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(54) MULTI-SECTOR BACK-OFF LOGIC ALGORITHM FOR OBTAINING OPTIMAL SLICE-SENSITIVE COMPUTED TOMOGRAPHY PROFILES

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A61B 6/00 (2006.01)

(52) **U.S. Cl.** **378/4**; 378/8; 378/901

(58) **Field of Classification Search** 378/4–20
See application file for complete search history.

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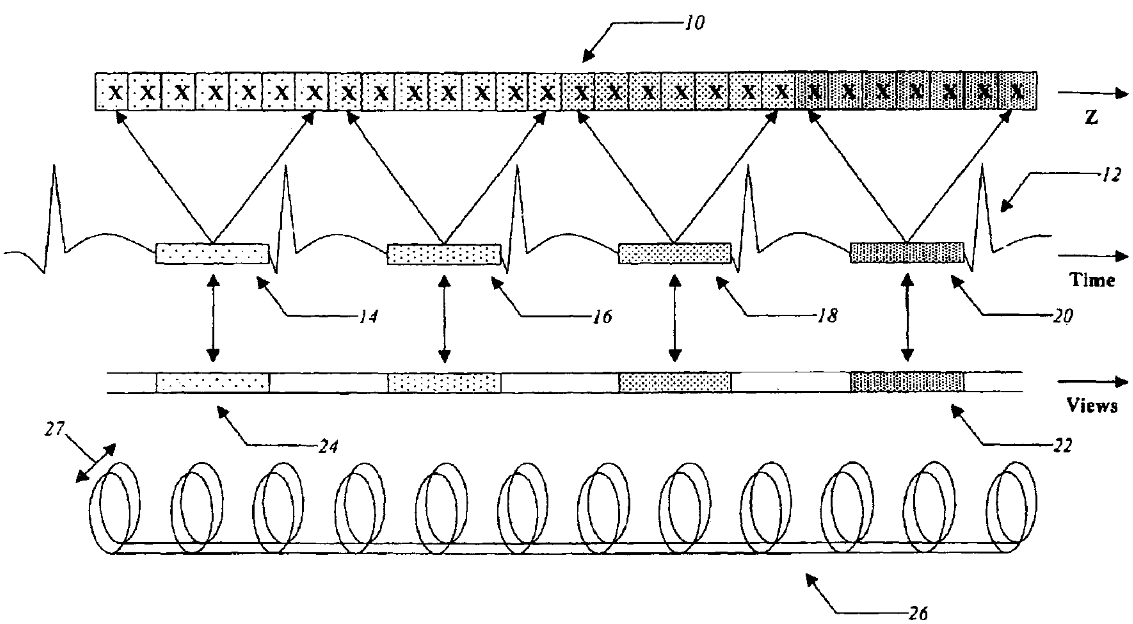
(57) **ABSTRACT**

A multi-sector back-off logic algorithm for obtaining optimal slice-sensitive computed tomography ("CT") profiles. The systems and methods of the present invention improving the temporal resolution of a CT system by checking for Z location errors between sectors and automatically backing-off to an alternative multi-sector algorithm when necessary (i.e., selecting an optimized maximum number of sectors to reconstruct), providing less Z location error. Based upon this Z location error, the systems and methods of the present invention also calculating the maximum number of sectors that should be used for reconstruction "on-the-fly" (i.e., on a per image basis across an entire series of images). These systems and methods utilizing the Recommended Protocol for Cardiac Reconstruction Algorithms.

