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(71) Applicant: **KONINKLIJKE PHILIPS N.V.** [NL/NL];
High Tech Campus 5, 5656 AE Eindhoven (NL).

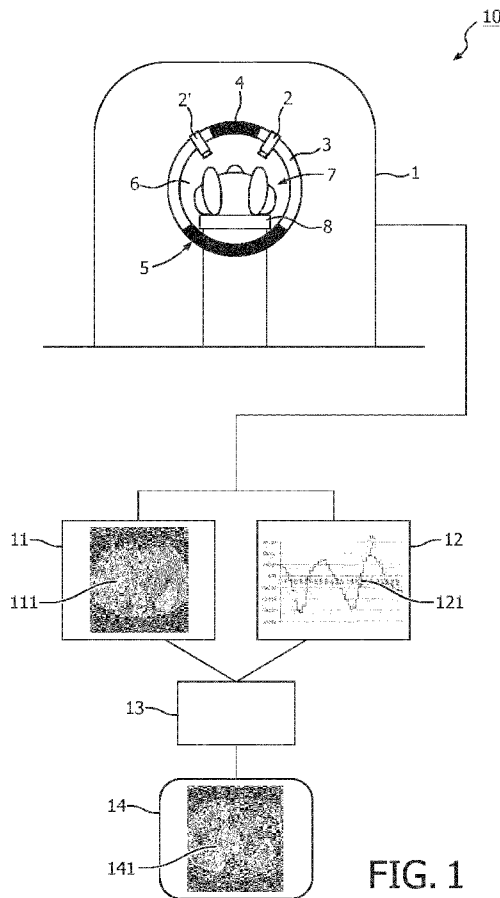
(72) Inventors: **GRASS, Michael**; c/o High Tech Campus 5,
5656 AE Eindhoven (NL). **PROKSA, Roland**; c/o High
Tech Campus 5, 5656 AE Eindhoven (NL). **KRUEGER,
Sascha**; c/o High Tech Campus 5, 5656 AE Eindhoven
(NL).

(74) Agents: **VERSTEEG, Dennis John** et al.; High Tech
Campus 5, 5656 AE Eindhoven (NL).

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[Continued on next page]

(54) Title: PERFUSION IMAGING



(57) Abstract: The present invention is directed to a perfusion imaging device and method, wherein perfusion data of at least a tissue of interest is obtained from medical imaging and blood pulsation parameters are determined on or near the tissue of interest without physical contact to a patient. Perfusion phase parameters are determined based on the perfusion data and the blood pulsation parameters

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LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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Perfusion imaging

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FIELD OF THE INVENTION

The present invention generally relates to a perfusion imaging device, a method for obtaining perfusion-pulsation parameters and a computer program product for determining perfusion-pulsation parameters.

10

BACKGROUND OF THE INVENTION

Computed tomography (CT), as well as other imaging modalities, is used, amongst others, for perfusion imaging. Generally, perfusion imaging is an imaging approach for capturing information corresponding to the passage of fluid (e.g., blood, lymph fluid, etc.) through anatomical tissue of interest (e.g. the brain, muscles or the cardiac area) and quantifying the information to facilitate identifying a health state of the tissue or other tissue. For example, myocardial perfusion imaging can be used to measure oxygen supply of muscle tissue in the heart. As such, the heart of a patient can be imaged in three dimensions (3D) before and during injection of radio-opaque contrast material, and the differences in the reconstructed images can be attributed to the contrast material that is washed into the tissue. Muscle tissue can then be classified according to the degree of contrast material uptake, and pathologies can be detected, for example, myocardial infarction or coronary occlusion.

20

Prospectively Electrocardiogram (ECG) gated CT has been used for perfusion imaging. With this technique a certain or particular cardiac phase (e.g., systole, diastole, etc.) is selected for the prospective gating. As such data acquisition may be performed consistently in a single pulsation state. This is important for perfusion scans, since a time point of each temporal frame of a perfusion image sequence may be acquired in the same cardiac phase. Moreover, repeated scans of a same patient which are acquired in different sessions can be made more consistent which is especially important for the quantitative analysis of signals over time.

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However, a problem with ECG gated CT is that the motion states of the heart in the different time frames of the cardiac cycle may differ. This generally is due to the fact that the ECG gating relies on an electrical signal and not on the actual mechanical motion. Furthermore, the ECG probe is usually placed close to the tissue of interest. As a

consequence, the ECG or imaging data may be influenced by incoming (x-ray) radiation (e.g. occurrence of hardening or other artifacts, physically blocking radiation emitted towards the tissue of interest or generation of electric signals within the probe due to absorbed radiation causing false or distorted data).

5 It would therefore be desirable to obtain consistent information about blood pulsation parameters, such as the cardiac phase during a perfusion imaging procedure without the need for using ECG gating.

