(19) NL Octrooicentrum

(11) **2004366**

(12)C **OCTROOI**

(21) Aanvraagnummer: **2004366**

(22) Aanvraag ingediend: **09.03.2010**

(51) Int.Cl.:
A61B 6/00 (2006.01) ***A61B 6/10*** (2006.01)
G06Q 50/22 (2012.01)

(30) Voorrang:
20.03.2009 US 12/408394

(43) Aanvraag gepubliceerd:
29.09.2010

(47) Octrooi verleend:
08.08.2013

(45) Octrooischrift uitgegeven:
14.08.2013

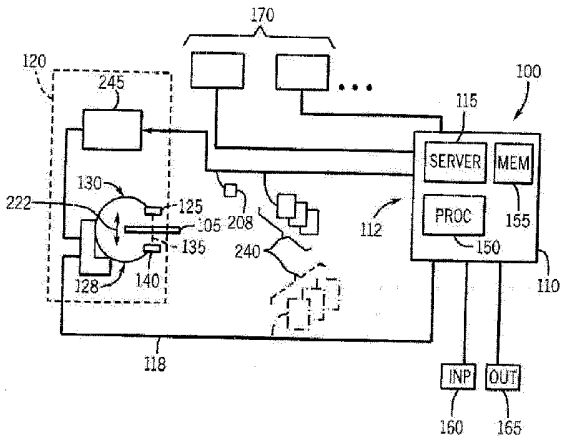
(73) Octrooihouder(s):
General Electric Company te Schenectady, New York, Verenigde Staten van Amerika (US).

(72) Uitvinder(s):
Guillaume Bourdeaux te PARIS (FR).
Jennifer Esposito te WHITEFISH BAY, WISCONSIN (US).
David Ysseldyke te DELAFIELD, WISCONSIN (US).
Barry Belanger te CHENEQUA, WISCONSIN (US).

(74) Gemachtigde:
Ir. H.V. Mertens c.s. te Rijswijk.

(54) **System and method of remote reporting of radiation dose usage in image acquisition.**

(57) A system (100) and method (200) to manage direction of an ionizing radiation (135) toward an exposed subject (105) is provided. The system (100) can perform receiving a request from a customer to establish a broadband connection (118) to communicate between a remote office (112) and the system (120) directing the ionizing radiation (135) toward the exposed subject (105); automatically communicating a status information and individual dose data associated with an event where direction of ionizing radiation (135) that exceeds a threshold; automatically creating and communicating a report (180, 240) via the broadband connection (118) to the customer. The report (180, 240) can include an indication of the event where direction of ionizing radiation (135) exceeds the threshold (610) and a comparison of the individual radiation dose data and an individual status operation of system (120) at time of the event relative to a benchmark defined by radiation dose data and status information acquired from a population of other systems (120).



NL C 2004366

SYSTEM AND METHOD OF REMOTE REPORTING OF RADIATION DOSE USAGE IN IMAGE ACQUISITION

BACKGROUND

[0001] The subject matter of this application generally relates to ionizing radiation (e.g., x-rays), and more specifically to a system and method to manage direction of ionizing radiation dose toward an exposed subject.

[0002] Employment of the use of ionizing radiation (e.g., x-ray) is well known in the therapy or image acquisition of an exposed subject. Fields of application of ionizing radiation is common in the medical field (e.g., fluoroscopic, computed tomography (CT), x-ray, ablation of tissue, etc.) and security screening (e.g., airport baggage inspection). For example, radiological image acquisition generally includes directing a stream of ionizing radiation at the exposed subject, and measuring the attenuation of the ionizing radiation passing therethrough.

[0003] One concern with use of ionizing radiation include an increased likelihood of harm or injury associated with radiation-induced injury to the tissue of the exposed subject. These deterministic risks can include skin reddening, rashes, burns, or hair loss. In fact, use of ionizing radiation is well-known in chemo-therapy or the ablation of diseased tissue. A variable that affects a likelihood of causing radiation-induced injury to tissue of an exposed subject includes a dose of radiation absorbed by the exposed subject. Variables that affect a dose of radiation absorbed by the exposed subject include a rate of delivery of radiation to the exposed subject, a time of exposure of radiation to the exposed subject, a fraction of radiation absorbed by the exposed subject, age or other characteristics of the exposed subject, and a location of exposure of radiation to the exposed subject. Another concern with use of ionizing radiation includes an increased likelihood of causing stochastic effects (e.g., radiation-induced cancers) to the exposed subject.

BRIEF DESCRIPTION OF CLAIMED SUBJECT MATTER

[0004] In view of the above concerns associated with use of ionizing radiation, there is a need for improved access to data or increased knowledge to manage direction of radiation dose toward the exposed subject (e.g., patient) for different applications (e.g., fluoroscopic imaging, x-ray imaging, CT imaging of various exposed areas (e.g., chest, arms, legs, etc.) of an exposed subject). This improved access to data can benefit the establishment of standard operating procedures and protocols in the use of ionizing radiation to perform various tasks, as well as benefit the measurement and evaluation of an impact of each procedure's protocol in the likelihood for deterministic or stochastic effects associated with exposure to ionizing radiation relative to the characteristics of exposed subjects. The above-described needs and benefits are addressed by the embodiments of the subject matter described herein.

[0005] One embodiment of the subject matter includes a method to manage direction of an ionizing radiation toward an exposed subject, comprising the steps of receiving a request from a customer to establish an internet connection to communicate between a remote office and the system directing the ionizing radiation toward the exposed subject; automatically communicating a status information and individual dose data associated with an event where direction of ionizing radiation that exceeds a threshold; automatically creating and communicating a report via the internet connection to the customer, the report including an indication of the event where direction of ionizing radiation exceeds the threshold and a comparison of the individual radiation dose data and an individual status operation of system at time of the event relative to a benchmark defined by radiation dose data and status information acquired from a population of other systems that direct ionizing radiation and communicate data to the remote office.

[0006] Another embodiment of the subject matter includes A computer readable medium including a plurality of program instructions for execution by a processor to perform the steps of: receiving a request from a customer to establish an internet connection to communicate between a remote office and the system directing the ionizing radiation toward the exposed subject; automatically communicating a status information

and individual dose data associated with an event where direction of ionizing radiation that exceeds a threshold; automatically creating and communicating a report via the internet connection to the customer, the report including an indication of the event where direction of ionizing radiation exceeds the threshold and a comparison of the individual radiation dose data and an individual status operation of system at time of the event relative to a benchmark defined by radiation dose data and status information acquired from a population of other systems that direct ionizing radiation and communicate data to the remote office.

[0007] Systems and methods of varying scope are described herein. In addition to the aspects and advantages described in this summary, further aspects and advantages will become apparent by reference to the drawings and with reference to the detailed description that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Fig. 1 shows a schematic diagram of an embodiment of a system to manage direction or delivery of ionizing radiation dose toward an exposed subject.

[0009] Fig. 2 shows a schematic diagram of a method of operating the system to manage direction or delivery of ionizing radiation toward an exposed subject.

[0010] Fig. 3 shows an embodiment of an illustration of a number of examinations or image acquisitions or scans performed by the imaging system130 and a tracked duration thereof over a period of time, generated by the system of Fig. 1.

[0011] Fig. 4 shows an embodiment of an illustration of a duration per protocol employing direction of ionizing radiation to the exposed subject and comparison of performance of different protocols relative to one another, generated by the system of Fig. 1.

[0012] Fig. 5 shows an embodiment of an illustration of measured radiation dose directed to the exposed subject and cumulative percentile (%) for comparison relative to type of protocol and image acquisition mode, generated by the system of Fig. 1.

[0013] Fig. 6 shows an embodiment of an illustration of a distribution of a number of events that exceed a certain grouping or threshold range of radiation dose directed to the exposed subject, generated by the system of Fig. 1.

[0014] Fig. 7 shows an embodiment of an illustration of a distribution of radiation dose directed to the exposed subject relative to variance in the source to image distance (SID) of the ionizing radiation system, generated by the system of Fig. 1.

[0015] Fig. 8 shows an embodiment of an illustration of a distribution of SID for an individual imaging system relative to a benchmark defined by data acquired from one or more similar types of imaging systems, similar protocols of image acquisition, or similar modes of image acquisition or combination thereof, generated by the system of Fig. 1.

[0016] Fig. 9 shows an embodiment of an illustration of an incident map that correlates dose level and location of the direction of an above-threshold radiation directed to an exposed subject relative to the geometry of the gantry in support of the ionizing radiation source, generated by the system of Fig. 1.

DETAILED DESRIPTION

[0017] In the following detailed description, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration specific embodiments, which may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the embodiments, and it is to be understood that other embodiments may be utilized and that logical, mechanical, electrical and other changes may be made without departing from the scope of the

embodiments. The following detailed description is, therefore, not to be taken in a limiting sense.

[0018] Fig. 1 illustrates one embodiment of a management system 100 to remotely monitor and report usage of radiation dose in acquisition of medical images or other protocol involving direction of ionizing radiation dose toward an exposed subject 105. The system 100 can generally include a controller 110 located at a remote workstation or office 112 having a server 115 in communication via an internet or broadband or wireless connection 118 with an ionizing radiation generating or emitting system or device 120. Remote office 112 as used herein generally refers to a location off-site of the facility or entity or address of the location of the customer. Yet, an embodiment of the system 100 can include one or more portions located at the customer and is not limiting on the subject matter.

[0019] One example of the ionizing radiation system 120 includes a radiation source 125 (e.g., x-ray tube assembly to generate x-rays) supported on a gantry 128 of a radiological imaging system 130. Examples of the radiological imaging system 130 generally include an x-ray machine, computed tomography (CT), a fluoroscopic imaging system, etc. having the radiation source 125 projecting a beam of ionizing radiation (e.g., x-rays) 135 through the exposed subject 105 to be received at a detector 140 in a conventional manner. The ionizing radiation can be attenuated with passing through exposed subject 105, until impinging upon the detector 140. The detector 140 can translate the attenuation of ionizing radiation to generate the image or image frames illustrative of a region of interest of the exposed subject 105. An example of the radiological imaging system 130 can also include a software product or package operable to combine a series of acquired images to create the reconstructed three-dimensional image. An example of the software product is INNOVA® 3D as manufactured by GENERAL ELECTRIC®. The software product can also operable to measure a volume, a diameter, and a general morphology of a vessel (e.g., vein, artery, etc.) or other anatomical structures.

[0020] An embodiment of the system 100 can generally include the controller 110 in communication via the internet connection 118 to acquire data from the radiation source 125 or radiological imaging system 130. One embodiment of the system 100 includes a software product such as INSITE® as manufactured by GENERAL ELECTRIC COMPANY®or INNERVISION PLUS as manufactured by TOSHIBA® to establish the connection 118 between the ionizing radiation system 130 and the controller 100 at the remote office 112.

[0021] Although the controller 110 can be described at the remote office 112, it should be understood that the controller 110 can otherwise be located integrated with or adjacent to the system 130 directing of ionizing radiation dose toward an exposed subject 105.

[0022] An embodiment of the controller 110 can be generally configured to process and analyze the acquired data (e.g. status information). An embodiment of the controller 110 generally includes a processor 150 in communication with a memory 155. The memory 155 can generally include a computer readable storage medium operable to receive and store computer readable program instructions for execution by the processor 150. The memory 155 is also generally operable to store acquired data communicated by the radiation source 125 or imaging system 130 or from other sources 170 (e.g., MRI systems, PET imaging system, picture archival system (PACS), etc.). The type of memory 155 can include disk storage, tape drive, random access memory (RAM), read-only memory (ROM), flash memory, compact disk (CD), digital versatile disks (DVDs), magnetic cassettes, magnetic tape, magnetic disk storage, or any other medium operable to be used to store computer readable instructions.