38 Claims, 4 Drawing Sheets



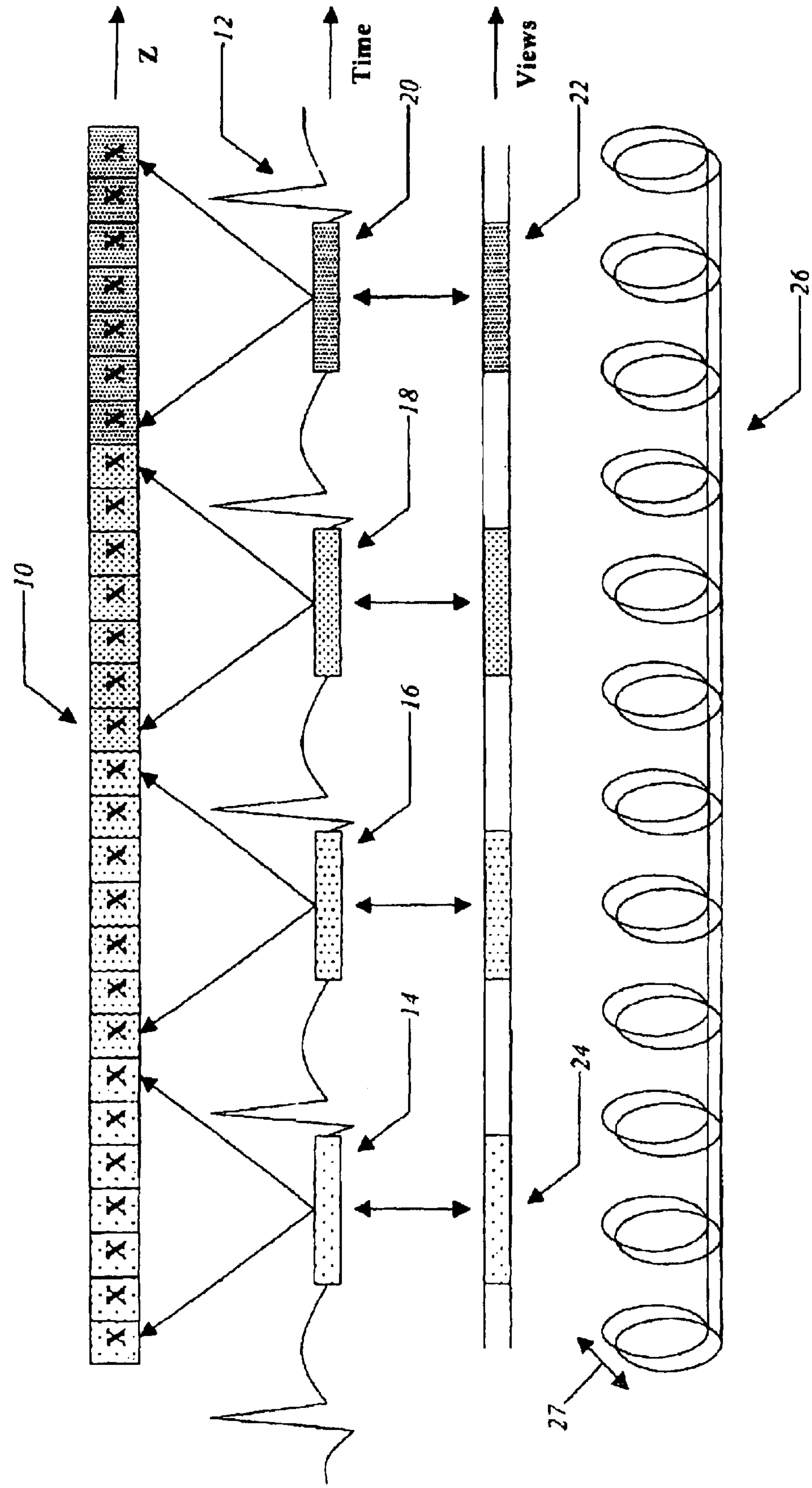


FIG. 1.