SUMMARY OF THE INVENTION

10 Embodiments according to the present invention are directed to a perfusion imaging device comprising a medical imager comprising an imaging region for imaging a tissue of interest of a patient configured to generate perfusion data of at least the tissue of interest; a contactless blood pulsation parameter determiner configured to determine blood pulsation parameters on or near the tissue of interest without physical contact to the patient;
15 and a perfusion phase parameter determiner that determines a perfusion phase parameter based on the perfusion data and the blood pulsation parameters. Such a system is capable to obtain reliable blood pulsation information without the need for placing a device, such as an ECG probe, in the imaging beam. In the context of the present invention the term ‘contactless’ means without direct physical contact to the patient, i.e. determining perfusion phase
20 parameters without the use of a probe attached to or placed directly on the patient.

 Preferably, the contactless blood pulsation parameter determiner comprises a skin image provider, such as an optical camera, and a skin image analyzer. The contactless blood pulsation parameter determiner preferably determines blood pulsation parameters based on skin color variations due to changing blood flow conditions, preferably based on
25 remote photoplethysmography.

 Preferably, the contactless blood pulsation parameter comprises a cardiac phase.

 Further embodiments according to the present invention are directed to a perfusion imaging device according to any of the previous claims, wherein the medical
30 imager is selected from a group comprising a computed tomography imager, a magnetic resonance imager, a positron emission tomography imager or a single-photon emission computed tomography. The present invention is particularly suitable for tomographic imagers, but is well-suited for non-tomographic imagers as well.

Further embodiments according to the present invention are directed to a method for obtaining perfusion-pulsation parameters comprising the steps of obtaining a medical scan image of an tissue of interest of a patient; determining perfusion parameters of the tissue of interest from the medical scan; contactless obtaining of blood pulsation parameters of the patient on or near the tissue of interest; and obtaining perfusion-pulsation parameters by linking the perfusion parameters and the blood pulsation parameters.

Preferably the steps of obtaining a medical scan image and contactless perfusion parameters are performed concurrently.

Preferably, the contactless obtaining of blood parameters comprises obtaining a skin image of a part of the patient's skin and/or the blood pulsation parameters comprise a cardiac phase and/or the blood pulsation parameter determiner are determined based on skin color-spectral variations due to changing blood flow conditions, preferably based on remote photoplethysmography.

The method preferably further comprises displaying at least one of the perfusion parameters, the blood pulsation parameters or the perfusion-pulsation parameters.

Preferably, the medical scan is obtained by a medical imager selected from a group comprising a computed tomography imager, an x-ray imager, a magnetic resonance imager, a positron emission tomography imager or a single-photon emission computed tomography.

Further embodiments according to the present invention are directed to a computer program product for determining perfusion-pulsation parameters when the computer program product is run on the computer comprising instructions to execute the steps of determining perfusion parameters from a medical scan; and determining perfusion-pulsation parameters by linking the perfusion parameters with contactlessly obtained blood pulsation parameters.

Further advantages and variations are addressed in the description of the embodiments. Still further aspects and embodiments of the present invention will be appreciated by those of ordinary skill in the art upon reading and understanding the following detailed description. Numerous additional advantages and benefits will become apparent to those of ordinary skill in the art upon reading the following detailed description of preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by drawings of which

Fig. 1 shows an embodiment of a perfusion imaging device according to the present invention;

Fig. 2 shows an example of a blood pulsation signal obtained with a blood pulsation determiner;

5 Fig. 3 shows embodiments of a gantry of a perfusion imaging device according to the present invention, in which fig. 3a shows an embodiment with one skin image provider mounted to the gantry and fig. 3b shows an embodiment with two skin image providers mounted to the gantry;

10 Fig. 4 shows a schematic depiction of a method for obtaining perfusion-pulsation parameters according to the present invention.

The invention may take form in various components and arrangements of components, and in various process operations and arrangements of process operations. The drawings are only for the purpose of illustrating preferred embodiments and are not to be construed as limiting the invention. To better visualize certain features may be omitted or
15 dimensions may be not be according to scale.

DETAILED DESCRIPTION OF EMBODIMENTS

The present invention is illustrated using CT as an example, but the invention is not limited to CT, but may be readily adapted to be suitable for other (tomographic and
20 non-tomographic) imaging modalities, such as for instance x-ray, magnetic resonance (MR), positron emission tomography (PET) or single proton emission computed tomography (SPECT) imaging or combinations thereof.

