to open and close CMOS analog switches 66, 68 of the positive peak detector 44, respectively. The positive peak detector 44 is not limited to the embodiment illustrated in FIG. 9.

[0018] Referring to FIGS. 3 and 10, the negative peak detector 46 receives the differentiated and gain-adjusted detection signal 56. At an appropriate time period relating to a transition of the differentiated and gain-adjusted detection signal 56, the negative peak detector 46 captures, holds, and ultimately outputs the minimum value of the differentiated and gain-adjusted detection signal 56 (hereinafter referred to as the "negative peak 70" of the differentiated and gain-adjusted detection signal 56). The negative peak detector 46 may capture and hold the negative peak 70, for example, by charging a capacitor. Referring to FIG. 5, the appropriate time period for detecting the negative peak 70 is identified by reference element "72". In the embodiment illustrated in FIG. 10, inputs 72, 74 received from a microcontroller are operable to open and close CMOS analog switches 76, 78 of the negative peak detector 46, respectively. The negative peak detector 46 is not limited to the embodiment illustrated in FIG. 10.

[0019] Referring to FIGS. 3 and 11, the difference amplifier 48 receives as inputs the positive peak 48 and the negative peak 70 output by the positive peak detector 44 and the negative peak detector 46, respectively. The difference amplifier 48 determines the absolute value of the sum of the positive peak 58 and the negative peak 70, and outputs this value as the adjusted peak-to-peak amplitude value 38 described above. In some instances, unwanted signal components (e.g., unwanted noise components, unwanted distortion components, etc.) may be present in the differentiated and gain-adjusted detection signal 56. Such unwanted signal components are processed by both the positive peak detector 44 and the negative peak detector 46, and thus are cancelled out when the difference amplifier 48 determines the absolute value of the sum of the positive peak 58 and the negative peak 70. The difference amplifier 48 is not limited to the embodiment illustrated in FIG. 11.

[0020] Referring to FIGS. 3 and 12, the sample and hold device 50 receives the adjusted peak-to-peak amplitude value 38 that is output by the difference amplifier 48. The sample and hold device 50 captures and holds the adjusted peak-to-peak amplitude value 38 until it can be read by the processor 20 of the system 10, at which time the sample and hold device 50 outputs the adjusted peak-to-peak amplitude value 38. The sample and hold device 50 is not limited to the embodiment illustrated in FIG. 12.

Operation

[0021] FIG. 13 illustrates a timing diagram for the system 10 illustrated in FIGS. 1-12. In FIG. 13, steps (A) through (E) are illustrated. In step (A), the system 10 is reset; e.g., any values previously captured and held by the positive peak detector 44, the negative peak detector 46, and the sample and hold device 50 are erased or reset. In step (B), for a predetermined period of time, the light source 26 emits input light 30 that penetrates the biological tissue of interest 32. In step (C), towards the beginning of the predetermined period of time of light emission by the light source 26, the light detector 28 detects the attenuated output light 34 exiting the biological tissue of interest 32, and converts the output light 34 into a detection signal 36, and the detection circuit 22 captures and holds the positive peak 58. In step (D), towards the end of the predetermined period of time of light emission by the light source 26, the detection circuit 22 captures and holds the negative peak 70. In step (E), the sample and hold device 50 receives from the difference amplifier 48 the adjusted peak-to-peak amplitude value 38, which is representative of the absolute value of the sum of the positive peak 58 and the negative peak 70. In step (E), the sample and hold device 50 captures and holds the adjusted peak-to-peak amplitude value 38 until it can be read by the processor 20 of the system 10. Steps (A) through (E) are sequentially repeated, providing the processor 20 with a plurality of adjusted peak-to-peak amplitude values 38, each being representative of the amplitude of the detection signal 36 adjusted for an unwanted noise component that may be included in the detection signal 36.

[0022] While various embodiments of the present invention have been disclosed, it will be apparent to those of ordinary skill in the art that many more embodiments and implementations are possible within the scope of the invention. Accordingly, the present invention is not to be restricted except in light of the attached claims.

Claims

1. A system (10) for spectroscopic measurement of a characteristic of a biological tissue (32), the system (10) comprising:

   at least one light source (26) operable to emit light (30) that penetrates the biological tissue (32);
   at least one light detector (28) operable to detect

light (34) emitted by the at least one light source (26) and passed through the biological tissue (32), and operable to convert the detected light (34) into a detection signal (36); and

a processor (20) operable to receive the detection signal (36), and operable to determine an adjusted peak-to-peak amplitude value (38) that is representative of an amplitude of the detection signal (36) adjusted to account for an unwanted noise component present in the detection signal (36);

wherein, in order to determine the adjusted peak-to-peak amplitude value (38), the processor (20) includes a filter (40) operable to convert the detection signal (36) into a differentiated detection signal (52);

wherein the processor (20) is operable to convert the differentiated detection signal (52) into a differentiated and gain-adjusted detection signal (56); and

wherein the processor (20) is operable to determine a maximum value (58) of the differentiated and gain-adjusted detection signal (56), and a minimum value (70) of the differentiated and gain-adjusted detection signal (56).

2. The system (10) of claim 1, wherein the processor (20) includes a detector circuit (22), the detector circuit (22) comprising:

a differentiating amplifier (40) operable to receive the detection signal (36), and operable to convert the detection signal (36) into the differentiated detection signal (52);

an adjustable gain amplifier (42) operable to receive the differentiated detection signal (52), and operable to convert the differentiated detection signal (52) into the differentiated and gain-adjusted detection signal (56);

a positive peak detector (44) operable to receive the differentiated and gain-adjusted detection signal (56), and operable to determine the maximum value (58) of the differentiated and gain-adjusted detection signal (56);

a negative peak detector (46) operable to receive the differentiated and gain-adjusted detection signal (56), and operable to determine the minimum value (70) of the differentiated and gain-adjusted detection signal (56);

a difference amplifier (48) operable to determine the adjusted peak-to-peak amplitude value (38) using the maximum value (58) received from the positive peak detector (44) and the minimum value (70) received from the negative peak detector (46); and

a sample and hold device (50) operable to receive and hold the adjusted peak-to-peak amplitude value (38).