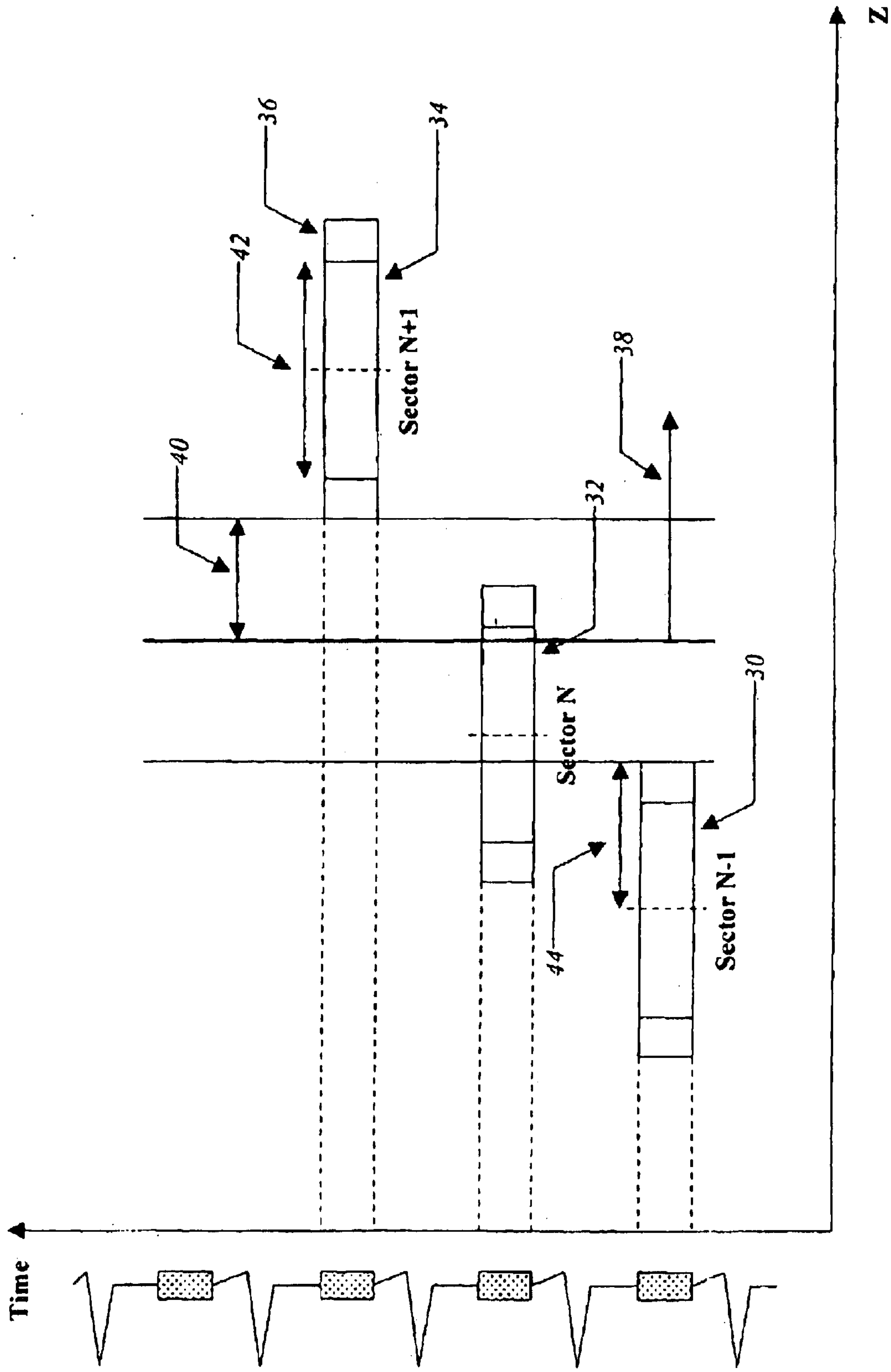
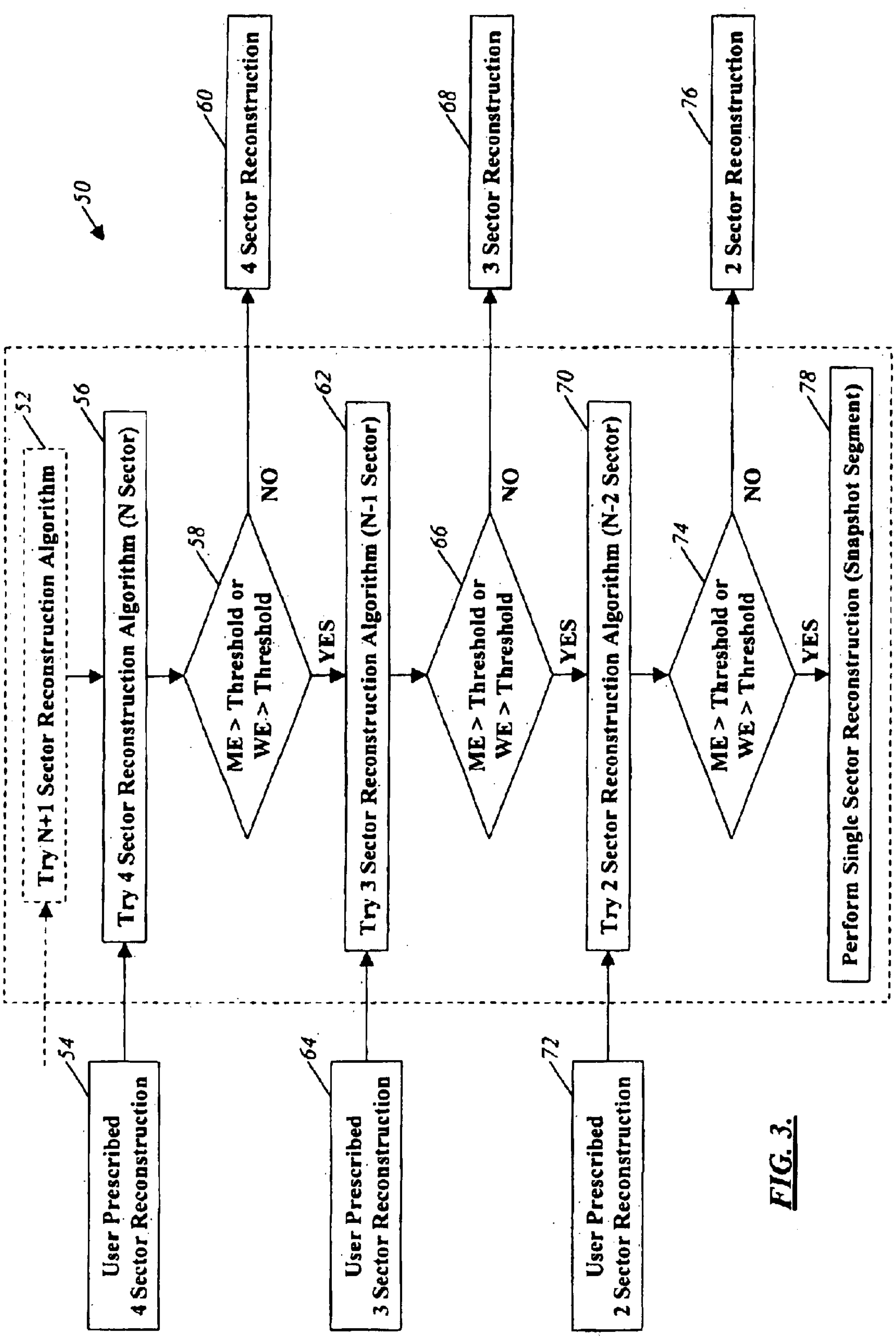