Fig. 1 shows an embodiment of a perfusion imaging device 10 according to the present invention. The perfusion imaging device 10 comprises a CT imaging system 1, with a gantry 3 that, when in use, rotates around an examination area 6. X-ray radiation is emitted from x-ray source 4 towards detector 5, both of which are mounted in the gantry
25 opposite of each other. The x-ray radiation traverses the examination region 6 from the source 4 to the detector. When a subject to be imaged, such as a patient 7, is placed in the examination region 6, x-ray images can be obtained from every angle. Usually the patient lies on a patient support 8 that is moved through the examination region 6 during the imaging
30 procedure, as such a three dimensional scan data of (part of) the patient 7 may be obtained. This scan data may then be further processed into a displayable image 111.

In perfusion imaging contrast agent passing through the tissue of interest 71 is analyzed. This could be time dependent tracking, wherein the tissue of interest 71 is imaged

at various moments in time while the contrast agent passes through it or it could be determining the contrast agent perfusion in the tissue of interest 71 at a predetermined time (e.g. a specific time period after start of contrast agent flow). The contrast agent usually travels in a medium, such as blood or lymph fluid. This medium normally does not flow through a body at a constant speed, but is for instance propelled forward in pulses by the heart and therefore is submitted to the cardiac cycle. To be able to properly compare perfusion data taken at different moments, it is necessary to know the blood pulsation parameters at which the data was obtained. Such blood pulsation parameters may be the phase of the cardiac cycle in which the perfusion data was obtained, but also for instance of patient-specific or situational data such as his or her position, activity level and other parameters that may influence blood pulsation. As mentioned previously, this is commonly done by applying an ECG probe to the patient 7 and linking ECG data with the perfusion data.

As mentioned before having the ECG placed near or in the imaging beam may cause problems with the reliability. A common solution to this is to place the ECG on the patient at a location remote from the tissue of interest (e.g. on the patient's arm or leg). However, this has the drawback that the blood pulsation parameters are likely to be out of phase with those near the location of the tissue of interest, which is difficult to accurately correct. Furthermore, for physicians and supporting staff it is a common practice for other medical procedures to place the ECG probe near the tissue of interest for more reliable perfusion data.

The present invention is based on the insight that perfusion data would be more consistent and reliable if more or different information than the pure ECG information is available and that this could be achieved by using a contactless blood pulsation parameter determiner that determines the blood pulsation parameters on or near the tissue of interest, but which does not interfere with the medical scan.

The perfusion imaging device 10 of the present invention comprises a medical imager 1 that is configured to generate perfusion data. It further comprises a contactless blood pulsation parameter determiner 12 that determines a blood pulsation parameter of the patient 7 without physical contact to the patient 7. The blood pulsation parameter is determined for the location of the tissue of interest 71 or a location 72 that is near to this. With the term 'near' it is meant in the context of this invention, that it might not be possible to determine the blood pulsation parameter at the exact location of the tissue of interest 71, e.g. because it is located inside the patient's body, but that it is determined in the immediate vicinity (e.g. on the skin above or beside the tissue of interest). At its broadest, the term 'near'

encompasses anywhere on the patient's body the area that is within the examining beam 61. The blood pulsation parameter determiner may be a single device or an assembly of different devices or means, including a computer program product. A perfusion-pulsation parameter determiner determines a perfusion-pulsation parameter based on the perfusion data and the
5 determined blood pulsation parameter. An example of a perfusion-pulsation parameter is for instance perfusion data tagged or imprinted with a cardiac cycle in which the perfusion data was acquired. As a result, by contactless measurement of the blood pulsation parameters, no blood pulsation determiner, such as an ECG probe or another device, needs to be physically present within the examining beam 61. Therefore, the influence from the blood pulsation
10 parameter determiner on the medical scan is reduced or even completely eliminated, making the determined perfusion data more accurate, reliable and consistent.

In a preferred embodiment of the perfusion imaging device according to the present invention, the blood pulsation parameter determiner comprises a skin image provider 2, which provides an image of at least a part of a skin 72 of the patient 7, and a skin image
15 analyzer 12 that is configured to analyze the provided skin image to determine a blood pulsation parameter from the skin image. Preferably the skin image provider 2 is an optical camera.

The skin is particularly suitable for contactless determining of the blood pulsation parameter. Each time the patient's heart beats a new blood flow reaches the skin,
20 leading to minute variations of a color of the skin. These variations are usually referred to as micro-blushes. While these micro-blushes cannot be observed by the human eye, a regular optical camera with a skin analyzer (e.g. dedicated software means) allows detection of micro-blushes by imaging light reflected from the skin. By providing skin images over time and recording the micro-blushes, cardiac cycle data is obtained. This method is called remote
25 photoplethysmography (remote PPG). Figure 2 depicts a graph 121 of a cardiac cycle recorded by remote PPG on a face of a human subject. The horizontal axis of the graph of figure 2 depicts time (in linear arbitrary units) and the vertical axis depicts skin color intensity (in arbitrary units). Cardiac blood pulsation parameters can be easily determined
30 from this data and has shown good accuracy under stable light conditions for situations ranging from monitoring stationary subjects to monitoring during physical exercises. As an example, in perfusion CT imaging of the brain each temporal frame may be acquired in the same pulsation state. It is therefore advantageous that the pulsation of the blood in the patient's face is directly correlated to the pulsation in the head, and therefore the brain.