[0023] The controller 110 is also in communication with an input device 175 and an output device 180. An embodiment of the input 175 can include a keyboard, user interface with touch-screen capability, mouse device, etc. operable to receive instructions or data from a user of the system 100. An embodiment of the output device 180 can

include a monitor, audible or visual alarms, etc. operable to illustrate output from the system 100 to the user.

[0024] Having described the general construction of the system 100, the following is a description of a method 200 of operating the system 100 in management of delivery or direction of ionizing radiation to the exposed subject 105. It should be understood that the foregoing sequence of acts or steps comprising the method 200 can vary, that the method 200 may not include each every act or step in the following description, and the method 200 can include additional acts or steps not disclosed in the following description. One or more of the following acts or steps comprising the method 200 can be represented as computer-readable programmable instructions for storage in the memory or on a portable computer readable medium 155 and for execution by the processor 150 of the controller 110.

[0025] Assume for sake of example that an exposed subject 105 is a patient and the ionizing radiation system 130 includes a computed tomography (CT) imaging system operable to perform image acquisition.

[0026] Step 205 includes receiving a request 208 to establish a broadband connection 118 (e.g., internet) between the radiological imaging system 130 and the remoter workstation 112(e.g., remote office). The format of the request 208 can be an electronic message (e.g., email) over the internet, electronic communication over the internet or broadband connection 118, electronic communication via a webpage, etc. An embodiment of step 205 can include establishing a connection 118 via INSITE® product as manufactured by GENERAL ELECTRIC COMPANY®. Step 210 includes acquiring an upper threshold of radiation dose to direct from the radiological imaging system to the patient. One embodiment of acquiring the upper threshold can be from a user of the radiological imaging system 130 and can be communicated via the broadband connection 118. Yet, the mode of communicating (e.g., telephone, electronic mail, etc.) the upper threshold can vary. Step 215 includes directing or delivering the beam or stream of ionizing radiation 135 through the exposed subject 105.

[0027] Step 215 includes data associated with performing image acquisition on the patient 105. An embodiment of step 215 includes acquiring a protocol or task 216 (See Fig. 5) of image acquisition to perform on the patient 105, a location 218 (e.g., anatomical region) of image acquisition on the patient 105, etc.

[0028] Step 220 includes acquiring a dose or dose rate of radiation (e.g., absorbed dose in Gray (Gy), cumulative air kerma with regards to fixed reference position with regards to the interventional reference point at a fixed distance from the isocenter of the imaging system 130, equivalent dose in sievert (Sv), effective dose relative to a tissue weighting factor, Computed Tomography Dose Index (CTDI), weighted CTDI, volume CTDI, multiple scan average dose (MSAD), dose length product (DLP), etc.) directed by the individual imaging system 130 in acquisition of images of the patient 105, a patient position relative to the imaging system 130 or radiation source 125, a distance between the radiation source 125(e.g., x-ray tube assembly focal spot where the electron beam hits the anode target) to the scintillator of the flat panel detector) (also referred to as source to image distance (SID)) 222, a comparison of the directed dose relative to the acquired upper dose threshold, a measure of radiation dose directed per SID, a cumulative dose directed to the patient for each SID or SID grouping, details of the status information (e.g., acquisition mode, positioning of radiation source 125 and/or scanner/detector 140 in relation in time to direct radiation dose or cumulative dose, frame rate, auto exposure preference, detail level of image data, total number of runs or scans, total scan time or duration of image acquisition, details associated with calibration (e.g., calibration date, etc.) of the imaging system 130, and total radiation dose directed to the patient 105).

[0029] Step 220 can also include acquiring data (e.g., calibration status, dates, etc.) associated with calibration of the individual imaging system 130. Step 220 can also include acquiring status information associated with operation of the imaging system 130, including error messages, alerts, and other parameters, relative to manufacturer specifications.

[0030] Step 225 includes communicating a portion or all of the acquired data described under step 220 to the remote office or station 112. One embodiment of step 225 includes communicating the portion or all of the acquired data via the broadband connection 118. Yet, the acquired data can be communication over other modes of communication (e.g., wireless, telephone, broadband, attached files sent via electronic mail, etc. or combination). Step 225 can be performed in general real-time basis, on a batch basis, or periodically as predetermined by either the user of the imaging system 130 or the remote office 112.

[0031] One embodiment of step 225 can include communication of a portion or all of the acquired data described in step 220 with respect to an individual imaging system 130 in response to detecting an exceedance of the dose threshold (e.g., cumulative dose threshold, etc.).

[0032] Step 230 includes analyzing the acquired data from the individual imaging system 130. One embodiment of step 230 includes compared one or more types or parameters represented by the acquired data relative to a threshold. One embodiment of the threshold can be determined relative to a predetermined value (e.g., regulation) for radiation dose directed to the exposed subject 105. Another embodiment of step 230 can include grouping or categorizing the acquired data or characteristics of the individual imaging system 130 for comparison to acquired data from one or more other similar imaging systems 170 or similar procedures/tasks/protocol of image acquisition or combination thereof.

[0033] Step 235 includes generating a report 240 illustrative of the above-described analyses performed on the acquired data for illustration to the user at a display 245 of a user workstation or of the individual imaging system 130. One embodiment of the above-described report 240 can include graphic representations of the acquired data in step 220 in comparison relative to itself or relative to one or more atypical imaging systems in the population of imaging systems 170 that the remote office or station 112 acquires data from.

[0034] Referring to Fig. 3, an example of the report 240 can include an illustration 305 (e.g., bar graph) of a number of examinations or image acquisitions or scans performed by the imaging system130 and a tracked duration thereof over a period of time (e.g., per user input or standard periodic reporting period (e.g., monthly)).

[0035] Referring to Fig. 4, an example of the report 240 can include an illustration 405 (e.g., graphic pie chart) indicative of the duration of the protocol employing direction of ionizing radiation and/or total dose directed to the exposed subject per the distribution of protocols (e.g., imaging of aorta, aorta-arch, coronaries, femoral, other) exposed to the ionizing radiation). The illustrated Fig. 4 can illustrate a frequency of performance of different protocols relative to one another and an associated distribution of radiation dose to the exposed subject 105.

[0036] Referring to Fig. 5, an example of the report 240 can include an illustration 505 of measured radiation dose (e.g., cumulative dose, duration of exposure to radiation, DAP (product of dose multiplied by area of radiation beam) reported in Gy/cm^2) directed to the exposed subject and cumulative percentile (%) for comparison relative to type of protocol (aorta, coronaries, imaging of aorta-arch, femoral, foot, lower leg, carotids, etc.), as well as relative to image acquisition mode (e.g., cardiac, fluoroscopy, digital subtraction angiography (DSA), etc.).

[0037] Referring to Fig. 6, an example of the report 240 can include an illustration 605 (e.g., bar graph) of a distribution of a number of events (e.g., exams, radiation therapy treatments, etc.) that exceed a certain grouping or threshold range of radiation dose (e.g., grouped in 1 Gy dose range increments) directed to the exposed subject 105. An embodiment of the illustration can include a measure of number of image acquisitions (e.g., scans, exams) where the measured radiation dose exceeded the radiation dose threshold, as defined to the right relative to a graphic representation 610 of the threshold (e.g., dotted line).

[0038] Referring to Fig. 7, an example of the report 240 can include an illustration 705 (e.g., bar graph) of a distribution of radiation dose directed to the exposed subject 105 relative to variance in the source to image distance (SID) for the individual system 130. This illustration relative to the individual system 130 can include a comparison relative to analogous distribution of radiation dose versus variance in SID for a population of other image acquisition systems 170 of similar type, or employed in similar protocol of mode of image acquisition. The variance in SID (e.g., in centimeters) can be illustrated in groupings along the horizontal axis, and the vertical bar graphic illustration can represent the percentage of total monthly cumulative radiation dose directed (e.g., ESAK, %). From this illustration, the user of the imaging system 105 can understand a potential reduction in radiation dose with change in the SID.

[0039] Referring to Fig. 8, an example of the report 240 can include an illustration 805 (e.g., bar graph) of a distribution of SID for the individual imaging system 130 relative to a benchmark defined by data acquired from one or more similar types of imaging systems 170, similar protocols of image acquisition, or similar modes of image acquisition or combination thereof. The illustrated example shows the SID in groupings (e.g., range of centimeters) along the horizontal axis relative to a vertical bar graphic illustration of cumulative radiation dose for each SID grouping, and further split out or illustrated relative to mode of image acquisition (e.g., fluoroscopy, cardiac, etc.).

[0040] Referring to Fig. 9, an example of the report 240 can include an illustration 905 of an image acquisition scan or examination or therapy status information where a measure of the radiation dose (e.g., cumulative radiation dose) directed to an exposed subject exceeds the radiation dose threshold. The example illustration in Fig. 9 can include detailed status information associated with the examination, acquisition scan, or therapy session where the radiation dose threshold was exceeded, including the following: date/time stamp of examination, protocol (e.g., coronaries, etc.), type of acquisition mode (e.g., fluoroscopy), auto exposure preference, frame rate, image acquisition detail level, number of runs or scans in examination, total duration of

examination, and cumulative radiation dose (e.g., ESAK, Gy) and DAP (mGy/cm^2) directed to the exposed subject 105.

[0041] The example illustration 905 in Fig. 9 can further include a calculation of equivalent patient thickness (EPT) (i.e., a thickness of acrylic plastic or the like (PMMA) that produces the same average radiation attenuation as the patient of interest under the given situation that can represent an indication of the difficulty in penetrating the patient with a sufficient number of ionizing radiation to form a useful image) that can be employed by the user to manage imaging dose efficiency optimization, and to automatically set parameters of the imaging system when transitioning between imaging modes without acquiring test exposures. The example illustration 905 in Fig. 9 can further includes an illustration of the measure of cumulative radiation dose directed to the exposed subject 105 over time, and the point in time of the examination when the radiation dose exceeded the threshold for the examination of interest. The example illustration 905 in Fig. 9 can also include a graphic representation (e.g., bar graph) of the SID or grouping thereof relative to the measure of radiation dose directed to the exposed subject 105 during the examination of interest where the threshold was exceeded. The example illustration 905 can also show how changes in the SID can affect the radiation dose directed to the exposed subject 105.

[0042] The example illustration 905 in Fig. 9 can further include an embodiment of a cumulative dose incident map 910 associated with the examination of interest where the radiation dose exceeded the threshold. The embodiment of the cumulative dose incident map 910 can include an illustration of the measure of cumulative radiation dose (ESAK) directed o the exposed subject during the examination relative to the tracked position or angulation of the radiation source 125 and/or detector 140 of the imaging system 130. The tracked position (e.g. angulation) of the radiation source 125 and/or detector 140 can be correlated to the tracked position (e.g., angulation) of the gantry 128 in support of the radiation source 125 or detector 140. The cumulative dose incident map 910 can include a horizontal axis 912 to represent varied positions of the gantry 128 with respect to left / right anterior oblique (LAO/RAO) position of the exposed subject 105, and a vertical axis

913 that can represent cranial/caudal positions of the gantry 128. The cumulative dose incident map 910 can also include a graphic representation 914 of the distribution of the radiation dose (e.g., ESAK) to the exposed subject 105 relative to the position (e.g., angulation) of the gantry 128 (e.g., thirty degree increments) or the axes 912, 913. Thereby, the cumulative dose incident map 910 can illustrate the measure of the radiation dose as well as how radiation dose was directed to the exposed subject 105.