FIG. 2.



50
User Prescribed 4 Sector Reconstruction
54
Try N+1 Sector Reconstruction Algorithm
52
Try 4 Sector Reconstruction Algorithm (N Sector)
56
ME > Threshold or WE > Threshold
58
NO
YES
4 Sector Reconstruction
60
User Prescribed 3 Sector Reconstruction
64
Try 3 Sector Reconstruction Algorithm (N-1 Sector)
62
ME > Threshold or WE > Threshold
66
3 Sector Reconstruction
68
User Prescribed 2 Sector Reconstruction
72
Try 2 Sector Reconstruction Algorithm (N-2 Sector)
70
ME > Threshold or WE > Threshold
74
2 Sector Reconstruction
76
Perform Single Sector Reconstruction (Snapshot Segment)
78

FIG. 3.

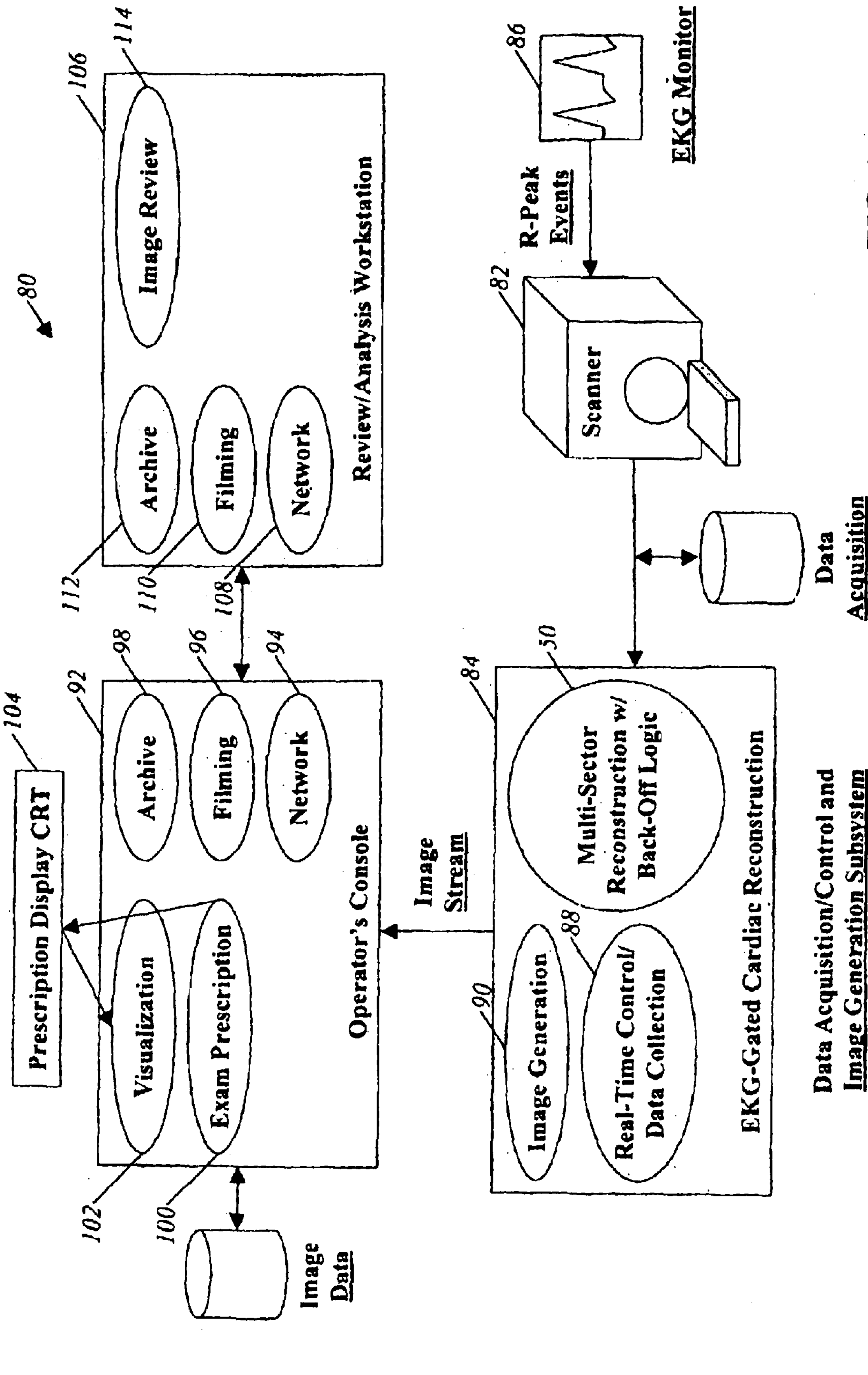

80
Review/Analysis Workstation
106
114
Image Review
Archive
Filming
Network
112
110
108
EKG Monitor
86
R-Peak Events
82
Scanner
Data Acquisition
Prescription Display CRT
104
92
98
96
94
Archive
Filming
Network
Visualization
Exam Prescription
Operator's Console
102
100
Image Data
Image Stream
84
50
Multi-Sector Reconstruction w/ Back-Off Logic
Image Generation
90
88
Real-Time Control/ Data Collection
EKG-Gated Cardiac Reconstruction
Data Acquisition/Control and Image Generation Subsystem

FIG. 4.

MULTI-SECTOR BACK-OFF LOGIC ALGORITHM FOR OBTAINING OPTIMAL SLICE-SENSITIVE COMPUTED TOMOGRAPHY PROFILES

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

FIELD OF THE INVENTION

The present invention relates generally to computed tomography ("CT") systems and methods. More specifically, the present invention relates to a multi-sector back-off logic algorithm for obtaining optimal slice-sensitive CT profiles, especially for cardiac applications.

BACKGROUND OF THE INVENTION

Computed tomography ("CT") systems are often used to image the heart and cardiovasculature. The data for a given image may be collected from multiple cardiac cycles using multiple sectors. This creates a number of challenges. In an ideal case, the multiple sectors used to reconstruct the heart and cardiovasculature overlap for a zero Z location error between sectors. This, however, is not always the case. For a relatively low heart rate and high pitch, for example, the sectors used to reconstruct the heart and cardiovasculature do not always overlap, resulting in a relatively large Z location error between sectors and relatively poor slice-sensitive profiles. Because of this, the data collected from multiple cardiac cycles may be too far apart, resulting in poor image quality.

Thus, what is needed are systems and methods that generate high temporal resolution images for cardiac CT applications while addressing the problem of bad images by checking for these Z location errors between sectors and automatically backing-off to an alternative multi-sector algorithm when necessary (i.e., selecting an optimized maximum number of sectors to reconstruct), providing less Z location error. What is also needed are systems and methods that, based upon this Z location error, calculate the maximum number of sectors that should be used for reconstruction "on-the-fly" (i.e., on a per image basis across an entire series of images). Preferably, these systems and methods utilize the Recommended Protocol for Cardiac Reconstruction Algorithms.

BRIEF SUMMARY OF THE INVENTION

Accordingly, the present invention provides a multi-sector back-off logic algorithm for obtaining optimal slice-sensitive computed tomography ("CT") profiles. The systems and methods of the present invention generate high temporal resolution images for cardiac CT applications and address the problem of bad images by checking for Z location errors between sectors and automatically backing-off to an alternative multi-sector algorithm when necessary (i.e., selecting an optimized maximum number of sectors to reconstruct), providing less Z location error. Based upon this Z location error, the systems and methods of the present invention also calculate the maximum number of sectors that should be used for reconstruction "on-the-fly" (i.e., on a per image basis across an entire series of images). These systems and methods utilize the Recommended Protocol for Cardiac Reconstruction Algorithms.