The remote PPG measurement does not interfere with the examination beam or with the patient's physiology and can be focused on a part of the skin that is as near to the tissue of interest as possible. As such, remote PPG is very suitable for use as contactless blood pulsation determination within the context of the present invention.

5 An alternate contactless pulsation determiner may be a temperature sensor that in some instances may be able to detect a cardiac pulse by measuring temperature variations.

Further alternate contactless pulsation determiners may be a breathing monitor, such as a sensor that remotely measures respiration (e.g. by detecting temperature differences in exhaled breath) or time-of-flight cameras that allow depth sensing.

10 A perfusion data determiner 11 determines perfusion data from obtained medical data 111. A perfusion-pulsation parameter determiner 13 combines perfusion data with blood pulsation parameters, for instance by recording the blood pulsation parameter with the perfusion data, selecting only perfusion data obtained at certain blood perfusion parameters (e.g. only perfusion data obtained in a particular cardiac phase). The perfusion
15 data, optionally together with the pulsation data, may be displayed as a perfusion image 141 on a display unit 14. A physician may optionally select only perfusion images obtained at a target cardiac phase or other blood pulsation parameter. Furthermore, the obtained propulsion data may be used in a feedback loop to the imaging device, such that it will only obtain medical images of the tissue of interest if the heart is in a desired phase.

20 The schematic illustration in Fig. 3 shows two exemplary embodiments of a gantry 3 of a perfusion imaging device according to the present invention with a radiation source 4, a detector 5 and a contactless blood pulsation parameter determiner 2, 2' mounted in or on the gantry 3. Fig. 3a shows an embodiment with one contactless blood pulsation parameter determiner 2 with a determination beam 21, while fig. 3b shows an embodiment
25 with two contactless blood pulsation parameter determiners 2, 2', each with its own determination beam 21, 21'. In these examples the blood pulsation parameter determiners 2, 2' are focused on a part of the patient's skin 72 that is near the tissue of interest 71, in that it is located at the patient's skin that has the least distance to the tissue of interest 71. Even though one blood pulsation parameter determiner 2 will usually suffice to obtain suitable data,
30 an advantage of using more than one blood pulsation parameter determiner 2, 2' is that each determines blood pressure parameters individually, which may be compared, averaged or otherwise used to obtain a more precise determination of blood pulsation parameters. Furthermore, if the part of the patient's skin 72 is temporarily obstructed from view for the medical imaging beam 61, there is still a back-up blood pulsation parameter determiner

available for the determination. Additionally or alternatively, the system 10 may have means to automatically provide a warning in case of line-of-sight blockage or missing image content. The blood pulsation parameter determiners 2, 2' may be focused on the same part of the patient's skin 72 (as is depicted in fig. 3b) or on different parts of the patient's skin 72 to obtain back-up or additional blood pulsation data. Of course it is possible to use even more contactless blood pulsation determiners.

The blood parameter determiners 2, 2' do not need to be attached to the source 4 and they do not need to rotate with the source. They can be part of the gantry 3 and just focus on a part of the patient's skin 72, e.g. on the face of the patient 7. Rotating blood parameter determiners 2, 2' would actually be below the table from time to time and thus not see the patient's skin 72.

Figure 4 depicts a schematic representation of a method for obtaining a perfusion-pulsation parameter. In step S101 a medical image of a tissue of interest 71 of a patient 7 is obtained. In step S102 perfusion parameters are determined from the medical scan. In step S103 blood pulsation parameters are obtained in a contactless way on a location on or near the tissue of interest. Preferably steps S101 and S103 are performed concurrently to obtain data that is temporarily matched. In step S104 the determined perfusion parameters and blood pulsation parameters are linked to obtain perfusion-pulsation parameters. In step S106 the perfusion parameters, pulsation parameters and/or perfusion-pulsation parameters may be displayed individually. The blood pulsation parameters obtained in step S103 may be fed back to the imaging device to allow for only performing subsequent steps S101 only when it has a predetermined or user-selected blood pulsation parameter value.

The determination steps of this method may be executed in a computer program product that comprises instructions to execute these steps when the computer program product is run on a computer.

While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments.

Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. For instance, imaging devices equipped with optical cameras are known. These cameras are used to accurately determine a patient's position on the patient support 8 or to facilitate interventional procedures. The present invention could be implemented by adapting at least one of these optical cameras to be part of a blood pulsation

parameter determiner (e.g. by adapting the camera requirements and coupling it to dedicated remote PPG software). Also, even though the present invention is explained using blood pulsation, it might be also adapted for other bodily fluids (e.g. lymph fluid or digestive fluids). Finally, the present invention may be used in place of ECG-assisted perfusion imaging, but could also be used alongside ECG-assisted perfusion imaging, for instance as a back-up or control for the other.

In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality.

A single processor or other unit may fulfill the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. A computer program may be stored/distributed on a suitable medium, such as an optical storage medium or a solid-state medium supplied together with or as part of other hardware, but may also be distributed in other forms, such as via the Internet or other wired or wireless telecommunication systems. Any reference signs in the claims should not be construed as limiting the scope.

CLAIMS:

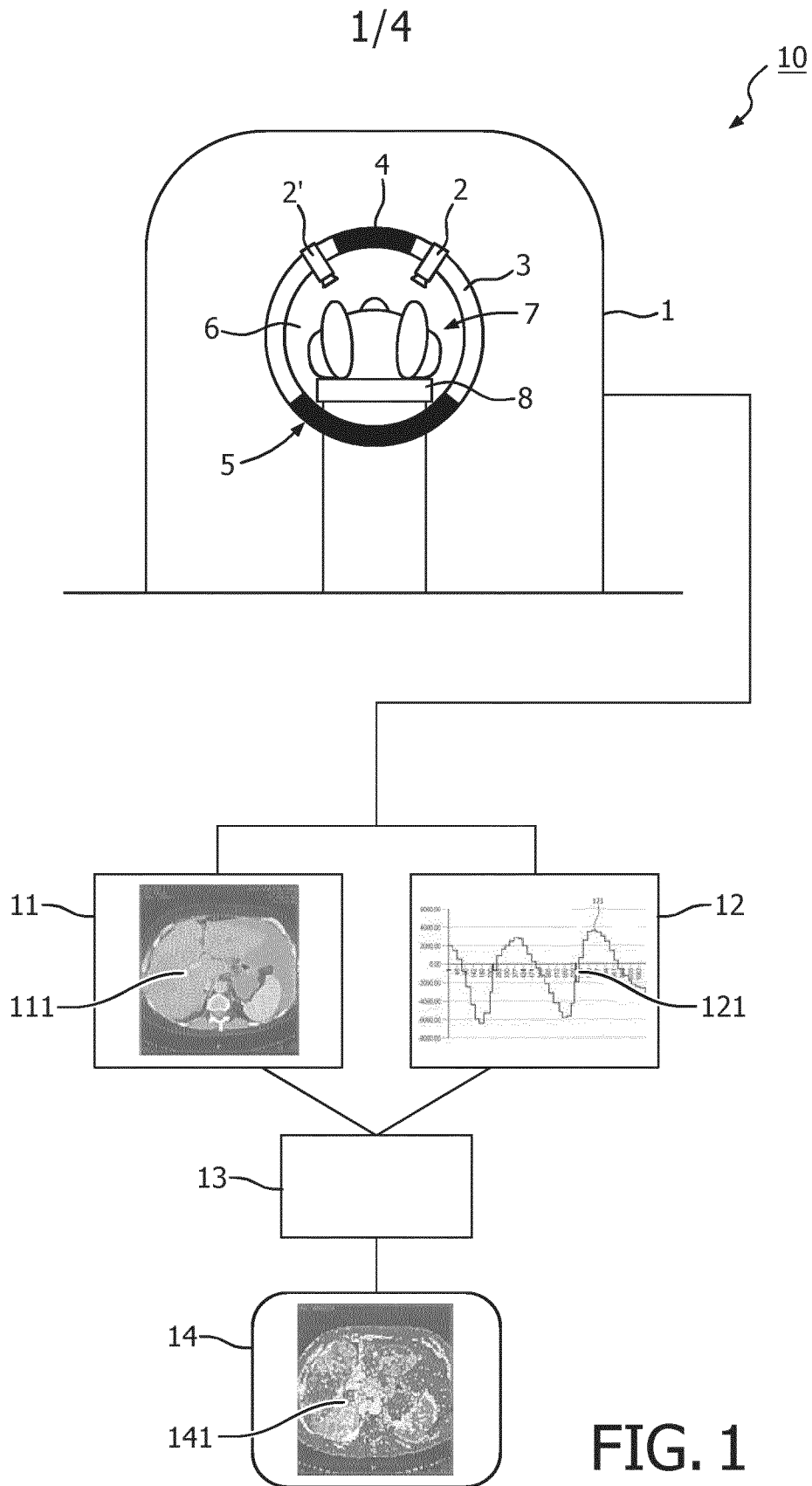
1. Perfusion imaging device comprising:
 - a medical imager comprising an imaging region for imaging a tissue of interest of a patient configured to generate perfusion data of at least the tissue of interest;
 - a contactless blood pulsation parameter determiner configured to determine
5 blood pulsation parameters on or near the tissue of interest; and
 - a perfusion phase parameter determiner that determines a perfusion phase parameter based on the perfusion data and the blood pulsation parameters.
2. Perfusion imaging device according to claim 1, wherein the contactless blood
10 pulsation parameter determiner comprises a skin image provider and a skin image analyzer.
3. Perfusion imaging device according to claim 1, wherein the skin image provider is an optical camera.
- 15 4. Perfusion imaging device according to any of the previous claims, wherein the contactless blood pulsation parameter determiner determines blood pulsation parameters based on skin color variations due to changing blood flow conditions, preferably based on remote photoplethysmography.
- 20 5. Perfusion imaging device according to any of the previous claims, wherein the contactless blood pulsation parameter comprises a cardiac phase.
6. Perfusion imaging device according to any of the previous claims, wherein the medical imager comprises a gantry and wherein the contactless blood pulsation parameter
25 determiner is mounted such that it is able to image a subject positioned inside a gantry of the medical imager.
7. Perfusion imaging device according to any of the previous claims, wherein the medical imager is selected from a group comprising a computed tomography imager, a