[0043] Step 235 can further include identifying a proposed response or action 915 (See Fig. 9) to reduce the radiation dose to the exposed subject 105, dependent in response to detecting the radiation dose exceeding the threshold according to the status information of the imaging system 130 in directing the ionizing radiation to the exposed subject 105. The proposed response or action 915 can be generated dependent on acquired data of responses or actions and tracked reduction in radiation dose to the exposed subject 105 as tracked or measured by one or more other users or other imaging systems 170, different from the imaging system 130 of interest. Although the proposed response or actions 915 is illustrated in Fig. 9, the proposed response or action 915 can be part of any of the other illustrated Figures 3-8 or independent thereof.

[0044] The subject matter herein describes the system 100 and method 200 to manage direction of the ionizing radiation 130 toward the exposed subject 105. The method 200 includes the steps of receiving a request 208 from a customer to establish an internet or broadband connection 118 to communicate between the remote office 112 and the system 130 directing the ionizing radiation toward the exposed subject 105; automatically communicating a status information and individual dose data associated with an event where direction of ionizing radiation 135 that exceeds a threshold; automatically creating and communicating the report 240 to the user display 245 of the customer, the report 240 including an indication of the event where direction of ionizing radiation 135 exceeds the threshold and a comparison of the individual radiation dose data and an individual status operation of the ionizing radiation system 120 at time of the event relative to a benchmark defined by radiation dose data and status information acquired from a population of other systems 170 that direct ionizing radiation and

communicate data to the remote office 112. The system 120 that directs the ionizing radiation can be a radiological imaging system 130, and the comparison can include a number of acquired images of the individual radiological imaging system 130 relative to a number of acquired images of at least one of the population of other radiological imaging systems 170.

[0045] The method 200 can include calculating the individual radiation dose data for at least one acquired image exceeds the threshold triggers the step of automatically communicating the acquired status information and individual dose data from the remote office 112 to the user display 245 of the customer. The method 200 can further include comparing data from the individual ionizing radiation system 120 can be relative to data of the one or more of the population of ionizing radiation systems 170 associated each of the following: a duration of a protocol employing the direction of ionizing radiation per a distribution of types of protocols, a frequency of performance of different protocols relative to one another and an associated distribution of radiation dose to the exposed subject 105, the radiation dose, duration of exposure to the ionizing radiation 135, product of the radiation dose multiplied by an area of the beam of ionizing radiation 135 directed to the exposed subject 105, and distribution of radiation dose relative to a type of image acquisition mode.

[0046] The method 200 can further include comparison of data from the individual ionizing radiation system 120 relative to data of the one or more of the population of ionizing radiation systems 170 associated each of the following: a distribution of a number of events with the individual system 120 where the radiation dose directed to the exposed subject exceeds the threshold radiation dose, a distribution of radiation dose directed to the exposed subject 105 relative to a variance in the source to image distance (SID), a distribution of SID for the individual system 120 relative to a benchmark defined by data acquired from one or more similar types of other systems 170 performing similar protocols or modes of ionizing radiation operation, an auto exposure preference, a frame rate of image acquisition, a calculated value of an equivalent exposed subject thickness

that produces the same average radiation attenuation, and a point in time of the examination when the radiation dose exceeded the radiation dose threshold.

[0047] The method 200 can further comprise the steps of calculating a individual trend in a history of the individual radiation dose acquired from the individual radiological imaging system 130; and comparing the individual trend relative to a population trend calculated from a history of the population radiation dose data acquired from the population of other radiological imaging systems 170 for a selected time frame as received from the customer.

[0048] Embodiments of the report 240 can include an illustration of a cumulative dose incident map 910 associated with the examination of interest where the radiation dose exceeded the threshold. The embodiment of the cumulative dose incident map 910 can include the measure of cumulative radiation dose (ESAK) directed o the exposed subject 105 during the examination relative to the tracked position or angulation of the radiation source 125 and/or detector 140 of the imaging system 130, the tracked position or angulation of the radiation source 125 and/or detector 140 can be correlated to the tracked position or angulation of the gantry 128 in support of the radiation source 125 or detector 140. Embodiments of the report 230 can includes a cumulative dose incident map 910 that comprises a graphic illustration of a horizontal axis 912 to represent varied positions of a gantry in support of a source of the ionizing radiation with respect to a left / right anterior oblique (LAO/RAO) position of the exposed subject, a graphic illustration of a vertical axis 913 that represents a cranial or caudal position of the gantry 128, and a graphic representation 914 of a distribution of radiation dose relative to the horizontal and vertical axes 912 and 913.

[0049] The subject matter herein also describes the system 100 can include a computer readable medium 155 including a plurality of program instructions for execution by a processor 150 to perform the steps of receiving the request 208 from the customer to establish the internet or broadband connection 118 to communicate between the remote office 112 and the system 120 directing the ionizing radiation toward the

exposed subject 105; automatically communicating a status information and individual dose data associated with an event where direction of ionizing radiation 135 that exceeds a threshold; automatically creating and communicating a report via the internet connection to the customer, the report including an indication of the event where direction of ionizing radiation exceeds the threshold and a comparison of the individual radiation dose data and an individual status operation of system at time of the event relative to a benchmark defined by radiation dose data and status information acquired from a population of other systems that direct ionizing radiation and communicate data to the remote office. The program instructions of the computer readable medium can instruct the processor 150 upon calculating the individual radiation dose data for at least one acquired image that exceeds the threshold, then to trigger the step of automatically communicating the acquired status information and individual dose data from the remote office 112 to the user display 245 of the customer.

[0050] The program instructions of the computer readable medium can further instruct the processor 150 to perform comparison of data from the individual ionizing radiation system 120 relative to data of the one or more of the population of ionizing radiation systems 170 further associated each of the following: a duration of a protocol employing the direction of ionizing radiation 135 per a distribution of types of protocols 216, a frequency of performance of different protocols 216 relative to one another and an associated distribution of radiation dose directed to the exposed subject 105, the radiation dose, duration of exposure to the ionizing radiation 135, a product of the radiation dose multiplied by an area of the beam of ionizing radiation 135 directed to the exposed subject 105, and a distribution of radiation dose relative to a type of image acquisition mode 216.

[0051] Another embodiment of the program instructions of the computer readable medium can further instruct the processor 150 to perform comparison of data from the individual ionizing radiation system 120 relative to data of the one or more of the population of ionizing radiation systems 170 further associated each of the following: a distribution of a number of events with the individual system 130 where the radiation

dose directed to the exposed subject 105 exceeds the threshold radiation dose, a distribution of radiation dose directed to the exposed subject 105 relative to a variance in the source to image distance (SID) 222, a distribution of SID for the individual system 120 relative to a benchmark defined by data acquired from one or more similar types of other systems 170 performing similar protocols 216 or modes of ionizing radiation operation, an auto exposure preference, a frame rate of image acquisition, a calculated value of an equivalent exposed subject thickness that produces the same average radiation attenuation, and a point in time of the examination when the radiation dose exceeded the radiation dose threshold.

[0052] Embodiments of the computer readable medium can further comprise program instructions to instruct the processor 150 to perform the steps of calculating a individual trend in a history of the individual radiation dose acquired from the individual radiological imaging system 170; and comparing the individual trend relative to a population trend calculated from a history of the population radiation dose data acquired from the population of other radiological imaging systems 170 for a selected time frame (e.g., received from the customer).

[0053] The computer readable medium can also include program instructions to instruct the processor 150 to generate the report 240 to include the cumulative dose map 910 associated with the examination of interest where the radiation dose exceeded the threshold. The embodiment of the cumulative dose incident map 910 can include an illustration of the measure of cumulative radiation dose (ESAK) directed o the exposed subject during the examination relative to the tracked position or angulation of the radiation source 125 and/or detector 140 of the imaging system 130, the tracked position or angulation of the radiation source 125 and/or detector 140 can be correlated to the tracked position or angulation of the gantry 128 in support of the radiation source 125 or detector 140.

[0054] Embodiment of the program instructions can also instruct the processor 150 to generate the report 240 to further include the cumulative dose incident map 910 that

comprises a graphic illustration 912 of a horizontal axis to represent varied positions of the gantry 128 in support of the source 125 of the ionizing radiation with respect to a left / right anterior oblique (LAO/RAO) position of the exposed subject 105, a graphic illustration 913 of a vertical axis that represents a cranial or caudal position of the gantry 128, and a graphic representation 914 of a distribution of radiation dose directed to the exposed subject 105 relative to the horizontal and vertical axes 912, 913 of the map 910.

[0055] A technical effect of the subject matter described above includes providing the system 100 and method 200 to address concerns associated with use of ionizing radiation, and the need for access to data or increased knowledge to manage directing radiation dose to the exposed subject (e.g., patient) for different applications (e.g., fluoroscopic imaging, x-ray imaging, CT imaging of various exposed areas (e.g., chest, arms, legs, etc.) of an exposed subject). This improved access to data can benefit the establishment of standard operating procedures and protocols in the use of ionizing radiation to perform various tasks, as well as benefit the measurement and evaluation of an impact of each procedure's protocol in the likelihood for burn or other late effects associated with exposure to ionizing radiation relative to the characteristics of exposed subjects 105.

[0056] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to make and use the invention. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

Parts List

Part No.	Reference Name
100	a management system
105	exposed subject
110	a controller
112	a remote workstation or office
115	a server
118	an internet or broadband or wireless connection
120	an ionizing radiation generating or emitting system or device
125	a radiation source
128	gantry
130	a radiological imaging system
135	a beam of ionizing radiation
140	a detector
150	a processor
155	memory
170	other sources (e.g., MRI systems, PET imaging system, picture archival system (PACS), etc.)
180	report/display
200	a method
205	step of establishing a broadband connection
208	request
210	step of acquiring an upper threshold of radiation doses
215	step of directing or delivering the beam or stream of ionizing radiation
216	task of image acquisition
218	location or region of imaging
220	step of acquiring a dose or dose rate of radiation
222	source to image distance
225	step of communicating to the remote office or station
230	step of analyzing the acquired data from the individual imaging system

235	step of generating a report
240	report
245	user display
305	an illustration
405	an illustration
505	an illustration
605	an illustration
610	a graphic representation of the threshold
705	an illustration 705 (e.g., bar graph) of a distribution of radiation dose
805	an illustration
905	an illustration
910	a cumulative dose map
915	proposed response or action

CONCLUSIES

1. Een computer-geïmplementeerde werkwijze (200) voor het besturen van de richting van ioniserende straling (135) naar een belicht subject (105), omvattende het gebruiken van een processor-gebaseerd systeem in een kantoor op afstand voor:

het uitvoeren van code op het processor-gebaseerd systeem om een internetverbinding (205) tot stand te brengen om te communiceren tussen een kantoor (112) op afstand en het systeem (120), dat de ioniserende straling (135) naar het belichte subject (105) richt;

het uitvoeren van code op het processor-gebaseerde systeem voor het communiceren van statusinformatie en individuele dosisgegevens, verbonden met een gebeurtenis, waarin de richting van ioniserende straling (135) een drempel (610) overschrijdt;

het uitvoeren van code op het processor-gebaseerde systeem voor het creëren en communiceren van een rapport via de internetverbinding naar een beeldscherm van een gebruikerswerkstation, het rapport omvattende een indicatie van de gebeurtenis, waarin de richting van ioniserende straling (135) de drempel (610) overschrijdt en een vergelijking van de individuele stralingsdosisgegevens en een individuele statuswerking van het systeem (120) op het moment van de gebeurtenis ten opzichte van een referentiepunt, gedefinieerd door stralingsdosisgegevens en statusinformatie, verkregen van een populatie van andere systemen (120), die ioniserende straling (135) richten, waarbij het rapport eveneens een grafische voorstelling omvat, omvattende:

een cumulatieve-invalsdosiskaart (910) die een maat van een cumulatieve stralingsdosis gericht naar het belicht object weergeeft, en die ten minste twee assen heeft die overeenstemmen met een geometrie van het systeem dat de ioniserende straling naar het object stuur, waarbij de ten minste twee assen van de cumulatieve-invalsdosiskaart een grafische illustratie van een horizontale as (912) omvatten om variërende posities van een portaal (128), dat een bron (125) van de ioniserende straling (135) ondersteunt, met betrekking tot een linker/rechter voorste schuine (LAO/RAO) positie van het belichte subject (105) te representeren, en een grafische illustratie van een verticale as (913), die craniale of caudale positie van het portaal (128) representeert; en een grafische representatie van een verdeling van stralingsdosis (705) ten opzichte van de ten minste twee assen.