In one embodiment of the present invention, a computed tomography method includes determining a maximum Z

location error and determining a weighted average Z location error. The computed tomography method also includes selecting a threshold value associated with the maximum Z location error and the weighted average Z location error. The computed tomography method further includes prescribing an N+1 sector reconstruction algorithm. If the maximum Z location error is less than or equal to the threshold value or the weighted average Z location error is less than or equal to the threshold value, the computed tomography method includes performing an N+1 sector reconstruction. If the maximum Z location error exceeds the threshold value or the weighted average Z location error exceeds the threshold value, the computed tomography method includes prescribing an N sector reconstruction.

In another embodiment of the present invention, a computed tomography method for obtaining optimal slice-sensitive profiles includes determining a maximum Z location error associated with a computed tomography system and determining a weighted average Z location error associated with the computed tomography system. The computed tomography method also includes selecting a threshold value associated with the maximum Z location error and the weighted average Z location error. The computed tomography method further includes prescribing an N+1 sector reconstruction algorithm. If the maximum Z location error is less than the threshold value or the weighted average Z location error is less than the threshold value, the computed tomography method includes performing an N+1 sector reconstruction. If the maximum Z location error exceeds the threshold value or the weighted average Z location error exceeds the threshold value, the computed tomography method includes prescribing an N sector reconstruction.

In an further embodiment of the present invention, an imaging method for obtaining optimal slice-sensitive profiles includes determining a maximum Z location error associated with an imaging system and determining a weighted average Z location error associated with the imaging system. The imaging method also includes selecting a threshold value associated with the maximum Z location error and the weighted average Z location error. The imaging method further includes prescribing an N+1 sector reconstruction algorithm. If the maximum Z location error is less than the threshold value or the weighted average Z location error is less than the threshold value, the imaging method includes performing an N+1 sector reconstruction. If the maximum Z location error exceeds the threshold value or the weighted average Z location error exceeds the threshold value, the imaging method includes prescribing an N sector reconstruction.

In a still further embodiment of the present invention, a computed tomography system includes a computed tomography scanner, a first algorithm operable for determining a maximum Z location error associated with the computed tomography system, and a second algorithm operable for determining a weighted average Z location error associated with the computed tomography system. The computed tomography system also includes a third algorithm operable for selecting a threshold value associated with the maximum Z location error and the weighted average Z location error. The computed tomography system further includes means for prescribing an N+1 sector reconstruction algorithm. The computed tomography system still further includes a fourth algorithm operable for, if the maximum Z location error is less than the threshold value or the weighted average Z location error is less than the threshold value, performing an N+1 sector reconstruction, and wherein the fourth algorithm is further operable for, if the maximum Z location error exceeds the threshold value or the weighted average Z location error exceeds the threshold value, prescribing an N sector reconstruction.

In a still further embodiment of the present invention, an imaging system includes an imaging scanner, a first algorithm operable for determining a maximum Z location error associated with the imaging system, and a second algorithm operable for determining a weighted average Z location error associated with the imaging system. The imaging system also includes a third algorithm operable for selecting a threshold value associated with the maximum Z location error and the weighted average Z location error. The imaging system further includes means for prescribing an N+1 sector reconstruction algorithm. The imaging system still further includes a fourth algorithm operable for, if the maximum Z location error is less than the threshold value or the weighted average Z location error is less than the threshold value, performing an N+1 sector reconstruction, and wherein the fourth algorithm is further operable for, if the maximum Z location error exceeds the threshold value or the weighted average Z location error exceeds the threshold value, prescribing an N sector reconstruction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram illustrating a retrospectively EKG-gated reconstruction associated with the systems and methods of the present invention;

FIG. **2** is a graph illustrating the Z location error concepts associated with the systems and methods of the present invention;

FIG. **3** is a flow chart illustrating one embodiment of the multi-sector back-off logic algorithm for obtaining optimal slice-sensitive CT profiles of the present invention; and

FIG. **4** is a schematic diagram illustrating one embodiment of a computed tomography ("CT") system incorporating the multi-sector back-off logic algorithm for obtaining optimal slice-sensitive CT profiles of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The systems and methods of the present invention allow for the creation of relatively high temporal resolution images for cardiac applications while addressing the problem of the generation of bad images due to relatively large Z location errors between sectors that are used for reconstruction. In general, the algorithm of the present invention is based upon the measurement of maximum Z location error ("ME") and weighted average Z location error ("WE") and determining how far these measurements are from predetermined limits.

The computation of the Z location error, ME, and WE includes a number of steps beginning with calculating half the detector coverage (i.e., the distance from the center of the detector to the center of the outer row). This is done using the following equation:

$$\text{half the detector coverage}=[(\text{num\_rows}/2)-1]*\text{detector width}. \quad (1)$$

Next, the Z location error is computed for each sector. This is done by finding the Z location of the center view in the table space and calculating upper ("maximum") limit and the lower ("minimum") limit that the detector may cover at this particular Z location. The maximum limit and the minimum limit are given by:

$$\text{maximum limit}=\text{center Z location}+\text{half the detector coverage}, \quad (2)$$

$$\text{minimum limit}=\text{center Z location}-\text{half the detector coverage}. \quad (3)$$

The Z location error is computed for each sector using the following algorithm and is a signed value:

$$\text{if Z location}<\text{lower limit, Z location error}=\text{lower limit}-\text{Z location} \quad (4)$$

$$\text{if Z location}>\text{upper limit, Z location error}=\text{upper limit}-\text{Z location} \quad (5)$$

$$\text{if lower limit}<\text{Z location}<\text{upper limit, Z location error}=0. \quad (6)$$

Next, the maximum error between the upper most and lower most error sectors is calculated. This also involves calculating the maximum and minimum errors within the set of sectors and the maximum error spread. The maximum error spread is given by:

$$\text{maximum error spread}=\text{maximum error}-\text{minimum error}-\max(Zi-Z_{desired})-\min(Zi-Z_{desired}). \quad (7)$$

Next, WE is calculated using the average error weighted by the number of views in each sector:

$$WE=\text{total error over all sectors/total view over all sectors}=\text{sum}(0,\ \text{sector}-1)|Zi-Z_{desired}|*Wi. \quad (8)$$

The percentage of image locations, or images, that fall into the gap is given by gap/(gap+overlap).