magnetic resonance imager, a positron emission tomography imager or a single-photon emission computed tomography.

- 5 8. Method for obtaining perfusion-pulsation parameters comprising the steps of
- obtaining a medical scan image of an tissue of interest of a patient;
 - determining perfusion parameters of the tissue of interest from the medical scan;
 - contactless obtaining of blood pulsation parameters of the patient on or near the tissue of interest;
- 10 - obtaining perfusion-pulsation parameters by linking the perfusion parameters and the blood pulsation parameters.
- 15 9. Method according to claim 8, wherein the steps of obtaining a medical scan image and contactless perfusion parameters are performed concurrently.
10. Method according to claim 8 or 9, wherein the contactless obtaining of blood parameters comprises obtaining a skin image of a part of the patient's skin.
- 20 11. Method according to any of the claims 8 to 10, wherein the blood pulsation parameters comprise a cardiac phase.
- 25 12. Method according to any of the claims 8 to 11, wherein the blood pulsation parameters are determined based on skin color variations due to changing blood flow conditions, preferably based on remote photoplethysmography.
13. Method according to any of the claims 8 to 12, further comprising displaying at least one of the perfusion parameters, the blood pulsation parameters or the perfusion-pulsation parameters.
- 30 14. Method according to any of the claims 8 to 13, wherein the medical scan is obtained by a medical imager selected from a group comprising a computed tomography imager, an x-ray imager, a magnetic resonance imager, a positron emission tomography imager or a single-photon emission computed tomography.

15. A computer program product for determining perfusion-pulsation parameters when the computer program product is run on the computer comprising instructions to execute the steps of

- determining perfusion parameters from a medical scan;
- 5 - determining perfusion-pulsation parameters by linking the perfusion parameters with contactlessly obtained blood pulsation parameters.



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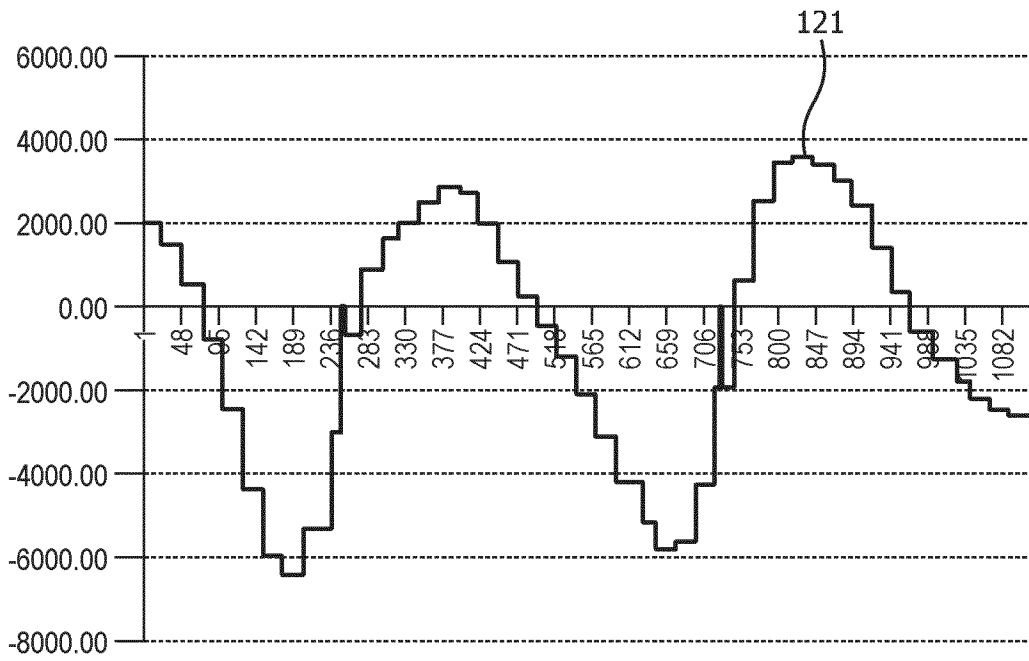


