

Claims

1. A method of generating a three-dimensional representation of a region of interest on a target object, comprising the steps of:

5 a) identifying a fiducial marker of known geometry in a region of interest of the target object or on a moveable surface which is fixed relative to the region of interest;

b) creating a first image of the fiducial marker and first image of the region of interest by detecting radiation from a radiation source with a detector when the region of interest and fiducial marker are in a first position relative to the radiation source and the detector is in a first detector position relative to the radiation source;

10 c) moving the fiducial marker and region of interest relative to the radiation source to a second position relative to the radiation source and moving the detector to a second detector position relative to the radiation source;

15 d) creating a second image of the fiducial marker and a second image of the region of interest by detecting radiation from the radiation source with the detector when the region of interest and fiducial marker are in the second position relative to the radiation source and the detector is in the second detector position relative to the radiation source;

20 e) calculating an expected second image of the fiducial marker based on an intended spatial relationship between the radiation source, region of interest and fiducial marker and the detector in the second position, the geometry of the fiducial marker and the first position of the fiducial marker;

f) generating corrected second image data for the region of interest utilising a comparison of the second image of the fiducial marker with ~~information relating to an~~ the expected second image of the fiducial marker; and

25 fg) generating a three-dimensional representation of the region of interest utilising the first image, or a corrected first image data, and the corrected second image data for the region of interest.

2. A method according to claim 1, wherein the method comprises placing a fiducial marker on the region of interest or on the moveable surface.

3. A method according to claim 1, wherein the fiducial marker is within each image of the region of interest.

4. A method according to claim 1 or 2, wherein each image of the fiducial marker is separate from each image of the region of interest, and wherein the step of creating a first
5 image of the fiducial marker and a first image of the region of interest comprises holding the detector in a first detector position while moving the region of interest and fiducial marker sequentially to the first position.

5. A method according to claim 4, wherein the step of creating a second image of the fiducial marker and a second image of the region of interest is carried out after the step of
10 creating a first image of the fiducial marker and creating a first image the region of interest.

6. A method according to any preceding claim further comprising the steps of:

creating a third image of the fiducial marker and a third image of the region of interest by detecting radiation from the radiation source with the detector when the region of interest and fiducial marker are in a third position relative to the radiation source and the
15 detector is in a third detector position relative to the radiation source; and

generating corrected third image data for the region of interest utilising a comparison of the third image of the fiducial marker with information relating to an expected third image of the fiducial marker,

wherein the step of generating a three-dimensional representation of the region of
20 interest utilises the corrected third image data.

7. A method according to any preceding claim, wherein the fiducial marker comprises a plurality of fiducial marker elements.

8. A method according to any preceding claim wherein the expected second image of the fiducial marker is calculated based on an assumption that the fiducial marker, or each
25 fiducial marker element, has rotational symmetry.

9. A system for generating a three-dimensional representation of a region of interest on a target object comprising:

an x-ray source;

a support configured to support the target object and a fiducial marker of known geometry and a support transport mechanism configured to move the support;

an x-ray detector and detector transport mechanism configured to move the detector;

5 a motion controller connected to the support transport mechanism and the detector transport mechanism, the motion controller configured to supply command signals to the support transport mechanism to move the region of interest and fiducial marker from a first position to a second position and to supply command signals to the detector transport mechanism to move the detector from a first detector position to a second detector position
10 such that x-rays from the x-ray source are transmitted through the region of interest and the fiducial marker to the detector when the region of interest and fiducial marker are in the first position and the detector is in the first detector position to cause the detector to generate first position image information, and when the region of interest and fiducial marker are in the second position and the detector is in the second detector position to cause the
15 detector to generate second position image information;

an image processor coupled to the detector configured to receive the first position image information and the second position image information from the detector to generate a first image of the region of interest and a first image of the fiducial marker using the first position image information, and to generate a second image of the region of interest and a
20 second image of the fiducial marker using the second position image information, wherein the image processor is configured to:

calculate an expected image of the fiducial marker in the second position based on an intended spatial relationship between the radiation source, region of interest and fiducial marker and the detector in the second position, the geometry of the fiducial marker and the
25 first position of the fiducial marker,

generate a corrected second image of the region of interest using a comparison of the expected image of the fiducial marker in the second position with the second image of the fiducial marker; and

30 generate a three-dimensional representation of the region of interest utilising the first image of the region of interest, or corrected image data for the first image of the region of interest, and the corrected second image of the region of interest.

10. A system according to claim 9, further comprising a visual display configured to display image data based on signals from the detector, and a user interface, wherein the user interface is configured to allow a user to select a fiducial marker from within an image on the display.

5 11. A system according to claim 9 or 10, wherein the detector transport mechanism comprises a pivotable, arcuate track to which the detector is coupled.

12. A system according to any one of claims 9 to 11, wherein the support transport mechanism is configured to allow the support to move independently in three orthogonal directions.

10 13. A computer readable storage medium for use with an x-ray imaging apparatus, the x-ray imaging apparatus comprising: an x-ray source; a support transport mechanism that moves a support for a region of interest and a fiducial marker of known geometry; an x-ray detector; detector transport mechanism configured to move the detector; and a motion
15 mechanism, the motion controller configured to supply command signals to the support transport mechanism to move the region of interest and fiducial marker from a first position to a second position and to supply command signals to the detector transport mechanism to move the detector from a first detector position to a second detector position such that x-rays from the x-ray source are transmitted through the region of interest and the fiducial
20 marker to the detector when the region of interest and fiducial marker are in the first position and the detector is in the first detector position, and when the region of interest and fiducial marker are in the second position and the detector is in the second detector position, the computer readable storage medium holding executable instructions that, when executed by a computer processor that is connected to the x-ray imaging apparatus, cause
25 the computer processor to:

request a user to select a region of interest and select a fiducial marker;

generate images of the region of interest and the fiducial marker in the first and second positions based on received image data,

30 generate an expected image of the fiducial marker in the second position based on an intended spatial relationship between the radiation source, region of interest and fiducial

marker and the detector in the second position, the geometry of the fiducial marker and the first position of the fiducial marker,

- 5 generate corrected image data for the region of interest in the second position using a comparison of the expected image of the fiducial marker in the second position with the image of the fiducial marker in the second position;

generate a three-dimensional representation of the region of interest utilising an image of the region of interest in the first position or corrected image data for the region of interest in the first position, and the corrected image data for the region of interest in the second position.

- 10 14. A computer readable storage medium according to claim 13, holding executable instructions that, when executed by a computer processor connected to the x-ray imaging apparatus, control operation of the motion controller.

- 15 15. A computer readable storage medium in accordance with claim 13 or 14 in combination with one or more fiducial markers suitable for placement on a electronic circuit board.