2. De computer-geïmplementeerde werkwijze (200) volgens conclusie 1, waarbij het systeem (120), dat de ioniserende straling (135) richt, een radiologisch systeem (130) is, en waarbij de vergelijking een aantal verworven beelden van het individuele radiologische afbeeldingssysteem (130) ten opzichte van een aantal verworven beelden van ten minste een van de populatie van andere radiologische afbeeldingssystemen (130) bevat.

3. De computer geïmplementeerde werkwijze (200) volgens conclusie 2, waarbij het overschrijden van de drempel (610) bij het berekenen van de individuele stralingsdosisgegevens voor ten minste een verworven beeld de stap van het automatisch communiceren van de verworven status-informatie en individuele dosisgegevens van het kantoor (112) op afstand aan de cliënt triggert.

4. De computer geïmplementeerde werkwijze (200) volgens conclusie 1, waarbij de vergelijking van van het individuele radiologische afbeeldingssysteem (120) afkomstige gegevens met gegevens van een of meer van de populatie van ioniserende stralingssystemen (120) verder is verbonden met elk van de volgende onderdelen: een duur van een protocol, dat de richting van ioniserende straling (135) per verdeling van typen van protocol toepast, een frequentie van prestaties van verschillende protocols ten opzichte van elkaar en een bijbehorende verdeling van stralingsdosis (705) gericht op het belichte subject (105), de stralingsdosis, duur van blootstelling aan de ioniserende straling (135), product van de stralingsdosis vermenigvuldigd met een oppervlakte van de bundel van op het belichte subject (105) gerichte ioniserende straling (135), en verdeling van de stralingsdosis (705) met betrekking tot een type van beeldverwervingsmodus.

5. De computer geïmplementeerde werkwijze (200) volgens conclusie 1, waarbij de vergelijking van van het individuele radiologische afbeeldingssysteem (120) afkomstige gegevens met gegevens van een of meer van de populatie van ioniserende stralingssystemen (120) verder is verbonden met elk van de volgende onderdelen: een verdeling van een aantal gebeurtenissen bij het individuele systeem (120), waarin de op het belichte subject (105) gerichte stralingsdosis de drempel (610) overschrijdt, een verdeling van op het belichte subject (105) gerichte stralingsdosis (705) met betrekking tot een variantie in de afstand van bron tot beeld (SID) (222), een verdeling van SID voor het individuele systeem (120) met betrekking tot een referentiepunt, dat door van een of meer soortgelijke typen van andere systemen (120), die soortgelijke protocols of werkingsmodi van ioniserende straling (135) uitvoeren, verworven gegevens wordt gedefinieerd, een automatische belichtingsvoorkeur, een framesnelheid van beeldverwerving, een berekende waarde van een equivalente belicht subject (105) dikte, die dezelfde gemiddelde stralingsverzwakking produceert, en een punt in de tijd van het onderzoek, waarop de stralingsdosis de stralingsdosisdrempel (610) overschrijdt.

6. De computer geïmplementeerde werkwijze (200) volgens conclusie 1, verder omvattende de volgende stappen:

het berekenen van een individuele trend in een historie van de van het individuele radiologisch afbeeldingssysteem (130) verworven individuele stralingsdosis; en

het vergelijken van de individuele trend met een populatietrend, die is berekend uit een historie van de populatiestralingsdosisgegevens, die van de populatie van andere

radiologische afbeeldingssystemen (130) zijn verkregen, gedurende een gekozen tijdsframe zoals ontvangen van de gebruiker.

7. Werkwijze (200) volgens conclusie 1, waarbij de cumulatieve-invalsdosiskaart verbonden is met het onderzoek van belang, waarin de stralingsdosis de drempel (610) overschreden heeft en waarbij de cumulatieve-invalsdosiskaart de maat toont van tijdens het onderzoek op het belichte subject (105) gerichte cumulatieve stralingsdosis (ESAK) ten opzichte van de gevolgde positie of hoek van de stralingsbron (125) en/of detector (140) van het afbeeldingssysteem (130), waarbij de gevolgde positie of hoek van de stralingsbron (125) en/of detector (140) kan worden gecorreleerd met de gevolgde positie of hoek van het portaal (128), dat de stralingsbron (120) of de detector (140) ondersteunt.

8. Een niet-transitoir computer leesbaar medium (155), dat een aantal programma-instructies bevat voor uitvoering door een processor (150) om de volgende stappen uit te voeren:

het ontvangen van een verzoek van een cliënt om een internetverbinding tot stand te brengen om te communiceren tussen een kantoor (112) op afstand en het systeem (120), dat de ioniserende straling (135) naar het belichte subject (105) richt;

het automatisch communiceren van statusinformatie en individuele dosisgegevens, verbonden met een gebeurtenis, waarin de richting van ioniserende straling (135) een drempel (610) overschrijdt;

het automatisch creëren en via de internetverbinding aan de cliënt communiceren van een rapport (180, 240), waarbij het rapport een indicatie van de gebeurtenis, waarin de richting van ioniserende straling (135) de drempel (610) overschrijdt en een vergelijking van de individuele stralingsdosisgegevens en een individuele statuswerking van het systeem (120) op het moment van de gebeurtenis ten opzichte van een referentiepunt, gedefinieerd door stralingsdosisgegevens en statusinformatie, verkregen van een populatie van andere systemen (120), die ioniserende straling (135) richten en gegevens aan het kantoor (112) op afstand communiceren, bevat, waarbij het rapport eveneens een grafische voorstelling omvat omvattende:

een cumulatieve-invalsdosiskaart (910) die een maat van een cumulatieve stralingsdosis gericht naaret belicht object weergeeft, en die ten minste twee assen heeft die overeenstemmen met een geometrie van het systeem dat de ioniserende straling naar het object stuur, waarbij de ten minste twee assen van de cumulatieve-invalsdosiskaart een grafische illustratie van een horizontale as (912) omvatten om variërende posities van een portaal (128), dat een bron (125) van de ioniserende straling (135) ondersteunt, met betrekking tot een linker/rechter voorste schuine (LAO/RAO) positie van het belichte subject (105) te representeren, en een grafische illustratie van een verticale as (913), die craniale of

caudale positie van het portaal (128) representeert; en een grafische representatie van een verdeling van stralingsdosis (705) ten opzichte van de ten minste twee assen.

9. Het niet-transitoir computer leesbaar medium (155) volgens conclusie 8, waarbij het overschrijden van de drempel (610) bij het berekenen van de individuele stralingsdosisgegevens voor ten minste een verworven beeld de stap van het automatisch communiceren van de verworven statusinformatie en individuele dosisgegevens van het kantoor (112) op afstand aan de cliënt triggert.

10. Het niet-transitoir computer leesbaar medium (155) volgens conclusie 8, waarbij de vergelijking van van het individuele radiologische afbeeldingssysteem (120) afkomstige gegevens met gegevens van een of meer van de populatie van ioniserende stralingssystemen (120) verder is verbonden met elk van de volgende onderdelen: een duur van een protocol, dat de richting van ioniserende straling (135) per verdeling van typen van protocol toepast, een frequentie van prestaties van verschillende protocols ten opzichte van elkaar en een bijbehorende verdeling van stralingsdosis (705) gericht op het belichte subject (105), de stralingsdosis, duur van blootstelling aan de ioniserende straling (135), product van de stralingsdosis vermenigvuldigd met een oppervlakte van de bundel van op het belichte subject (105) gerichte ioniserende straling (135), en verdeling van de stralingsdosis (705) met betrekking tot een type van beeldverwervingsmodus.

11. Computer leesbaar medium (155) volgens conclusie 8, waarbij de vergelijking van van het individuele radiologische afbeeldingssysteem (120) afkomstige gegevens met gegevens van een of meer van de populatie van ioniserende stralingssystemen (120) verder is verbonden met elk van de volgende onderdelen: een verdeling van een aantal gebeurtenissen bij het individuele systeem, waarin de op het belichte subject (105) gerichte stralingsdosis de drempel (610) overschrijdt, een verdeling van op het belichte subject (105) gerichte stralingsdosis (705) met betrekking tot een variantie in de afstand van bron tot beeld (SID) (222), een verdeling van SID (222) voor het individuele systeem (120) met betrekking tot een referentiepunt, dat door van een of meer soortgelijke typen van andere systemen (120), die soortgelijke protocols of werkingsmodi van ioniserende straling (135) uitvoeren, verworven gegevens wordt gedefinieerd, een automatische belichtingsvoorkeur, een framesnelheid van beeldverwerving, een berekende waarde van een equivalente belicht subject (105) dikte, die dezelfde gemiddelde stralingsverzwakking produceert, en een punt in de tijd van het onderzoek, waarop de stralingsdosis de stralingsdosisdrempel (610) overschrijdt.

12. Het niet-transitoir computer leesbaar medium (155) volgens conclusie 8, verder omvattende de volgende stappen:

het berekenen van een individuele trend in een historie van de van het individuele radiologisch afbeeldingssysteem (130) verworven individuele stralingsdosis; en

het vergelijken van de individuele trend met een populatietrend, die is berekend uit een historie van de populatiestralingsdosisgegevens, die van de populatie van andere radiologische afbeeldingssystemen (130) zijn verkregen, gedurende een gekozen tijdsframe zoals ontvangen van de gebruiker.

13. Het niet-transitoir computer leesbaar medium (155) volgens conclusie 8, waarbij de cumulatieve-invalsdosiskaart verbonden is met het onderzoek van belang, waarin de stralingsdosis de drempel (610) overschreden heeft en waarbij de cumulatieve-invalsdosiskaart de maat weergeeft van tijdens het onderzoek op het belichte subject (105) gerichte cumulatieve stralingsdosis ten opzichte van de gevolgde positie of hoek van de stralingsbron en/of detector van het afbeeldingssysteem, waarbij de gevolgde positie of hoek van de stralingsbron en/of detector kan worden gecorreleerd met de gevolgde positie of hoek van het portaal, dat de stralingsbron of de detector ondersteunt.

14. De werkwijze volgens conclusie 1, waarbij het rapport verder een voorstelresponse omvat voor het reduceren van de stralingsdosis naar het belichte subject.