Referring to FIG. **1**, in one embodiment of the present invention, a retrospectively EKG-gated reconstruction is illustrated. The retrospectively EKG-gated reconstruction provides a plurality of image locations **10** that vary as a function of Z location associated with predetermined points along an EKG cycle **12** that vary as a function of time. The predetermined points along the EKG cycle **12** include, for example, a first cycle **14**, a second cycle **16**, a third cycle **18**, and a fourth cycle **20**. The reconstruction algorithm of the present invention provides a continuous view stream **22** consisting of a plurality of view regions **24** utilized by the reconstruction algorithm. These view regions **24** correspond to the first cycle **14**, the second cycle **16**, the third cycle **18**, and the fourth cycle **20**. A plurality of detector rows **27** are used to obtain images as part of a low-pitch helical scan **26**.

In another embodiment of the present invention, the Z location error concepts described above are illustrated in FIG. **2**. FIG. **2** shows a plurality of sectors, including a sector N−1 **30**, a sector N **32**, and a sector N+1 **34**. Each sector includes a tolerance level **36**. The Z location for a given image **38** and a Z location error >0 are also shown. Further, the half detector coverage **42** (i.e., 1.5 detector for a 4-row configuration, 3.5 detector for an 8-row configuration, 7.5 detector for a 16-row configuration) and the range **44** are also shown.

As described above, the multi-sector back-off logic algorithm for obtaining optimal slice-sensitive CT profiles of the present invention is based upon deciding the maximum number of sectors to reconstruct in a given situation. This determination is made based upon how far two given sectors are separated with respect to the Z location. The algorithm begins with a predetermined number of sectors and, based upon the maximum Z location error and the weighted average Z location error, backs off to a lesser number of sectors until images may be generated with minimum error. This algorithm is illustrated in FIG. **3**.

Referring to FIG. **3**, in a further embodiment of the present invention, the multi-sector back-off logic algorithm for obtaining optimal slice-sensitive CT profiles of the present invention **50** begins with the "auto burst" algorithm **50** trying an N+1 or N sector reconstruction algorithm **52**,**56**.

For example, a user may prescribe a four sector reconstruction **54** and the auto burst algorithm **50** may try a four sector (N sector) reconstruction algorithm **56**. If ME is less than the threshold or WE is less than the threshold **58**, then a four sector reconstruction is performed **60**. If ME exceeds the threshold or WE exceeds the threshold **58**, then the auto burst algorithm **50** tries a three sector (N−1 sector) reconstruction algorithm **62**. This is also the starting point if the user prescribes a three sector reconstruction **64**. If ME is less than the threshold or WE is less than the threshold **66**, then a three sector reconstruction is performed **68**. If ME exceeds the threshold or WE exceeds the threshold **66**, then the auto burst algorithm **50** tries a two sector (N−2 sector) reconstruction algorithm **70**. This is also the starting point if the user prescribes a two sector reconstruction **72**. If ME is less than the threshold or WE is less than the threshold **74**, then a two sector reconstruction is performed **76**. If ME exceeds the threshold or WE exceeds the threshold **74**, then the auto burst algorithm **50** performs a single sector reconstruction **78** (i.e., a snapshot segment).

Referring to FIG. **4**, in a still further embodiment of the present invention, a CT system **80** incorporating the multi-sector back-off logic algorithm for obtaining optimal slice-sensitive CT profiles **50** includes a CT scanner **82** coupled to a data acquisition/control and image generation sub-system **84**. Preferably, the CT scanner **82** is also coupled to an EKG monitor **86** or the like operable for measuring R-peak events or the like. The data acquisition/control and image generation subsystem **84** may be operable for performing, for example, an EKG-gated cardiac reconstruction. In order to do this, the data acquisition/control and image generation subsystem **84** includes a real-time control/data collection algorithm **88**, the auto burst algorithm **50**, and an image generation algorithm **90**. The data acquisition/control and image generation subsystem **84** is operable for transmitting an image stream to an operator's console **92** or the like including a network component **94**, a filming component **96**, an archive component **98**, an exam prescription component **100**, and a visualization component **102**. The exam prescription component **100** and the visualization component **102** may be associated with a prescription display CRT **104** or the like. The operator's console **92** is coupled to a review/analysis workstation **106** also including a network component **108**, a filming component **110**, and an archive component, as well as an image review component **114**.

It is apparent that there has been provided, in accordance with the systems and methods of the present invention, a multi-sector back-off logic algorithm for obtaining optimal slice-sensitive CT profiles. Although the systems and methods of the present invention have been described with reference to preferred embodiments and examples thereof, other embodiments and examples may perform similar functions and/or achieve similar results. All such equivalent embodiments and examples are within the spirit and scope of the present invention and are intended to be covered by the following claims.