3. The system (10) of claim 1 or 2, wherein the characteristic of the biological tissue (32) is selected from the group consisting of: oxygen saturation, hemoglobin concentration, and melanin concentration.

4. The system (10) of any preceding claim , wherein the processor (20) is operable to determine the adjusted peak-to-peak amplitude value (38) using the maximum value (58) and the minimum value (70).

5. A method for spectroscopic measurement of a characteristic of a biological tissue (32), the method comprising the steps of:

using at least one light source (26) to emit light (30) that penetrates the biological tissue (32);

using at least one light detector (28) to detect light (34) emitted by the at least one light source (26) and passed through the biological tissue (32), and to convert the detected light (34) into a detection signal (36), the detection signal (36) including an unwanted noise component; and

using a processor (20) to process the detection signal (36) and to determine an adjusted peak-to-peak amplitude value (38) that is representative of an amplitude of the detection signal (36) adjusted for the unwanted noise component present within the detection signal (36);

wherein the step of using the processor (20) to process the detection signal (36) and to determine the adjusted peak-to-peak amplitude value (38) includes:

converting the detection signal (36) into a differentiated detection signal (52);

converting the differentiated detection signal (52) into a differentiated and gain-adjusted detection signal (56); and

determining a maximum value (58) of the differentiated and gain-adjusted detection signal (56), and determining a minimum value (70) of the differentiated and gain-adjusted detection signal (56).

6. The method of claim 5, wherein the characteristic of the biological tissue (32) is selected from the group consisting of: oxygen saturation, hemoglobin concentration, and melanin concentration.

7. The method of claim 5 or 6, wherein the step of using the processor (20) to process the detection signal (36) and to determine the adjusted peak-to-peak amplitude value (38) includes determining the adjusted peak-to-peak amplitude value (38) using the maximum value (58) and the minimum value (70).

Patentansprüche

1. System (10) zur spektroskopischen Messung einer Eigenschaft eines biologischen Gewebes (32), wobei das System (10) umfasst:

   mindestens eine Lichtquelle (26), die betrieben werden kann, um Licht (30) auszustrahlen, welches das biologische Gewebe (32) durchdringt;
   mindestens einen Lichtdetektor (28), der betrieben werden kann, um Licht (34), das von der mindestens einen Lichtquelle (26) ausgestrahlt wird und durch das biologische Gewebe (32) hindurchgeführt wird, zu erfassen, und der betrieben werden kann, um das erfasste Licht (34) in ein Erfassungssignal (36) umzuwandeln; und
   einen Prozessor (20), der betrieben werden kann, um das Erfassungssignal (36) zu empfangen, und der betrieben werden kann, um einen angepassten Spitze-zu-Spitze-Amplitudenwert (38) zu bestimmen, der kennzeichnend für eine Amplitude des Erfassungssignals (36) ist, der angepasst ist, um einen in dem Erfassungssignal (36) vorhandenen unerwünschten Rauschanteil zu berücksichtigen;
   wobei, um den angepassten Spitze-zu-Spitze-Amplitudenwert (38) zu bestimmen, der Prozessor (20) einen Filter (40) einschließt, der betrieben werden kann, um das Erfassungssignal (36) in ein differenziertes Erfassungssignal (52) umzuwandeln;
   wobei der Prozessor (20) betrieben werden kann, um das differenzierte Erfassungssignal (52) in ein differenziertes und verstärkungsangepasstes Erfassungssignal (56) umzuwandeln; und
   wobei der Prozessor (20) betrieben werden kann, um einen Maximalwert (58) des differenzierten und verstärkungsangepassten Erfassungssignals (56) und einen Mindestwert (70) des differenzierten und verstärkungsangepassten Erfassungssignals (56) zu bestimmen.

2. System (10) nach Anspruch 1, wobei der Prozessor (20) einen Detektorkreis (22) einschließt, wobei der Detektorkreis (22) umfasst:

   einen Differenzierungsverstärker (40), der betrieben werden kann, um das Erfassungssignal (36) zu empfangen, und der betrieben werden kann, um das Erfassungssignal (36) in das differenzierte Erfassungssignal (52) umzuwandeln;
   einen regelbaren Verstärkungsverstärker (42), der betrieben werden kann, um das differenzierte Erfassungssignal (52) zu empfangen, und der betrieben werden kann, um das differenzierte Erfassungssignal (52) in das differenzierte und verstärkungsangepasste Erfassungssignal (56) umzuwandeln;
   einen positiven Spitzen-Detektor (44), der betrieben werden kann, um das differenzierte und verstärkungsangepasste Erfassungssignal (56) zu empfangen, und der betrieben werden kann, um den Maximalwert (58) des differenzierten und verstärkungsangepassten Erfassungssignals (56) zu bestimmen;
   einen negativen Spitzen-Detektor (46), der betrieben werden kann, um das differenzierte und verstärkungsangepasste Erfassungssignal (56) zu empfangen, und der betrieben werden kann, um den Mindestwert (70) des differenzierten und verstärkungsangepassten Erfassungssignals (56) zu bestimmen;
   einen Differenzverstärker (48), der betrieben werden kann, um den angepassten Spitze-zu-Spitze-Amplitudenwert (38) unter Verwendung des von dem positiven Spitzen-Detektor (44) empfangenen Maximalwerts (58) und des von dem negativen Spitzen-Detektor (46) empfangenen Mindestwerts (70) zu bestimmen; und
   eine Proben- und Haltevorrichtung (50), die betrieben werden kann, um den angepassten Spitze-zu-Spitze-Amplitudenwert (38) zu empfangen und zu halten.