FIG. 2

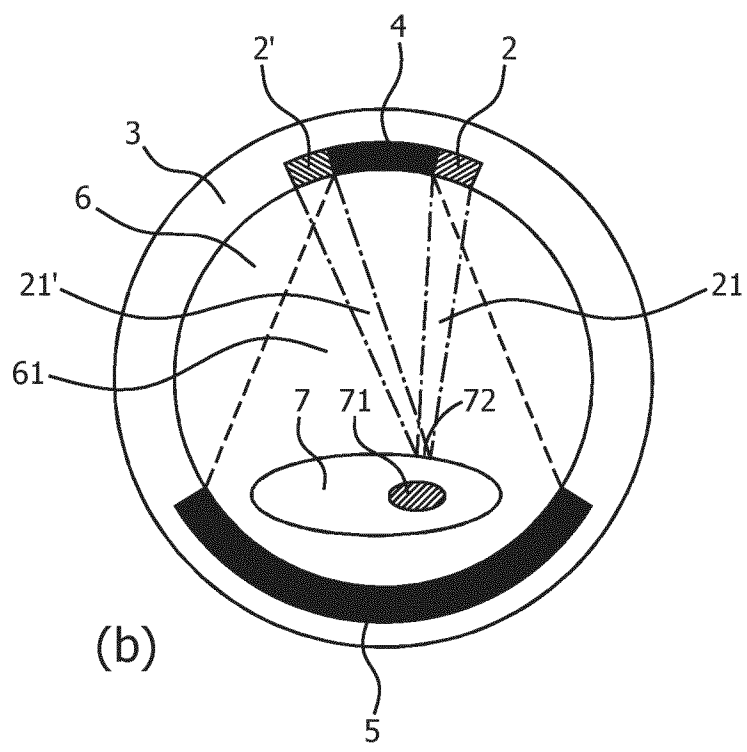
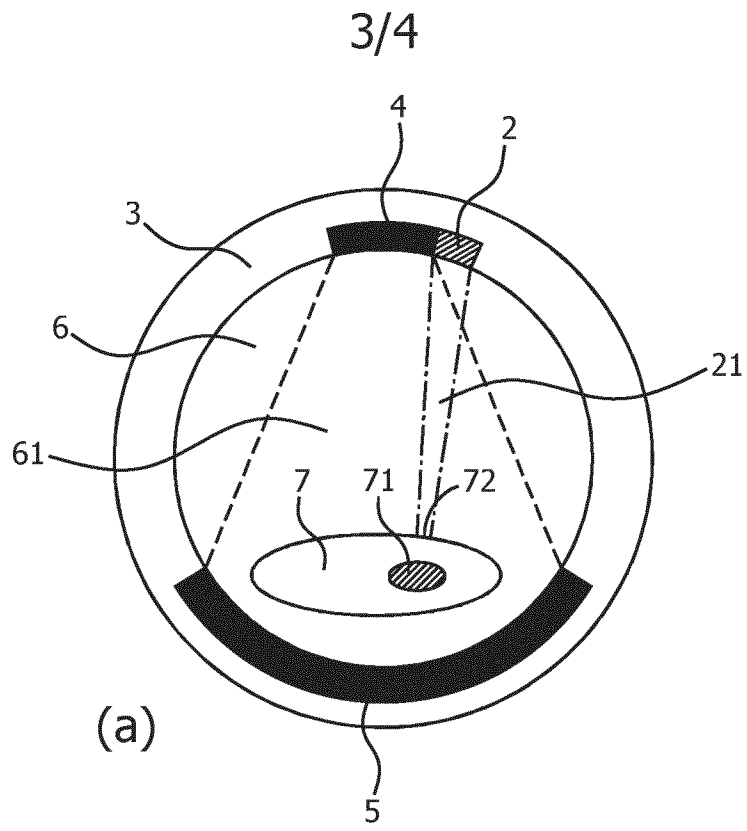