What is claimed is:

1. A computed tomography method, comprising:

determining a maximum Z location error;

determining a weighted average Z location error;

selecting a threshold value associated with the maximum Z location error and the weighted average Z location error;

prescribing an N+1 sector reconstruction algorithm;

if the maximum Z location error is less than the threshold value or the weighted average Z location error is less than the threshold value, performing an N+1 sector reconstruction; and

if the maximum Z location error exceeds the threshold value or the weighted average Z location error exceeds the threshold value, prescribing an N sector reconstruction.

2. The computed tomography method of claim **1**, further comprising, if [the] *a second* maximum Z location error is less than the threshold value or [the] *a second* weighted average Z location error is less than the threshold value, performing an N sector reconstruction.

3. The computed tomography method of claim **2**, further comprising, if the *second* maximum Z location error exceeds the threshold value or the *second* weighted average Z location error exceeds the threshold value, prescribing an N−1 sector reconstruction.

4. The computed tomography method of claim **1**, wherein the computed tomography method is used to perform cardiac imaging.

5. A computed tomography method for obtaining optimal slice-sensitive profiles, comprising:

determining a maximum Z location error associated with a computed tomography system;

determining a weighted average Z location error associated with the computed tomography system;

selecting a threshold value associated with the maximum Z location error and the weighted average Z location error;

prescribing an N+1 sector reconstruction algorithm;

if the maximum Z location error is less than the threshold value or the weighted average Z location error is less than the threshold value, performing an N+1 sector reconstruction; and

if the maximum Z location error exceeds the threshold value or the weighted average Z location error exceeds the threshold value, prescribing an N sector reconstruction.

6. The computed tomography method of claim **5**, further comprising, if [the] *a second* maximum Z location error is less than the threshold value or [the] *a second* weighted average Z location error is less than the threshold value, performing an N sector reconstruction.

7. The computed tomography method of claim **6**, further comprising, if the *second* maximum Z location error exceeds the threshold value or the *second* weighted average Z location error exceeds the threshold value, prescribing an N−1 sector reconstruction.

8. The computed tomography method of claim **5**, wherein the computed tomography method is used to perform cardiac imaging.

9. An imaging method for obtaining optimal slice-sensitive profiles, comprising:

determining a maximum Z location error associated with an imaging system;

determining a weighted average Z location error associated with the imaging system;

selecting a threshold value associated with the maximum Z location error and the weighted average Z location error;

prescribing an N+1 sector reconstruction algorithm;

if the maximum Z location error is less than the threshold value or the weighted average Z location error is less than the threshold value, performing an N+1 sector reconstruction; and

if the maximum Z location error exceeds the threshold value or the weighted average Z location error exceeds the threshold value, prescribing an N sector reconstruction.

10. The imaging method of claim **9**, further comprising, if **[**the**]** *a second* maximum Z location error is less than the threshold value or **[**the**]** *a second* weighted average Z location error is less than the threshold value, performing an N sector reconstruction.

11. The imaging method of claim **10**, further comprising, if the *second* maximum Z location error exceeds the threshold value or the *second* weighted average Z location error exceeds the threshold value, prescribing an N−1 sector reconstruction.

12. The imaging method of claim **9**, wherein the **[**computed tomography**]** *imaging* method is used to perform cardiac imaging.

13. A computed tomography system, comprising:

a computed tomography scanner;

a first algorithm operable for determining a maximum Z location error associated with the computed tomography system;

a second algorithm operable for determining a weighted average Z location error associated with the computed tomography system;

a third algorithm operable for selecting a threshold value associated with the maximum Z location error and the weighted average Z location error;

means for prescribing an N+1 sector reconstruction algorithm;

a fourth algorithm operable for, if the maximum Z location error is less than the threshold value or the weighted average Z location error is less than the threshold value, performing an N+1 sector reconstruction; and

wherein the fourth algorithm is further operable for, if the maximum Z location error exceeds the threshold value or the weighted average Z location error exceeds the threshold value, prescribing an N sector reconstruction.

14. The computed tomography system of claim **13**, wherein the fourth algorithm is further operable for, if **[**the**]** *a second* maximum Z location error is less than the threshold value or **[**the**]** *a second* weighted average Z location error is less than the threshold value, performing an N sector reconstruction.

15. The computed tomography system of claim **14**, wherein the fourth algorithm is further operable for, if the *second* maximum Z location error exceeds the threshold value or the *second* weighted average Z location error exceeds the threshold value, prescribing an N−1 sector reconstruction.

16. The computed tomography system of claim **13**, wherein the computed tomography system is used to perform cardiac imaging.

17. An imaging system, comprising:

an imaging scanner;

a first algorithm operable for determining a maximum Z location error associated with the imaging system;

a second algorithm operable for determining a weighted average Z location error associated with the imaging system;

a third algorithm operable for selecting a threshold value associated with the maximum Z location error and the weighted average Z location error;

means for prescribing an N+1 sector reconstruction algorithm;

a fourth algorithm operable for, if the maximum Z location error is less than the threshold value or the weighted average Z location error is less than the threshold value, performing an N+1 sector reconstruction; and

wherein the fourth algorithm is further operable for, if the maximum Z location error exceeds the threshold value or the weighted average Z location error exceeds the threshold value, prescribing an N sector reconstruction.

18. The imaging system of claim **17**, wherein the fourth algorithm is further operable for, if **[**the**]** *a second* maximum Z location error is less than the threshold value or **[**the**]** *a second* weighted average Z location error is less than the threshold value, performing an N sector reconstruction.

19. The imaging system of claim **18**, wherein the fourth algorithm is further operable for, if the *second* maximum Z location error exceeds the threshold value or the *second* weighted average Z location error exceeds the threshold value, prescribing an N−1 sector reconstruction.