3. System (10) nach Anspruch 1 oder 2, wobei die Eigenschaft des biologischen Gewebes (32) ausgewählt ist aus der Gruppe, bestehend aus: Sauerstoffsättigung, Hämoglobinkonzentration und Melaninkonzentration.

4. System (10) nach einem der vorstehenden Ansprüche, wobei der Prozessor (20) betrieben werden kann, um den angepassten Spitze-zu-Spitze-Amplitudenwert (38) unter Verwendung des Maximalwerts (58) und des Mindestwerts (70) zu bestimmen.

5. Verfahren zur spektroskopischen Messung einer Eigenschaft eines biologischen Gewebes (32), wobei das Verfahren die folgenden Schritte umfasst:

   Verwenden mindestens einer Lichtquelle (26), um Licht (30) auszustrahlen, welches das biologische Gewebe (32) durchdringt;
   Verwenden mindestens eines Lichtdetektors (28), um Licht (34) zu erfassen, das von der mindestens einen Lichtquelle (26) ausgestrahlt und durch das biologische Gewebe (32) hindurchgeführt wird, und um das erfasste Licht (34) in ein Erfassungssignal (36) umzuwandeln, wobei das Erfassungssignal (36) einen unerwünschten Rauschanteil einschließt; und
   Verwenden eines Prozessors (20), um das Erfassungssignal (36) zu verarbeiten und einen angepassten Spitze-zu-Spitze-Amplitudenwert

(38) zu bestimmen, der kennzeichnend für eine Amplitude des Erfassungssignals (36) ist, der auf den unerwünschten Rauschanteil, der innerhalb des Erfassungssignals (36) vorhanden ist, angepasst ist;
wobei der Schritt des Verwendens des Prozessors (20) zum Verarbeiten des Erfassungssignals (36) und zum Bestimmen des angepassten Spitze-zu-Spitze-Amplitudenwerts (38) einschließt:

Umwandeln des Erfassungssignals (36) in ein differenziertes Erfassungssignal (52);
Umwandeln des differenzierten Erfassungssignals (52) in ein differenziertes und verstärkungsangepasstes Erfassungssignal (56); und
Bestimmen eines Maximalwerts (58) des differenzierten und verstärkungsangepassten Erfassungssignals (56) und Bestimmen eines Mindestwerts (70) des differenzierten und verstärkungsangepassten Erfassungssignals (56).

6. Verfahren nach Anspruch 5, wobei die Eigenschaft des biologischen Gewebes (32) ausgewählt ist aus der Gruppe, bestehend aus: Sauerstoffsättigung, Hämoglobinkonzentration und Melaninkonzentration.

7. Verfahren nach Anspruch 5 oder 6, wobei der Schritt des Verwendens des Prozessors (20) zum Verarbeiten des Erfassungssignals (36) und zum Bestimmen des angepassten Spitze-zu-Spitze-Amplitudenwerts (38) Bestimmen des angepassten Spitze-zu-Spitze-Amplitudenwerts (38) unter Verwendung des Maximalwerts (58) und des Mindestwerts (70) einschließt.

Revendications

1. Système (10) pour la mesure spectroscopique d'une caractéristique d'un tissu biologique (32), le système (10) comprenant :

au moins une source de lumière (26) utilisable pour émettre une lumière (30) qui pénètre dans le tissu biologique (32) ;
au moins un détecteur de lumière (28) utilisable pour détecter une lumière (34) émise par l'au moins une source de lumière (26) et passée à travers le tissu biologique (32), et utilisable pour convertir la lumière (34) détectée en un signal de détection (36) ; et
un processeur (20) utilisable pour recevoir le signal de détection (36), et utilisable pour déterminer une valeur d'amplitude crête à crête ajustée (38) qui est représentative d'une amplitude du signal de détection (36) ajustée pour prendre en compte une composante de bruit indésirable présente dans le signal de détection (36) ;
dans lequel, afin de déterminer la valeur d'amplitude crête à crête ajustée (38), le processeur (20) inclut un filtre (40) utilisable pour convertir le signal de détection (36) en un signal de détection différencié (52) ;
dans lequel le processeur (20) est utilisable pour convertir le signal de détection différencié (52) en un signal de détection différencié et à gain ajusté (56) ; et
dans lequel le processeur (20) est utilisable pour déterminer une valeur maximale (58) du signal de détection différencié et à gain ajusté (56), et une valeur minimale (70) du signal de détection différencié et à gain ajusté (56).

2. Système (10) selon la revendication 1, dans lequel le processeur (20) inclut un circuit de détecteur (22), le circuit de détecteur (22) comprenant :

un amplificateur différenciateur (40) utilisable pour recevoir le signal de détection (36), et utilisable pour convertir le signal de détection (36) en le signal de détection différencié (52) ;
un amplificateur à gain ajustable (42) utilisable pour recevoir le signal de détection différencié (52), et utilisable pour convertir le signal de détection différencié (52) en le signal de détection différencié et à gain ajusté (56) ;
un détecteur de crête positive (44) utilisable pour recevoir le signal de détection différencié et à gain ajusté (56), et utilisable pour déterminer la valeur maximale (58) du signal de détection différencié et à gain ajusté (56) ;
un détecteur de crête négative (46) utilisable pour recevoir le signal de détection différencié et à gain ajusté (56), et utilisable pour déterminer la valeur minimale (70) du signal de détection différencié et à gain ajusté (56) ;
un amplificateur différentiel (48) utilisable pour déterminer la valeur d'amplitude crête à crête ajustée (38) en utilisant la valeur maximale (58) reçue à partir du détecteur de crête positive (44) et la valeur minimale (70) reçue à partir du détecteur de crête négative (46) ; et
un échantillonneur-bloqueur (50) utilisable pour recevoir et conserver la valeur d'amplitude crête à crête ajustée (38).