FIG. 3

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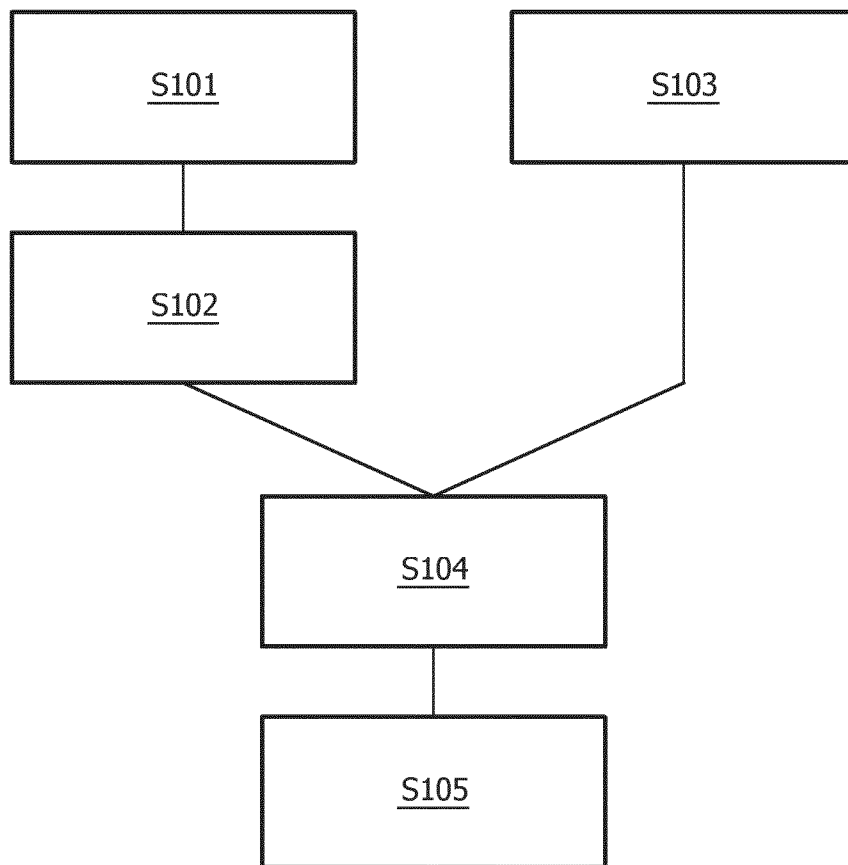


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/079596

A. CLASSIFICATION OF SUBJECT MATTER
 INV. G06K9/46 A61B5/00 A61B6/00 A61B8/08 A61B5/024
 G06K9/20
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 According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
 Minimum documentation searched (classification system followed by classification symbols)
 G06K A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	PAOLA E.P SMANIO ET AL: "Value of Gating of Technetium-99m Sestamibi Single-Photon Emission Computed Tomographic Imaging", JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY, vol. 30, no. 7, 1 December 1997 (1997-12-01), pages 1687-1692, XP055193244, ISSN: 0735-1097, DOI: 10.1016/S0735-1097(97)00363-X page 1687 - page 1688 ----- -/--	1-15

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
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- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

8 February 2016

Date of mailing of the international search report

17/02/2016

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040,
 Fax: (+31-70) 340-3016

Authorized officer

Neubüser, Bernhard

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/079596

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	<p>JOSE A. ROCHA-FILHO ET AL: "Incremental Value of Adenosine-induced Stress Myocardial Perfusion Imaging with Dual-Source CT at Cardiac CT Angiography 1", RADIOLOGY, vol. 254, no. 2, 1 February 2010 (2010-02-01), pages 410-419, XP055193260, ISSN: 0033-8419, DOI: 10.1148/radiol.09091014 page 412</p> <p style="text-align: center;">-----</p>	1-15
L	<p>Anonymous: "Guidelines to Prevent Excessive Heating and Burns Associated with Magnetic Resonance Procedures", 17 March 2015 (2015-03-17), pages 1-5, XP055193247, Retrieved from the Internet: URL:http://www.mrisafety.com/SafetyInfo.asp?SafetyInfoID=166 [retrieved on 2015-06-02] The references cited in this document provide evidence concerning the underlying problem</p> <p style="text-align: center;">-----</p>	1-15
Y	<p>WIM VERKRUYSSE ET AL: "Remote plethysmographic imaging using ambient light", OPTICS EXPRESS, vol. 16, no. 26, 22 December 2008 (2008-12-22), page 21434, XP055193251, DOI: 10.1364/OE.16.021434 abstract</p> <p style="text-align: center;">-----</p>	1-15
Y	<p>JIA ZHENG ET AL: "A remote approach to measure blood perfusion from the human face", PROCEEDINGS OF SPIE, vol. 7169, 1 January 2009 (2009-01-01), pages 716917-716917-7, XP055016740, ISSN: 0277-786X, DOI: 10.1117/12.807354 abstract</p> <p style="text-align: center;">-----</p>	1-15
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INTERNATIONAL SEARCH REPORT

International application No
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