20. The imaging system of claim **17**, wherein the imaging system is used to perform cardiac imaging.

21. The computed tomography method of claim 1 wherein:

determining the maximum Z location error further comprises determining a first maximum Z location error and a second maximum Z location error; and

determining the weighted average Z location error further comprises determining a first weighted average Z location error and a second weighted average Z location error.

22. The computed tomography method of claim 5 wherein:

determining the maximum Z location error further comprises determining a first maximum Z location error and a second maximum Z location error; and

determining the weighted average Z location error further comprises determining a first weighted average Z location error and a second weighted average Z location error.

23. The imaging method of claim 9 wherein:

determining the maximum Z location error further comprises determining a first maximum Z location error and a second maximum Z location error; and

determining the weighted average Z location error further comprises determining a first weighted average Z location error and a second weighted average Z location error.

24. The computed tomography system of claim 13 wherein:

the first algorithm is further operable for determining a first maximum Z location error and a second maximum Z location error; and

the second algorithm is further operable for determining a first weighted average Z location error and a second weighted average Z location error.

25. The imaging system of claim 17 wherein:

the first algorithm is further operable for determining a first maximum Z location error and a second maximum Z location error; and

the second algorithm is further operable for determining a first weighted average Z location error and a second weighted average Z location error.

26. An imaging apparatus comprising:

an imager; and

a computer programmed to:

acquire scan data;

select a predetermined number of sectors corresponding to the scan data;

determine a multiple-sector Z location error corresponding to the predetermined number of sectors for a desired Z location;

select a Z location error threshold;

reconstruct an image from less than the predetermined number of sectors if the multiple-sector Z location error is above the Z location error threshold; otherwise

reconstruct an image from the predetermined number of sectors.

27. The imaging apparatus of claim 26 wherein the computer is further programmed to:

determine a Z location for each of the predetermined number of sectors;

determine a detector coverage associated with the imager;

calculate an upper limit and a lower limit of the detector coverage for each of the predetermined number of sectors; and

determine a single-sector Z location error for each of the predetermined number of sectors based on the respective Z location, the upper limit, and the lower limit of each sector.

28. The imaging apparatus of claim 27 wherein the computer is further programmed to:

set the single-sector Z location error for each sector equal to the lower limit minus the Z location, if the respective single-sector Z location is less than the lower limit;

set the single-sector Z location error for each sector equal to the upper limit minus the Z location, if the respective single-sector Z location is greater than the upper limit; otherwise

set the single-sector Z location equal to zero.

29. The imaging apparatus of claim 27 wherein the computer is further programmed to:

identify an upper-most Z location error sector of the predetermined number of sectors based on the single-sector Z location error of each sector;

identify a lower-most Z location error sector from the predetermined number of sectors based on the single-sector Z location error of each sector; and

determine the multi-sector Z location error by calculating a maximum Z location error based on the upper-most Z location error sector and the lower-most Z location error sector.

30. The imaging apparatus of claim 29 wherein the computer is further programmed to calculate the maximum Z location error in accordance with:

maximum_error_spread=maximum_error−minimum_error

where:

maximum_error represents the single-sector Z location error corresponding to the upper-most Z location error sector and minimum_error represents the single-sector Z location error corresponding to the lower-most Z location error sector.

31. The imaging apparatus of claim 29 wherein the computer is further programmed to determine the multiple-sector Z location error by calculating a weighted average Z location error based on the upper-most Z location error sector and the lower-most Z location error sector.

32. The imaging apparatus of claim 31 wherein the computer is further programmed to calculate the weighted average Z location error in accordance with:

WE=total error over all sectors/total view over all sectors

where:

WE represents the weighted average Z location error and total error over all sectors represents a total Z location error over all sectors.

33. An imaging method comprising:

accessing a predetermined number of sectors to reconstruct;

receiving scan data associated with the predetermined number of sectors;

determining a Z location error threshold;

determining a plurality of Z locations for a desired Z location corresponding to the predetermined number of sectors;

calculating a first multi-sector Z location error based on the plurality of Z locations;

reconstructing less than the predetermined number of sectors to create an image if the first multi-sector Z location error is above the Z location error threshold; otherwise

reconstructing the predetermined number of sectors to create an image.

34. The method of claim 33 further comprising:

determining a plurality of detector coverage limits, each detector coverage limit corresponding to a respective one of the predetermined number of sectors;

determining a plurality of single-sector Z location errors based on the plurality of detector coverage limits; and

calculating the first multi-sector Z location error based on the plurality of single-sector Z location errors.

35. The method of claim 33 wherein reconstructing less than the predetermined number of sectors further comprises:

calculating a second multi-sector Z location error based on the plurality of Z locations; and

reconstructing a set of sectors having one less sector than the predetermined number of sectors if the second multi-sector Z location error is below the Z location error threshold.

36. The method of claim 33 wherein calculating the first multi-sector Z location error comprises calculating a maximum Z location error and a weighted average Z location error based on the plurality of Z locations.

37. The method of claim 33 wherein calculating the maximum Z location error comprises determining a maximum error between an upper most sector and a lower most sector of the predetermined number of sectors.

38. The method of claim 36 wherein calculating the weighted average Z location error comprises determining an average Z location error weighted by a total view of the predetermined number of sectors.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : RE 41,740 E
APPLICATION NO. : 11/706836
DATED : September 21, 2010
INVENTOR(S) : Okerlund et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Col. 4, line 16, delete “minimum error-max(*Zi*-” and substitute therefore
-- minimum error=max(*Zi*- --.

Col. 10, line 50 (Claim 37), delete “claim 33” and substitute therefore -- claim 36 --.

Signed and Sealed this

Thirtieth Day of November, 2010

David J. Kappos
Director of the United States Patent and Trademark Office