3. Système (10) selon la revendication 1 ou 2, dans lequel la caractéristique du tissu biologique (32) est sélectionnée dans le groupe constitué : d'une saturation en oxygène, d'une concentration en hémoglobine, et d'une concentration en mélanine.

4. Système (10) selon l'une quelconque des revendications précédentes, dans lequel le processeur (20) est utilisable pour déterminer la valeur d'amplitude crête à crête ajustée (38) en utilisant la valeur maximale (58) et la valeur minimale (70).

5. Procédé pour la mesure spectroscopique d'une caractéristique d'un tissu biologique (32), le procédé comprenant les étapes suivantes :

l'utilisation d'au moins une source de lumière (26) pour émettre une lumière (30) qui pénètre dans le tissu biologique (32) ;
l'utilisation d'au moins un détecteur de lumière (28) pour détecter une lumière (34) émise par l'au moins une source de lumière (26) et passée à travers le tissu biologique (32), et pour convertir la lumière (34) détectée en un signal de détection (36), le signal de détection (36) incluant une composante de bruit indésirable ; et
l'utilisation d'un processeur (20) pour traiter le signal de détection (36) et pour déterminer une valeur d'amplitude crête à crête ajustée (38) qui est représentative d'une amplitude du signal de détection (36) ajustée pour la composante de bruit indésirable présente dans le signal de détection (36) ;
dans lequel l'étape d'utilisation du processeur (20) pour traiter le signal de détection (36) et pour déterminer la valeur d'amplitude crête à crête ajustée (38) inclut :

la conversion du signal de détection (36) en un signal de détection différencié (52) ;
la conversion du signal de détection différencié (52) en un signal de détection différencié et à gain ajusté (56) ; et
la détermination d'une valeur maximale (58) du signal de détection différencié et à gain ajusté (56), et la détermination d'une valeur minimale (70) du signal de détection différencié et à gain ajusté (56).

6. Procédé selon la revendication 5, dans lequel la caractéristique du tissu biologique (32) est sélectionnée dans le groupe constitué : d'une saturation en oxygène, d'une concentration en hémoglobine, et d'une concentration en mélanine.

7. Procédé selon la revendication 5 ou 6, dans lequel l'étape d'utilisation du processeur (20) pour traiter le signal de détection (36) et pour déterminer la valeur d'amplitude crête à crête ajustée (38) inclut la détermination de la valeur d'amplitude crête à crête ajustée (38) en utilisant la valeur maximale (58) et la valeur minimale (70).