15. Het niet-transitoir computer leesbaar medium (155) volgens conclusie 8 waarbij het rapport verder een voorstelresponse omvat voor het reduceren van de stralingsdosis naar het belichte subject.

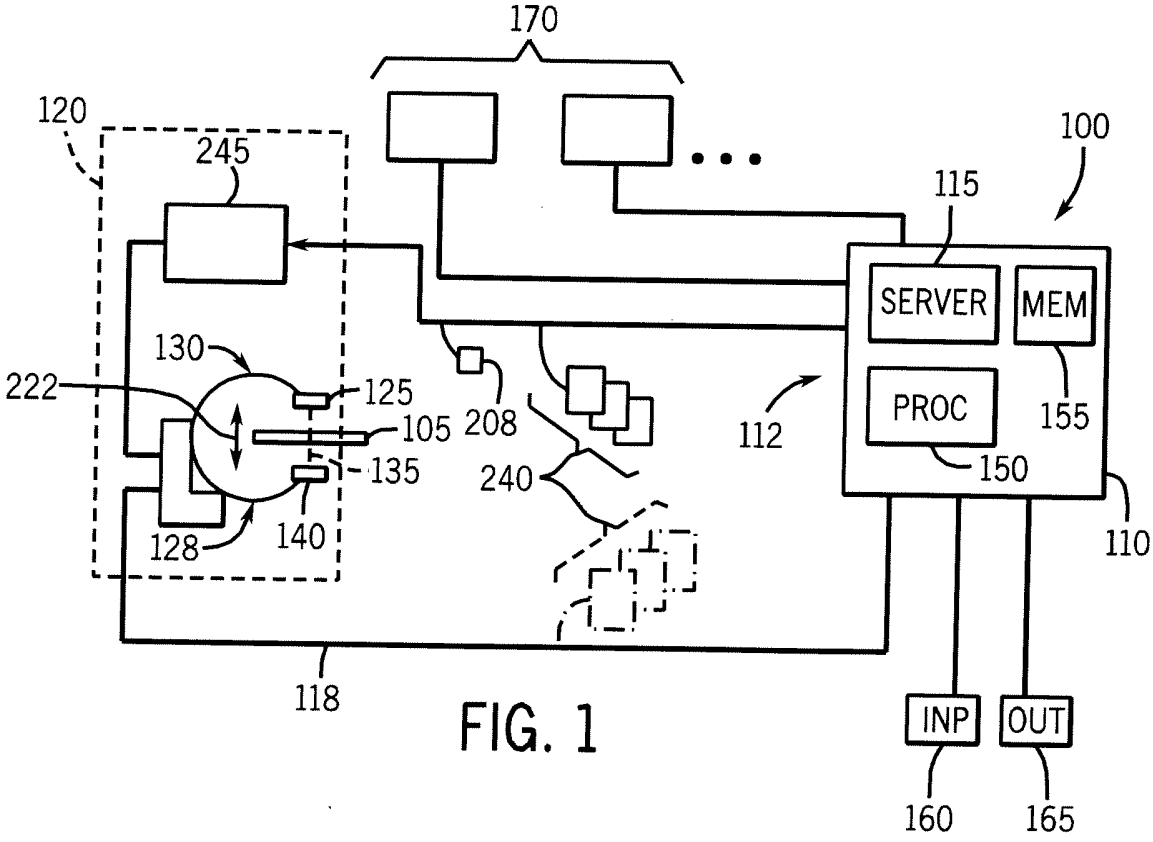

170
120
245
100
115
SERVER
MEM
130
222
125
105
135
208
240
112
PROC
155
150
110
128
140
118
INP
OUT
160
165

FIG. 1

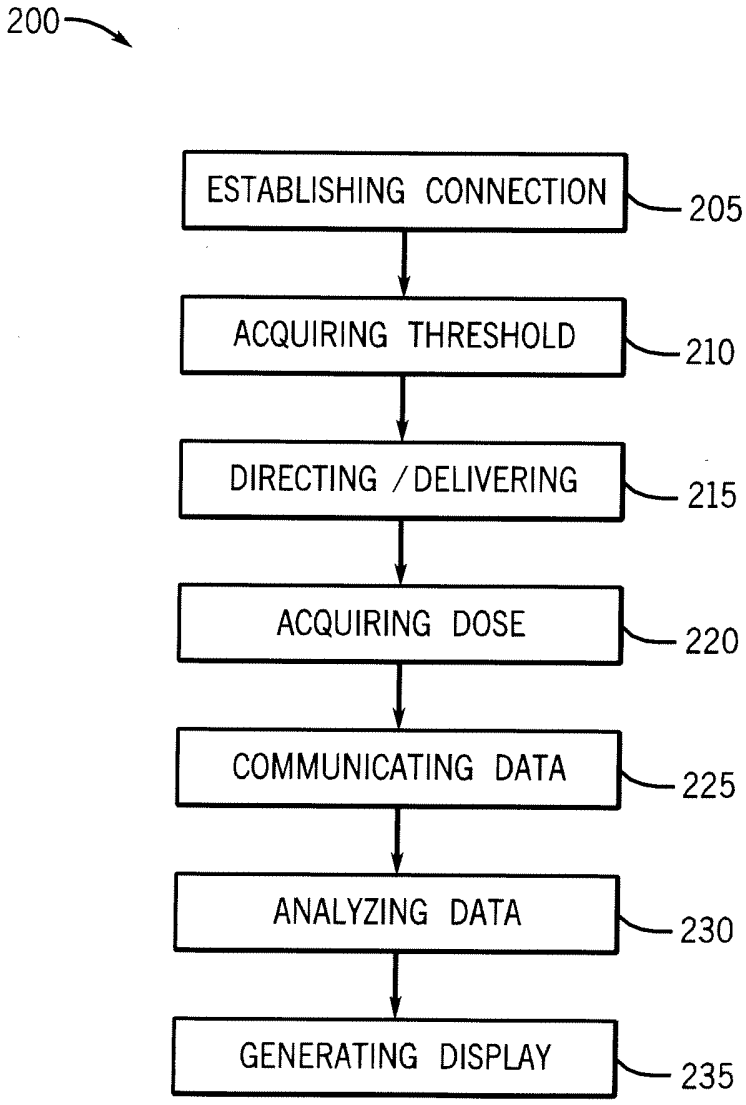

200
ESTABLISHING CONNECTION
205
ACQUIRING THRESHOLD
210
DIRECTING / DELIVERING
215
ACQUIRING DOSE
220
COMMUNICATING DATA
225
ANALYZING DATA
230
GENERATING DISPLAY
235

FIG. 2

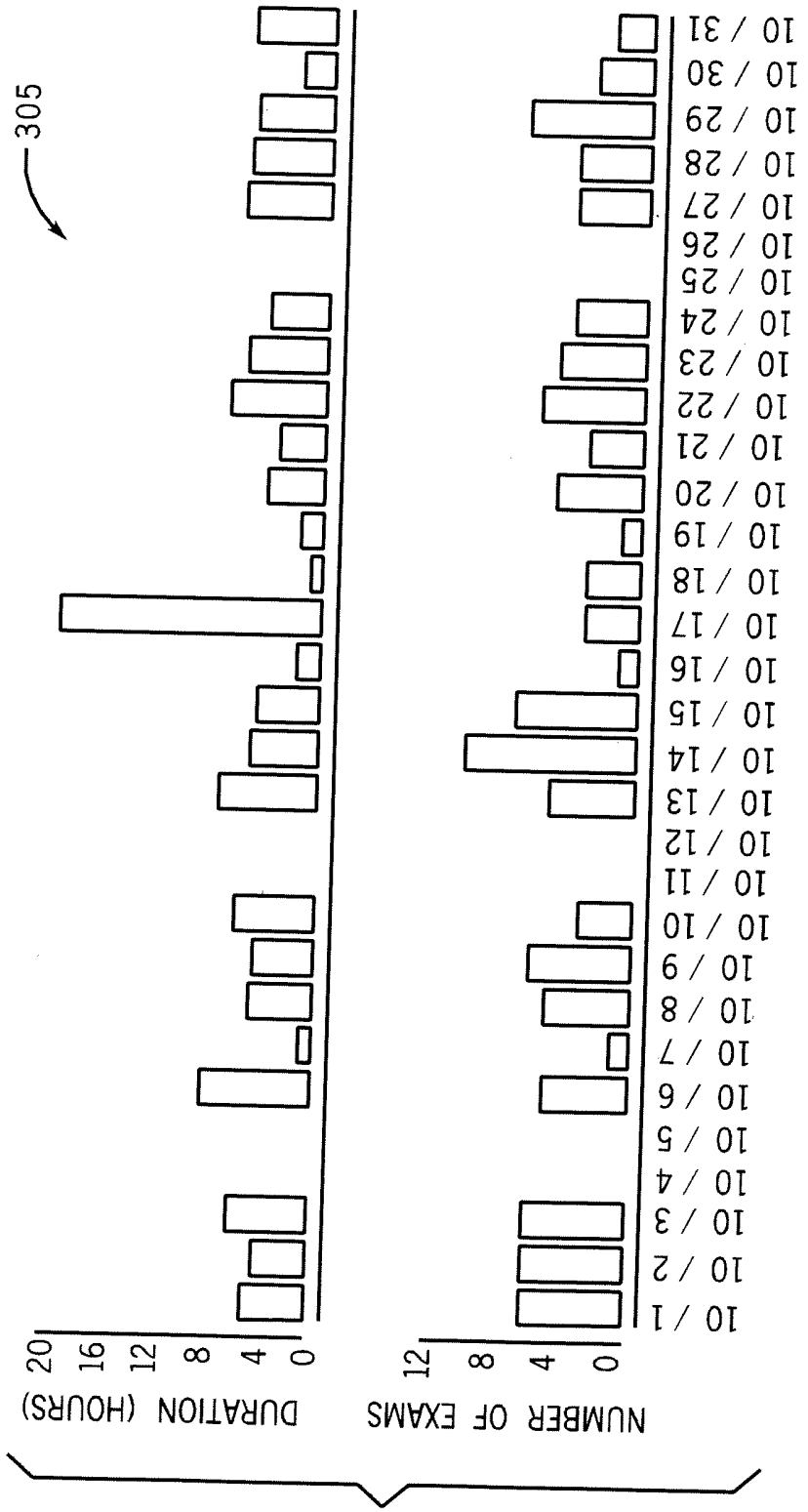

305
DURATION (HOURS)
20
16
12
8
4
0
NUMBER OF EXAMS
12
8
4
0
10 / 1
10 / 2
10 / 3
10 / 4
10 / 5
10 / 6
10 / 7
10 / 8
10 / 9
10 / 10
10 / 11
10 / 12
10 / 13
10 / 14
10 / 15
10 / 16
10 / 17
10 / 18
10 / 19
10 / 20
10 / 21
10 / 22
10 / 23
10 / 24
10 / 25
10 / 26
10 / 27
10 / 28
10 / 29
10 / 30
10 / 31