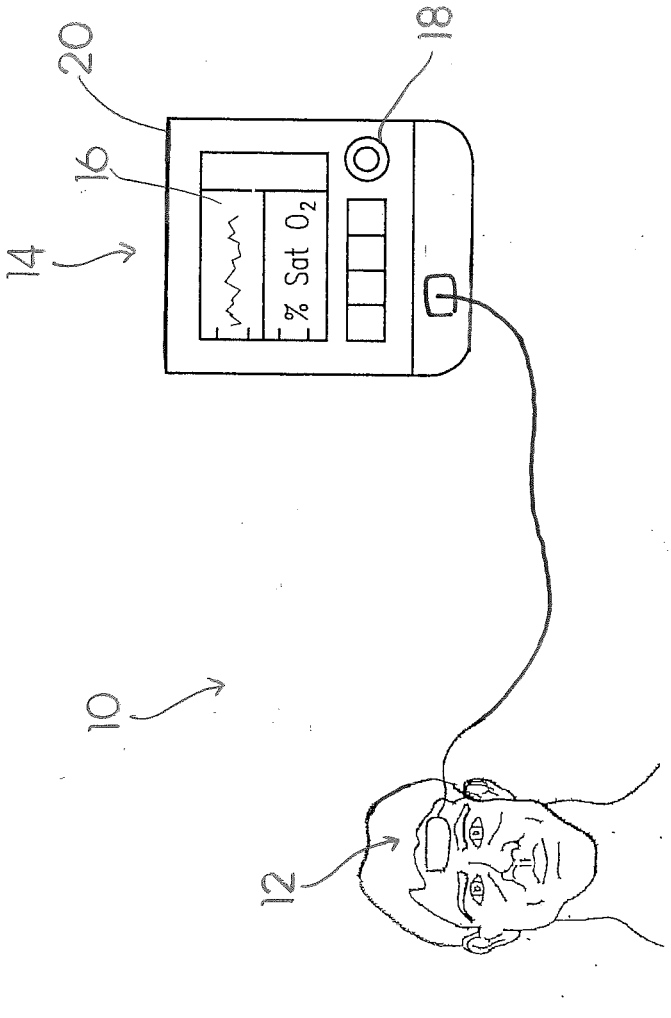

FIG. 1

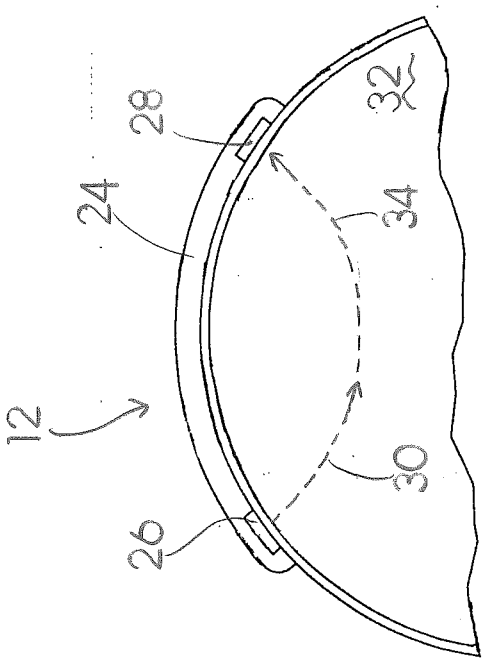

FIG. 2

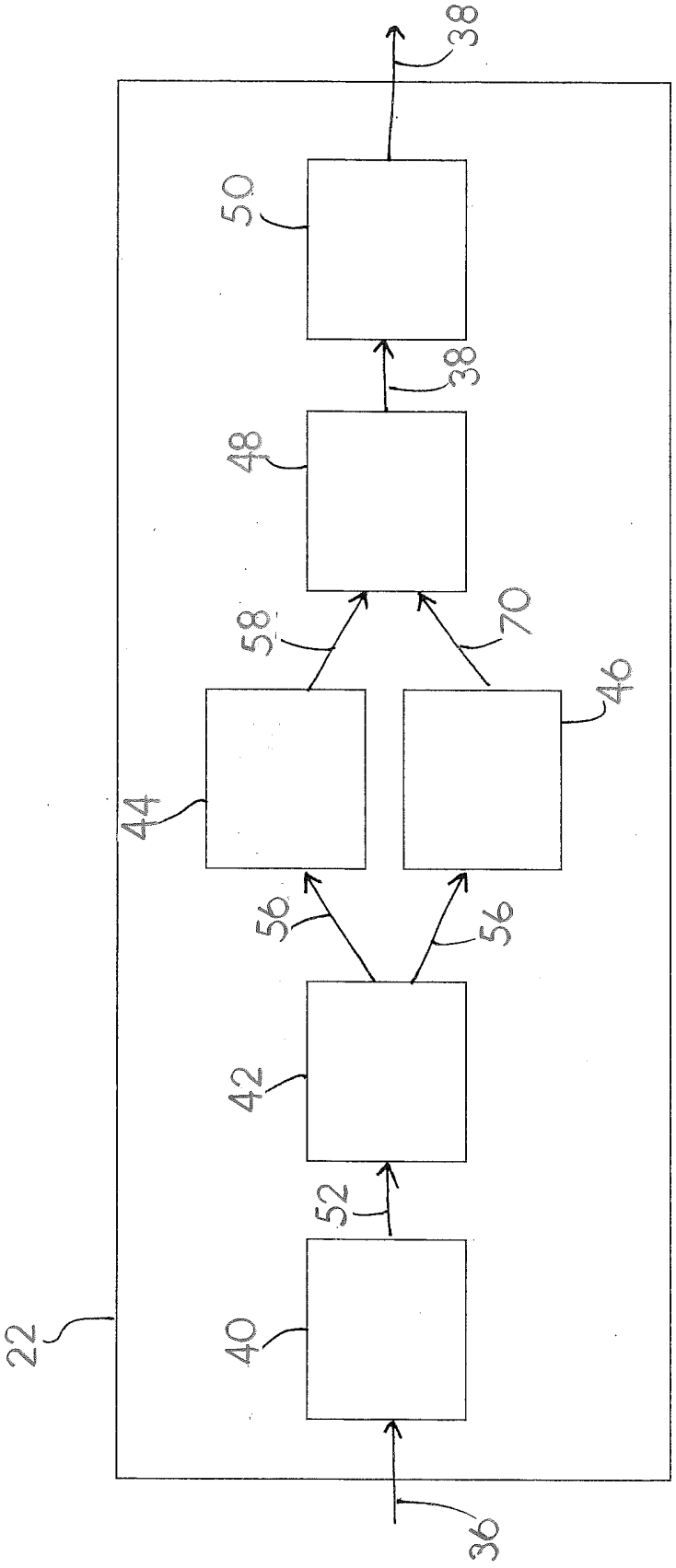

FIG. 3

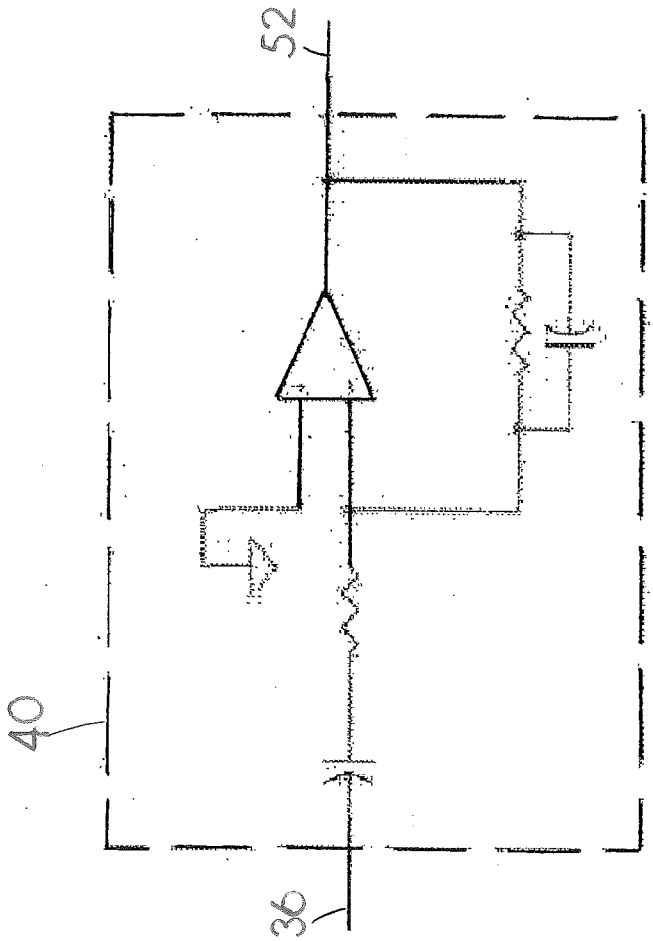

FIG 4

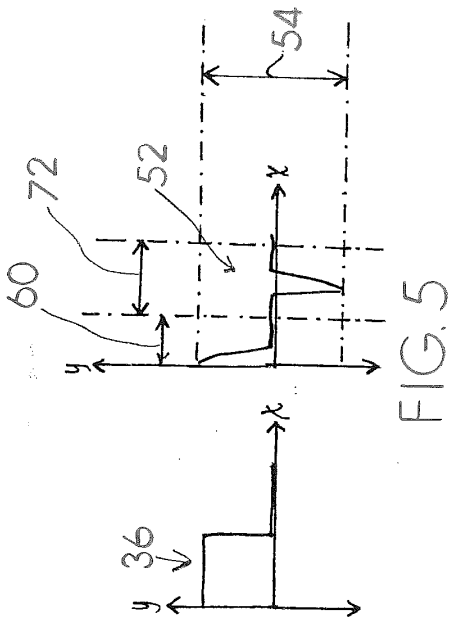

FIG. 5

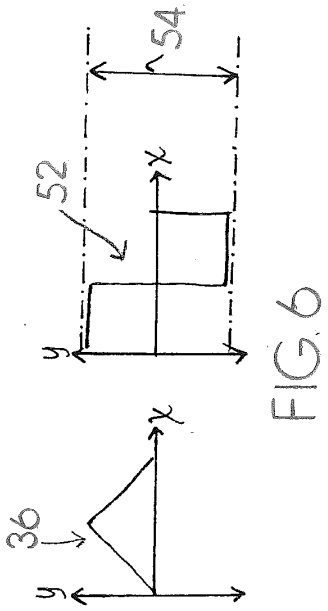

FIG. 6

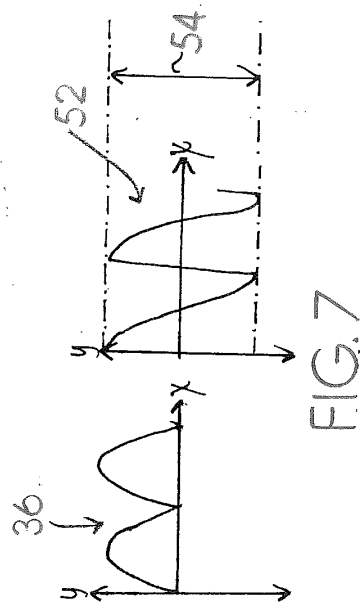

FIG. 7

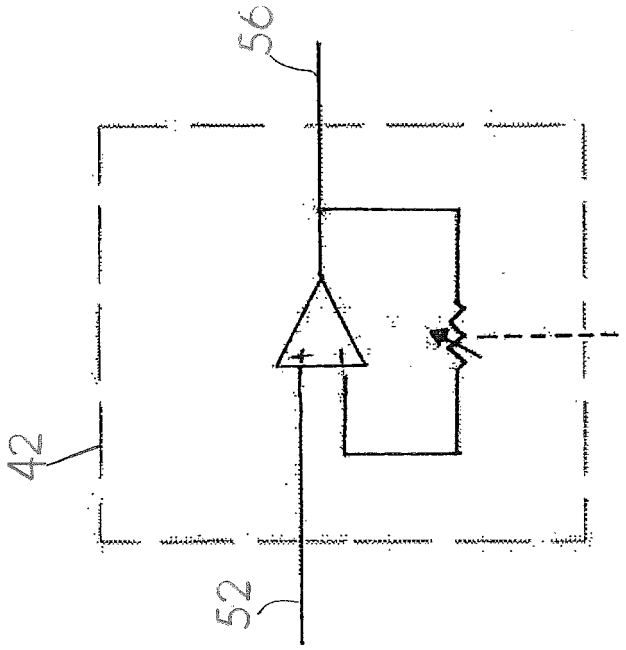

FIG. 8

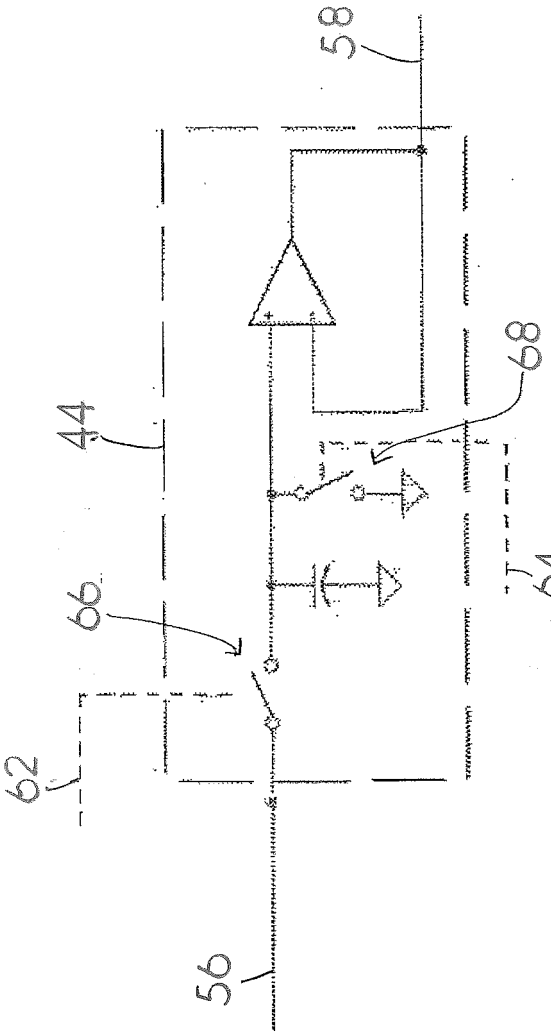

FIG 9

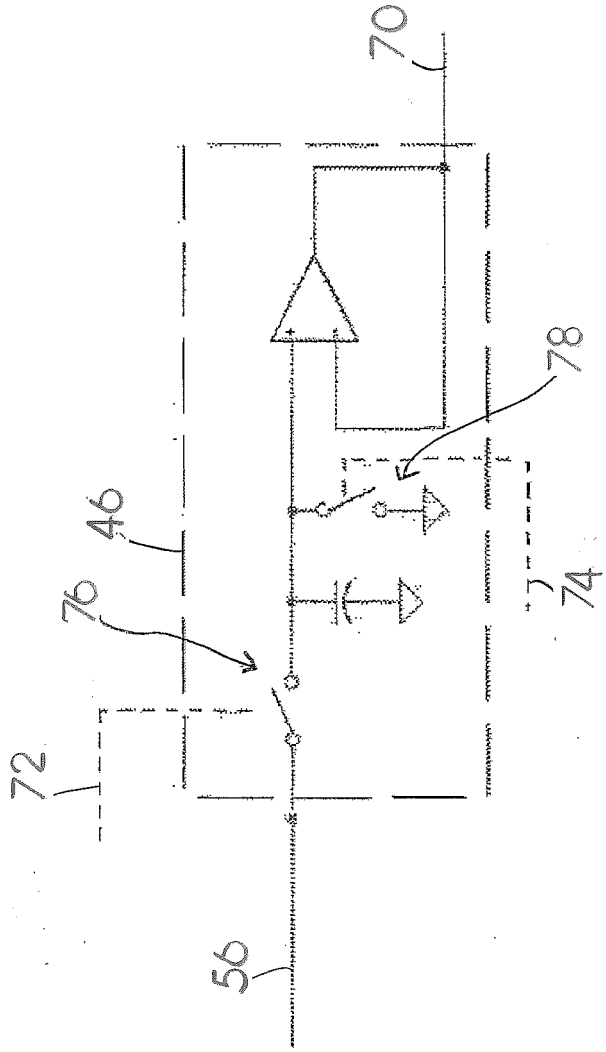

FIG. 10

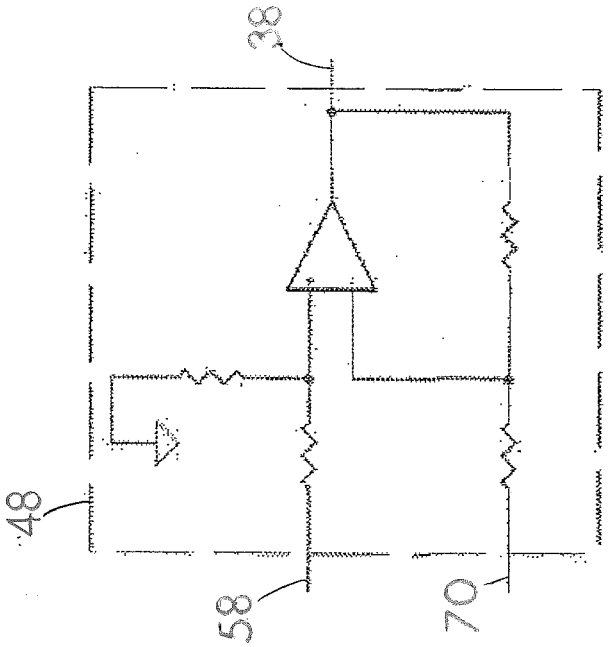

FIG 11

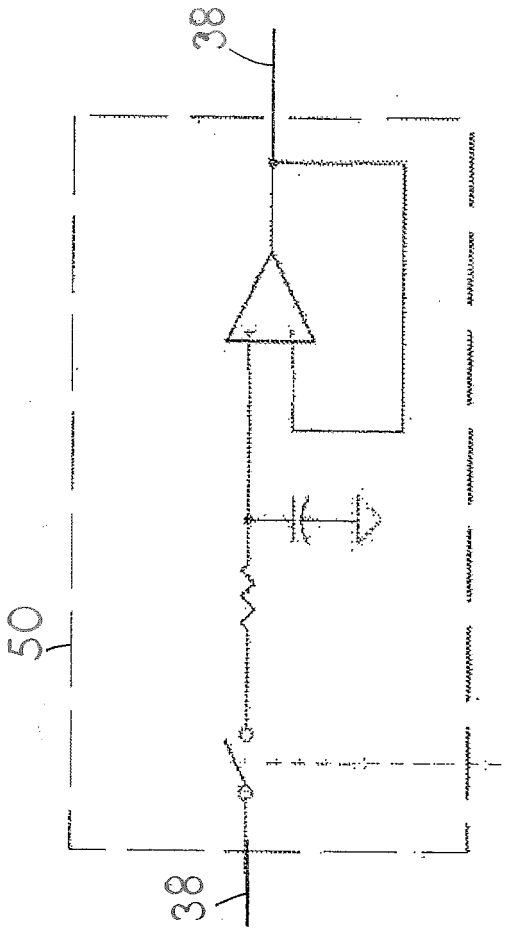

FIG 12

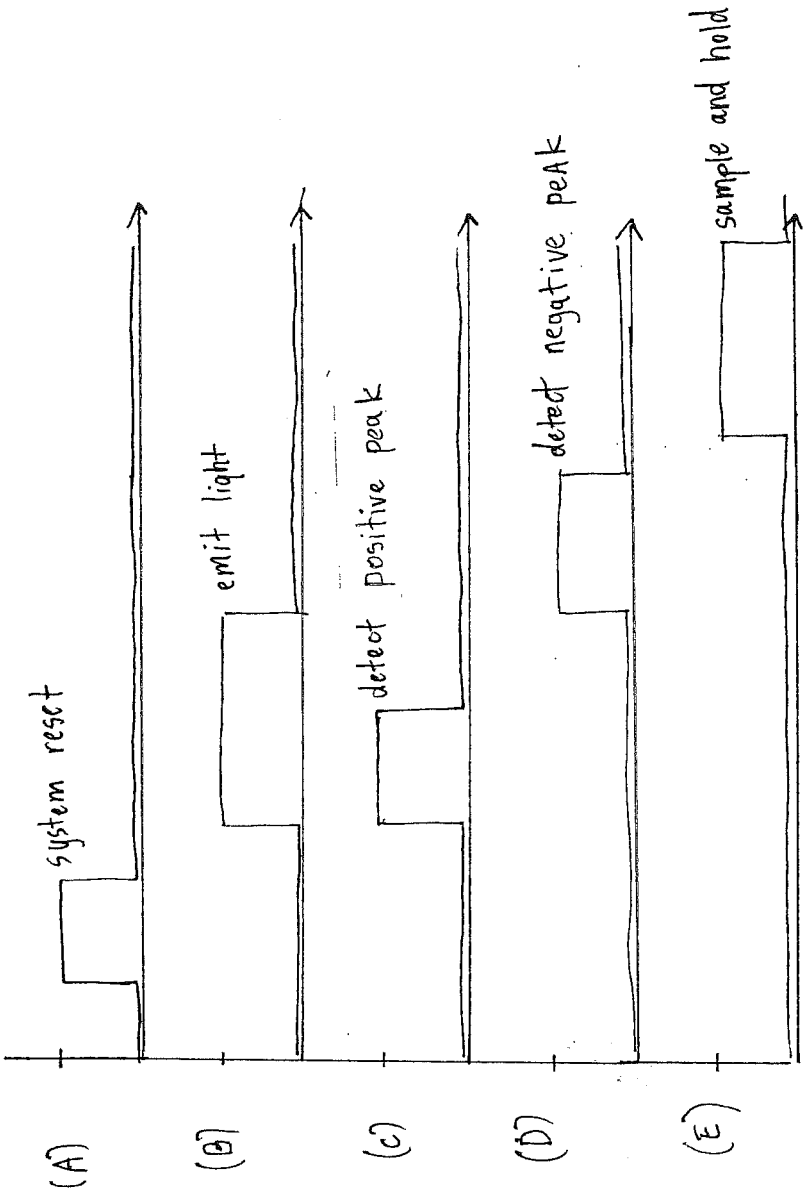
system reset
emit light
detect positive peak
detect negative peak
sample and hold
(A)
(B)
(C)
(D)
(E)

FIG. 13