FIG. 3

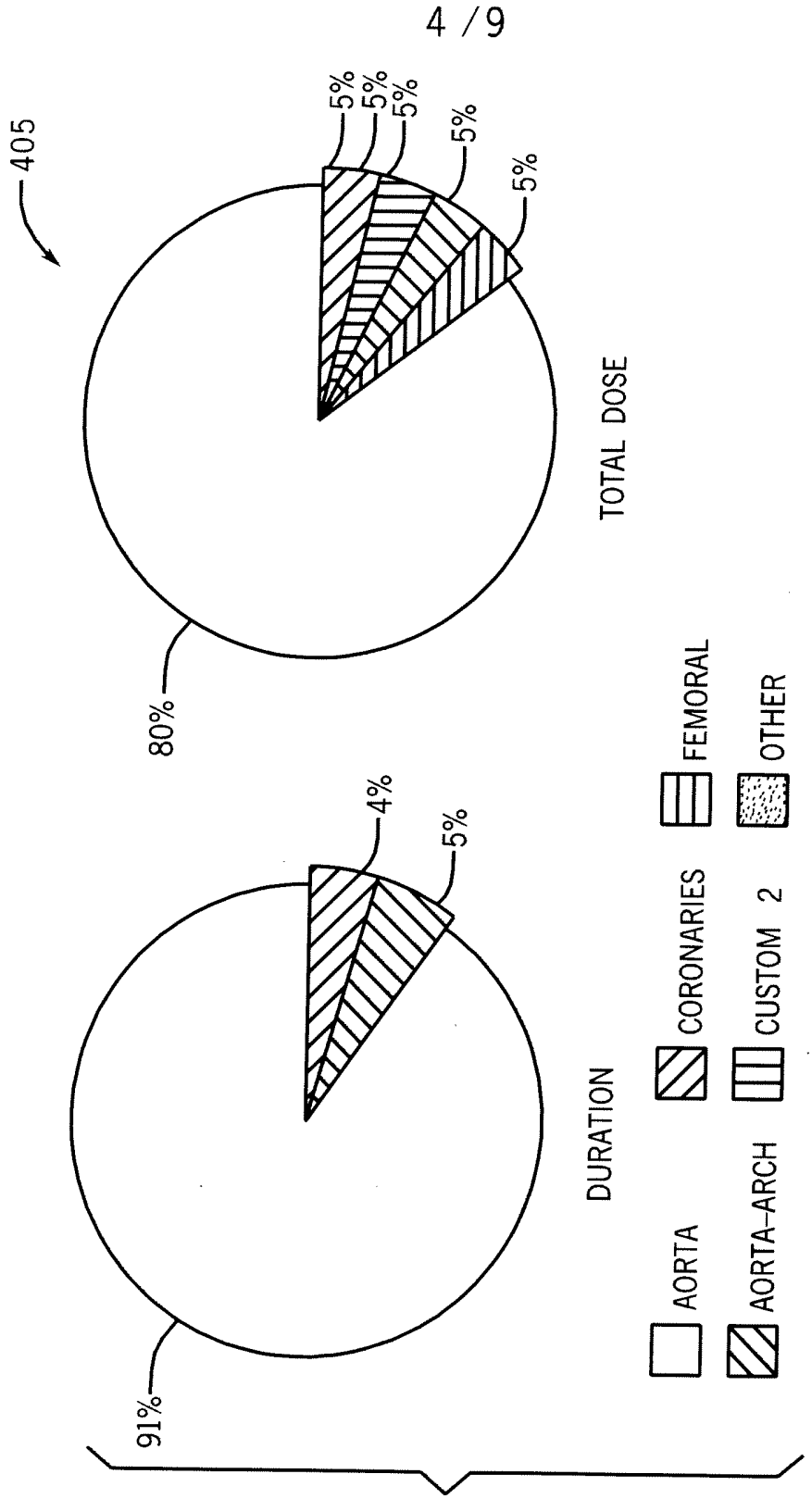

405
5%
5%
5%
5%
5%
80%
TOTAL DOSE
4%
5%
91%
DURATION
AORTA
CORONARIES
FEMORAL
AORTA–ARCH
CUSTOM 2
OTHER

FIG. 4

505

218 216

		DURATION (MIN)	DURATION (%)	TOTAL DOSE (ESAK, mGy)	TOTAL DOSE (ESAK, %)	DAP (mGy, cm^2)	DAP (%)
AORTA	FLUORO	1276	77.46%	48205	42.41%	509724	42.83%
	DSA	121	7.36%	46654	41.04%	511770	43.00%
	BOLUSCHASE	78	4.76%	777	0.68%	16039	1.35%
	CHASE	8	0.47%	662	0.58%	6697	0.56%
	3D	2	0.10%	396	0.35%	4085	0.34%
CORONARIES	CARDIAC	5	0.31%	3971	3.49%	21771	1.83%
	FLUORO	29	1.77%	2685	2.36%	14761	1.24%
AORTA-ARCH	DSA	6	0.35%	2937	2.58%	41906	3.52%
	FLUORO	40	2.40%	1754	1.54%	21229	1.78%
	BOLUSCHASE	11	0.64%	190	0.17%	4113	0.35%
	CHASE	0	0.02%	79	0.07%	654	0.05%
FEMORAL	FLUORO	37	2.24%	1293	1.14%	10595	0.89%
	DSA	5	0.32%	977	0.86%	5731	0.48%
CUSTOM2	CARDIAC	1	0.04%	1029	0.91%	3856	0.32%
	FLUORO	3	0.21%	233	0.20%	1138	0.10%
CUSTOM1	CARDIAC	1	0.04%	551	0.48%	3909	0.33%
	FLUORO	2	0.13%	222	0.20%	1557	0.13%
FOOT	FLUORO	10	0.61%	264	0.23%	3851	0.32%
	DSA	1	0.09%	238	0.21%	2413	0.20%
	BOLUSCHASE	2	0.14%	34	0.03%	756	0.06%
UNSUB DSA	DSA	0	0.03%	164	0.14%	667	0.06%
	FLUORO	0	0.02%	35	0.03%	206	0.02%
LOWER LEG	DSA	0	0.01%	97	0.09%	392	0.03%
	BOLUSCHASE	5	0.28%	88	0.08%	1135	0.10%
	FLUORO	1	0.05%	11	0.01%	141	0.01%
CAROTIDS	FLUORO	2	0.14%	72	0.06%	647	0.05%
	DSA	0	0.02%	50	0.04%	429	0.04%
TOTAL		1647	100%	113668	100%	1190172	100%

FIG. 5

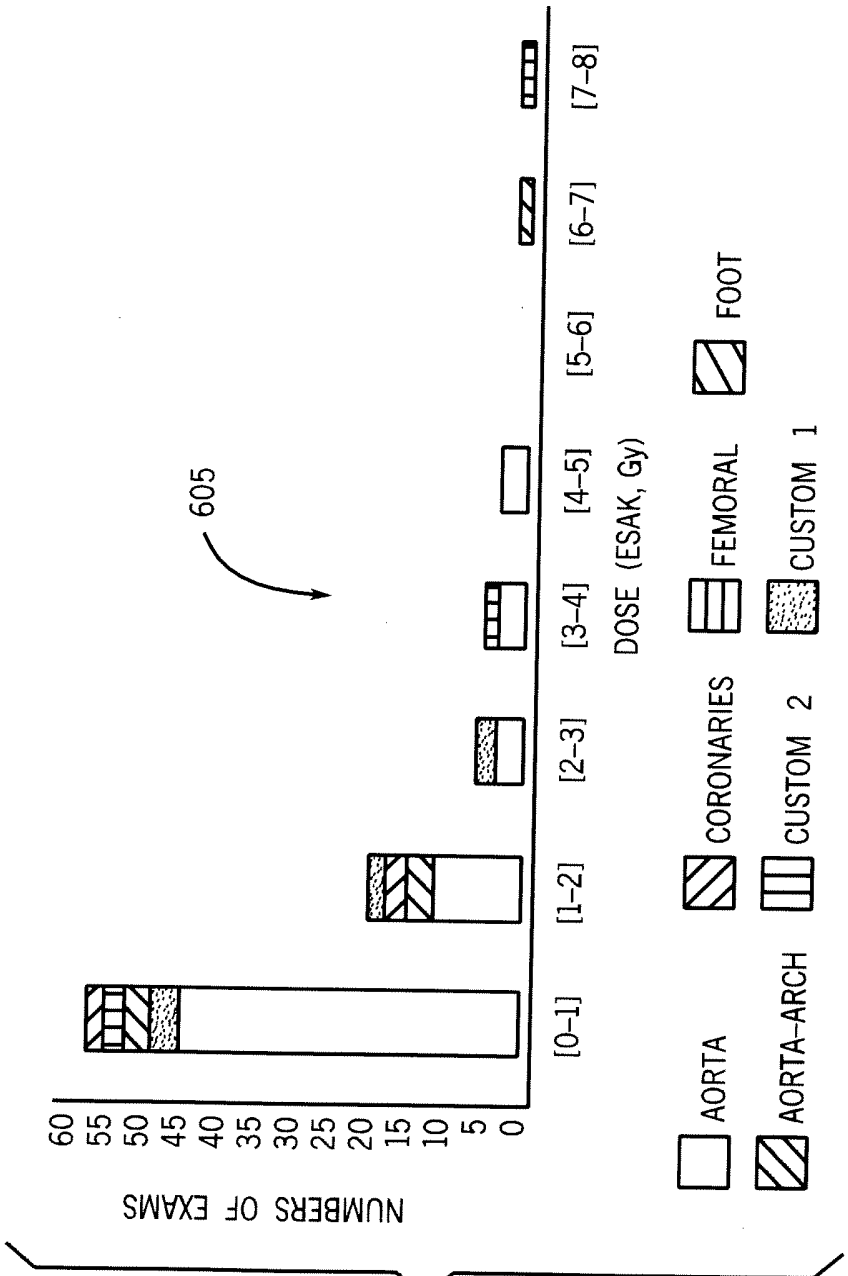

NUMBERS OF EXAMS
60
55
50
45
40
35
30
25
20
15
10
5
0
605
[0–1]
[1–2]
[2–3]
[3–4]
[4–5]
[5–6]
[6–7]
[7–8]
DOSE (ESAK, Gy)
AORTA
CORONARIES
FEMORAL
FOOT
AORTA–ARCH
CUSTOM 2
CUSTOM 1