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- GB 760729 A **[0002]**
- US 5801826 A **[0002]**
- US 20100049016 A **[0002]**

专利名称(译)	用于光谱测量生物组织特征的系统和方法		
公开(公告)号	EP2712544B1	公开(公告)日	2019-03-27
申请号	EP2013186637	申请日	2013-09-30
申请(专利权)人(译)	CAS医疗系统，INC.		
当前申请(专利权)人(译)	CAS医疗系统，INC.		
[标]发明人	KOSTURKO WILLIAM		
发明人	KOSTURKO, WILLIAM		
IPC分类号	A61B5/00 A61B5/1455		
CPC分类号	A61B5/0075 A61B5/14553 A61B5/7225 A61B2576/026 G16H30/40 G01N21/00 G01R29/26		
代理机构(译)	DEHNS		
优先权	61/707138 2012-09-28 US		
其他公开文献	EP2712544A1		
外部链接	Espacenet		

摘要(译)

提供了一种用于光谱测量生物组织特征的方法和系统。该方法包括以下步骤：1。使用至少一个光源发射穿透生物组织的光; 2.使用至少一个光检测器检测由所述至少一个光源发射并穿过所述生物组织的光，并将检测到的光转换为检测信号，所述检测信号包括不需要的噪声分量; 3.使用处理器（20）处理检测信号并确定调整后的峰峰值幅度值，该峰值幅度值表示针对不需要的噪声分量调整的检测信号的幅度。

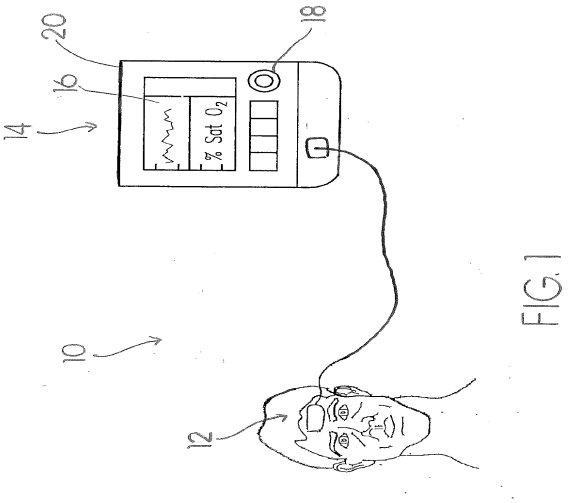

FIG. 1