FIG. 6

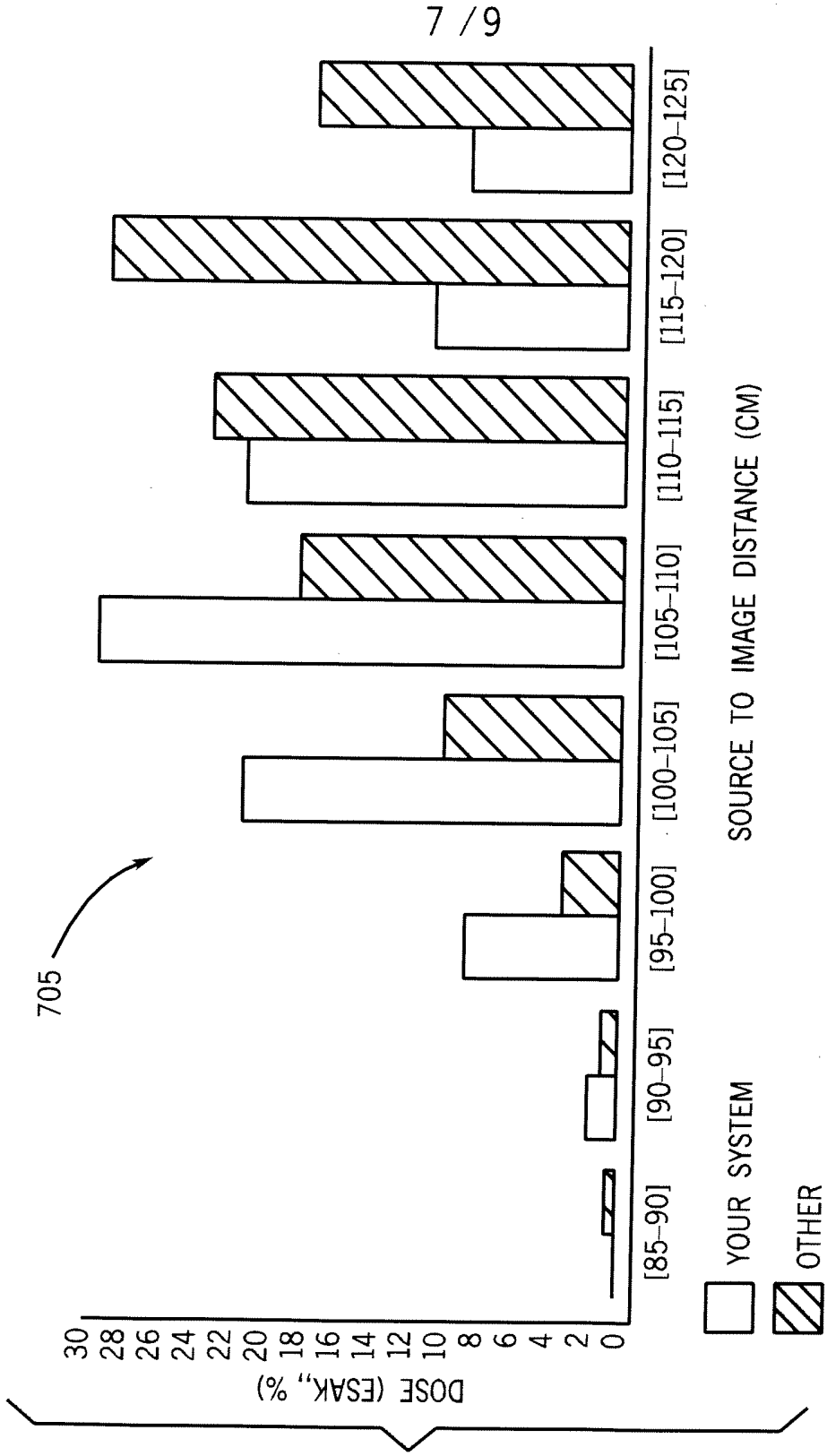

705
DOSE (ESAK, %)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
[85–90]
[90–95]
[95–100]
[100–105]
[105–110]
[110–115]
[115–120]
[120–125]
SOURCE TO IMAGE DISTANCE (CM)
YOUR SYSTEM
OTHER

FIG. 7

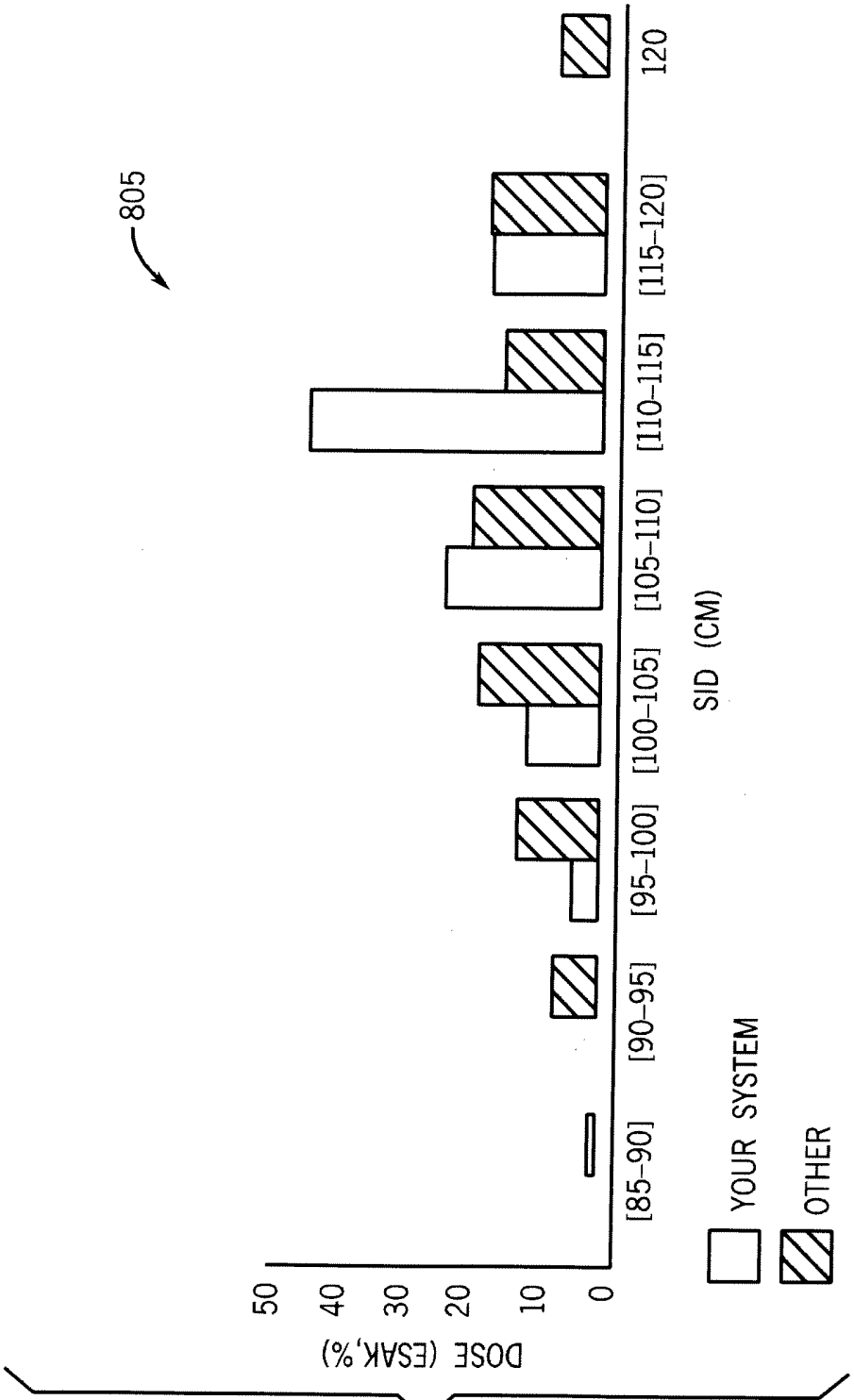

805
DOSE (ESAK,%)
50
40
30
20
10
0
[85–90]
[90–95]
[95–100]
[100–105]
[105–110]
[110–115]
[115–120]
120
SID (CM)
YOUR SYSTEM
OTHER

FIG. 8

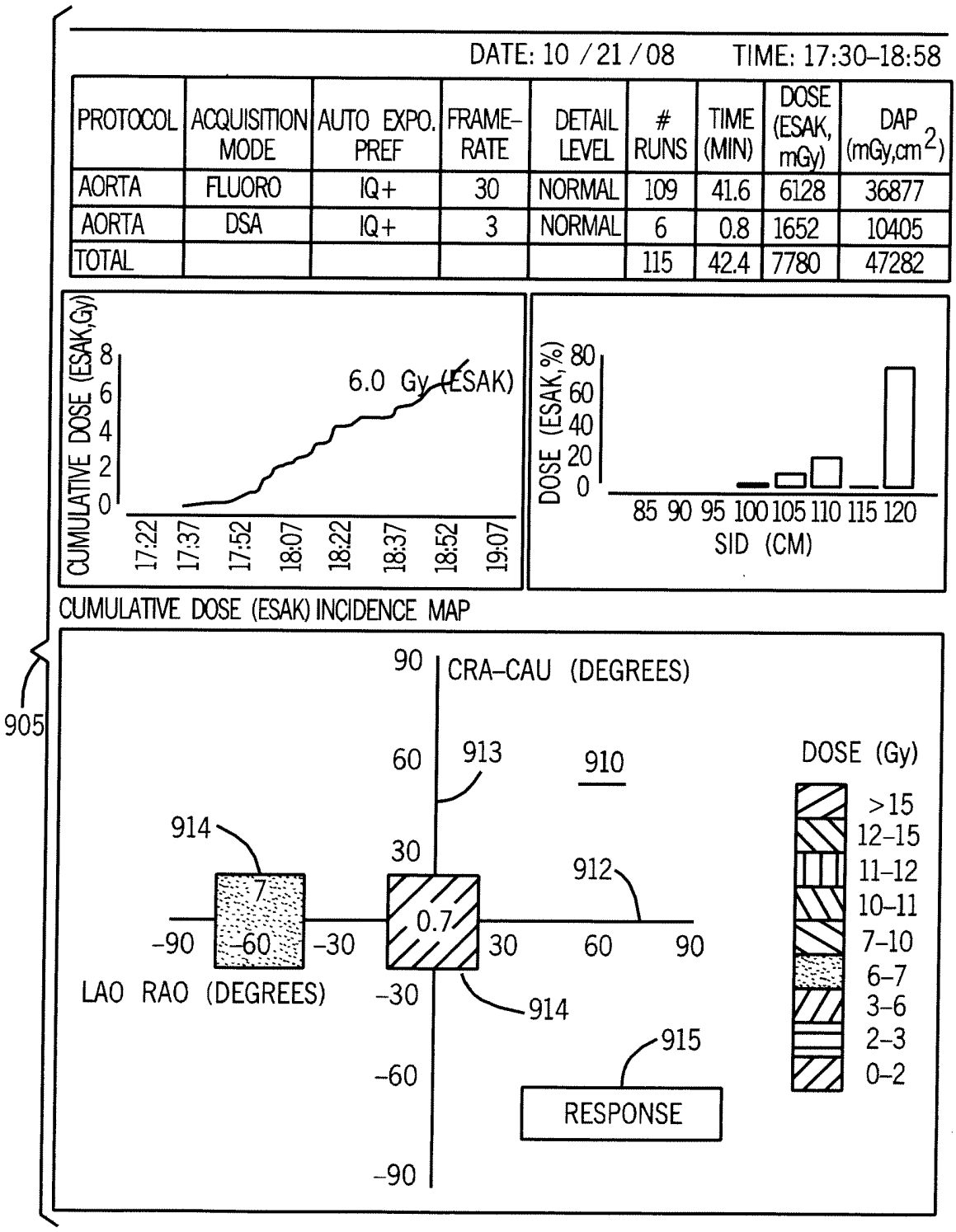

DATE: 10 / 21 / 08
TIME: 17:30–18:58
PROTOCOL | ACQUISITION MODE | AUTO EXPO. PREF | FRAME-RATE | DETAIL LEVEL | # RUNS | TIME (MIN) | DOSE (ESAK, mGy) | DAP (mGy,cm2)
AORTA | FLUORO | IQ+ | 30 | NORMAL | 109 | 41.6 | 6128 | 36877
AORTA | DSA | IQ+ | 3 | NORMAL | 6 | 0.8 | 1652 | 10405
TOTAL | | | | | 115 | 42.4 | 7780 | 47282
CUMULATIVE DOSE (ESAK,Gy)
6.0 Gy (ESAK)
17:22 17:37 17:52 18:07 18:22 18:37 18:52 19:07
DOSE (ESAK,%)
85 90 95 100 105 110 115 120
SID (CM)
CUMULATIVE DOSE (ESAK) INCIDENCE MAP
905
CRA–CAU (DEGREES)
LAO RAO (DEGREES)
913
910
912
914
915
RESPONSE
DOSE (Gy)
>15
12–15
11–12
10–11
7–10
6–7
3–6
2–3
0–2

FIG. 9

Agentschap NL
Ministerie van Economische Zaken

OCTROOIAANVRAAG NR.:
NO 137266
NL 2004366

ONDERZOEKSRAPPORT

BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK

RELEVANTE LITERATUUR

Categorie[1]	Literatuur met, voor zover nodig, aanduiding van speciaal van belang zijnde tekstgedeelten of figuren.	Van belang voor conclusie(s) nr:	Classificatie (IPC)
X	WO 2007/080522 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]; HOORNAERT BART P A J [BE]; BAKKER) 19 juli 2007 (2007-07-19) * samenvatting * * figuren 1-7 * * bladzijde 2, regel 11 - bladzijde 2, regel 20 * * bladzijde 5, regel 28 - bladzijde 9, regel 32 * -----	1-15	INV. A61B6/00 A61B6/10 G06Q50/22
A	CHUGH K ET AL: "A computer-graphic display for real-time operator feedback during interventional X-ray procedures", PROCEEDINGS OF SPIE, S P I E - INTERNATIONAL SOCIETY FOR OPTICAL ENGINEERING, US, deel 5367, nr. 1, 25 mei 2004 (2004-05-25), bladzijden 464-473, XP002429058, ISSN: 0277-786X, DOI: 10.1117/12.537230 * samenvatting * * figuren 1,2 * * Section 2.1.3.5 * -----	7,8,14, 15	Onderzochte gebieden van de techniek
A	WO 2006/116700 A2 (REINER BRUCE [US]) 2 november 2006 (2006-11-02) * samenvatting * * figuur 1 * * alinea [0008] - alinea [0030] * -----	1-15	A61B A61N G06Q

Indien gewijzigde conclusies zijn ingediend, heeft dit rapport betrekking op de conclusies ingediend op:

Plaats van onderzoek:	Datum waarop het onderzoek werd voltooid:	Bevoegd ambtenaar:
's-Gravenhage	22 mei 2013	Moehrs, Sascha

[1] CATEGORIE VAN DE VERMELDE LITERATUUR

X: de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur
Y: de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht
A: niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft
O: niet-schriftelijke stand van de techniek
P: tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur
T: na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding
E: eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven
D: in de octrooiaanvrage vermeld
L: om andere redenen vermelde literatuur
&: lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

EOB FORM 02.83 (P0414B)

AANHANGSEL BEHORENDE BIJ HET RAPPORT BETREFFENDE HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK, UITGEVOERD IN DE OCTROOIAANVRAGE NR.

NO 137266
NL 2004366

Het aanhangsel bevat een opgave van elders gepubliceerde octrooiaanvragen of octrooien (zogenaamde leden van dezelfde octrooifamilie), die overeenkomen met octrooischriften genoemd in het rapport.
De opgave is samengesteld aan de hand van gegevens uit het computerbestand van het Europees Octrooibureau per
De juistheid en volledigheid van deze opgave wordt noch door het Europees Octrooibureau, noch door het Bureau voor de Industriële eigendom gegarandeerd; de gegevens worden verstrekt voor informatiedoeleinden.

22-05-2013

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
WO 2007080522 A1	19-07-2007	CN 101371161 A	18-02-2009
		EP 1977269 A1	08-10-2008
		JP 2009523049 A	18-06-2009
		US 2009003527 A1	01-01-2009
		WO 2007080522 A1	19-07-2007
WO 2006116700 A2	02-11-2006	EP 1878239 A2	16-01-2008
		US 2006274145 A1	07-12-2006
		US 2011257919 A1	20-10-2011
		WO 2006116700 A2	02-11-2006

Algemene informatie over dit aanhangsel is gepubliceerd in de 'Official Journal' van het Europees Octrooibureau nr 12/82 blz 448 ev

SCHRIFTELIJKE OPINIE

DOSSIER NUMMER	INDIENINGSDATUM	VOORRANGSDATUM	AANVRAAGNUMMER
NO137266	09.03.2010	20.03.2009	NL2004366

CLASSIFICATIE
INV. A61B6/00 A61B6/10 G06Q50/22

AANVRAGER
General Electric Company

Deze schriftelijke opinie bevat een toelichting op de volgende onderdelen:

- ☒ Onderdeel I Basis van de schriftelijke opinie
- ☐ Onderdeel II Voorrang
- ☐ Onderdeel III Vaststelling nieuwheid, inventiviteit en industriële toepasbaarheid niet mogelijk
- ☐ Onderdeel IV De aanvraag heeft betrekking op meer dan één uitvinding
- ☒ Onderdeel V Gemotiveerde verklaring ten aanzien van nieuwheid, inventiviteit en industriële toepasbaarheid
- ☐ Onderdeel VI Andere geciteerde documenten
- ☒ Onderdeel VII Overige gebreken
- ☐ Onderdeel VIII Overige opmerkingen

DE BEVOEGDE AMBTENAAR
Moehrs, Sascha

Aanvraag nr.:

SCHRIFTELIJKE OPINIE

NL2004366

Onderdeel I Basis van de Schriftelijke Opinie

1. Deze schriftelijke opinie is opgesteld op basis van de meest recente conclusies ingediend voor aanvang van het onderzoek.

2. Met betrekking tot **nucleotide en/of aminozuur sequenties** die genoemd worden in de aanvraag en relevant zijn voor de uitvinding zoals beschreven in de conclusies, is dit onderzoek gedaan op basis van:

   a. type materiaal:

   ☐ sequentie opsomming

   ☐ tabel met betrekking tot de sequentie lijst

   b. vorm van het materiaal:

   ☐ op papier

   ☐ in elektronische vorm

   c. moment van indiening/aanlevering:

   ☐ opgenomen in de aanvraag zoals ingediend

   ☐ samen met de aanvraag elektronisch ingediend

   ☐ later aangeleverd voor het onderzoek

3. ☐ In geval er meer dan één versie of kopie van een sequentie opsomming of tabel met betrekking op een sequentie is ingediend of aangeleverd, zijn de benodigde verklaringen ingediend dat de informatie in de latere of additionele kopieën identiek is aan de aanvraag zoals ingediend of niet meer informatie bevatten dan de aanvraag zoals oorspronkelijk werd ingediend.

4. Overige opmerkingen:

Aanvraag nr.:

SCHRIFTELIJKE OPINIE

NL2004366

Onderdeel V Gemotiveerde verklaring ten aanzien van nieuwheid, inventiviteit en industriële toepasbaarheid

1. Verklaring

Nieuwheid	Ja:	Conclusies 7, 8, 14, 15
	Nee:	Conclusies 1-6, 9-13
Inventiviteit	Ja:	Conclusies
	Nee:	Conclusies 1-15
Industriële toepasbaarheid	Ja:	Conclusies 1-15
	Nee:	Conclusies

2. Citaties en toelichting:

Zie aparte bladzijde

Onderdeel VII Overige gebreken

De volgende gebreken in de vorm of inhoud van de aanvraag zijn opgemerkt:

Zie aparte bladzijde

1 Reference is made to the following documents:

D1 *WO 2007/080522 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]; HOORNAERT BART P A J [BE]; BAKKER) 19 juli 2007 (2007-07-19)*

D2 *CHUGH K ET AL: "A computer-graphic display for real-time operator feedback during interventional X-ray procedures", PROCEEDINGS OF SPIE, S P I E - INTERNATIONAL SOCIETY FOR OPTICAL ENGINEERING, US, deel 5367, nr. 1, 25 mei 2004 (2004-05-25), bladzijden 464-473, XP002429058, ISSN: 0277-786X, DOI: 10.1117/12.537230*

Re Item V

2 Independent claims 1, and 9 are not clear because of the following reason:

It is not clear how a system which directs ionizing radiation might communicate with an office. Therefore, the feature has been interpreted such that system communicates with a device which might be placed in a (remote) office.

3 Notwithstanding the lack of clarity mentioned under paragraph 2, the subject-matter of independent claims 1, and 9 is not new, and the criteria of patentability are therefore not met.

3.1 Document *D1* discloses *(the references in parentheses applying to this document)*:

A method *(description, page 5, line 28 - page 9, line 23)* to manage direction *(the angulation according to the description, page 5, line 31)* of an ionizing radiation *(description, page 4, line 15)* toward an exposed subject *(description, page 4, line 15)*, comprising:
receiving a request *(the request via the input unit 106 according to the description, page 5, lines 28 - 34)* from a customer to establish a broadband connection *(figure 1: the communication between 105 and the imaging system 102, 103, 108 is considered as broadband connection)* to communicate

between a remote office *(it is not clear how an office might communicate, see also paragraph 2 above, therefore a communication to the devices 105, 106, 107 according to figure 1 is considered as a communication to an office as they might be placed in a remote office)* and the system directing the ionizing radiation *(figure 1: 102, 103, 108 is considered as the system which directs the radiation)* toward the exposed subject;
automatically communicating a status information and individual dose data associated *(the information and dose data according to figures 2 - 7)* with an event where direction of ionizing radiation that exceeds a threshold *(the threshold according to the description, page 8, lines 7 - 21)*:
automatically creating and communicating a report *(the visualisation of the dose according to figures 2 - 7 is considered as report)* via the broadband connection *(the connection between 105 and 102, 103, 108)* to the customer, the report including an indication of the event where direction of ionizing radiation exceeds the threshold *(the threshold according to the description, page 8, lines 7 - 21)* and a comparison of the individual radiation dose data *(data according to figures 2 - 7)* and an individual status operation of system *(status as displayed in figures 2 - 7)* at time of the event *(according to figure 2, the time is represented as well to deduce the time of events when a threshold is exceeded)* relative to a benchmark defined by radiation dose data and status information acquired from a population of other systems *(the standard values according to the description, page 2, lines 11 - 20 is considered as benchmark, e.g. to define the threshold)* that direct ionizing radiation and communicate data to the remote office *(figure 1: 105, 106, 107)*.

The subject - matter of independent claim 1 is therefore not new.

3.2 The argumentation according to paragraph 3.1 applies mutatis mutandis to the corresponding, independent claim 9. Thus, also the subject-matter of claim 9 is not new.

4 Dependent claims 2 - 8, 10 - 15 do not appear to contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of patentability.

4.1 The subject-matter of dependent claims 2 - 6, and 10 - 13 is not new, see particularly

Claim 2

D1: see figure 1; and the description, page 5, lines 28 -34;

Claims 3, and 10
D1: figure 7; and the change of color according to the description, page 9, lines 3 - 12 is considered as automatic communication;

Claims 4, and 11
D1: see the time/duration according to the description, page 8, line 22 - page 9, line 2;

Claims 5, and 12
D1: the data which is used for comparison includes the radiation threshold, see the description, page 2, lines 11 - 20;

Claims 6, and 13
D1: see figure 5, and the description, page 8, lines 7 - 21 for the trend over time;

4.2 The subject-matter of dependent claims 7, 8, 14, and 15 is not inventive. Document *D1* is considered as the closest prior art with respect to these claims and the person skilled in the art is aware of the additional features from the following documents:

Claims 7, 8, 14, and 15
D1: see the orientations according to figure 4; and the description, page 7, line 1 - page 8, line 6;
D2: abstract; figures 1, and 2; and see the cumulative dose according to Section 2.1.3.5.

Re Item VII

5 The relevant background art disclosed in *D1* is not mentioned in the description, nor is this document identified therein.