parameter value of a preset system according to the first evaluation result, and repeating the step of evaluating the imaging result according to a preset evaluation method, the method further includes: evaluating the imaging result according to the preset evaluation method to obtain a second evaluation result; completing the calibration of the scanning system in response to the second evaluation result meeting the preset condition; and adjusting, in response to the second evaluation result not meeting the preset condition, the geometric parameter value of the preset system according to a reference evaluation result, and repeating the step of evaluating the imaging result according to the preset evaluation method, wherein the reference evaluation result is characterized as a comparison value between the first evaluation result and the second evaluation result adjacent to the first evaluation result.

[0022] According to the embodiments of the present disclosure, after the step of performing X-ray scanning on the calibration phantom to obtain an imaging result of the calibration phantom, the method further includes: simulating a numerical model of the calibration phantom according to the geometric parameter value of the preset system to obtain a simulation result; comparing the simulation result with the imaging result to obtain a comparison data; completing the calibration of the scanning system in response to the comparison data meeting the preset condition; and adjusting, in response to the comparison data not meeting the preset condition, the geometric parameter value of the preset system according to the comparison data, and repeating the step of simulating the a numerical model of the calibration phantom according to the geometric parameter value of the preset system.

[0023] According to the embodiments of the present disclosure, a length direction of the calibration phantom is perpendicular to a scanning direction of the calibration phantom.

[0024] According to the embodiments of the present disclosure, the performing X-ray scanning on the calibration phantom includes: scanning the calibration phantom once in response to a size of the calibration phantom being close to a size of the scanning channel of the scanning system; and changing a position of the calibration phantom in the scanning channel and scanning the calibration phantom for a plurality of times in response to the size of the calibration phantom being smaller than the size of the scanning channel of the scanning system.

[0025] According to the embodiments of the present disclosure, the parameter includes:

wires may also be varied.

[0084] In order to obtain a better calibration effect, the calibration phantom in the CT scanning system should be a simple and easily distinguishable object so as to facilitate evaluating the reconstruction effect in the reconstructed image of the CT scanning system. Thus, effective projection information may be obtained from projection data of the calibration phantom as a "true value" of the target in the calibration process, so that a calibrated result may be as close to the "true value" as possible. In addition, the calibration phantom should cover an entire scanning region or a designated calibration region of the CT scanning system as much as possible, so that the effect of the reconstructed image within the region after calibration may reach an overall optimization, and a significant image quality degradation of the reconstructed image in some certain regions may be avoided.

[0085] As shown in FIG. 7 and FIG. 8, a multi-view scanning imaging manner may be implemented for the calibration phantom, that is, a fabricated calibration phantom instead of the inspected object 5 is placed on the conveyor 4 (such as a conveyor belt) moving in the scanning channel 6 of the CT scanning system, so that the calibration phantom moves in the scanning channel 6 with the conveyor 4, and the X-ray source 1 may generate X-ray beams under the control of the controller to achieve the scanning projection imaging under multiple imaging viewing angles. If an overall size of the calibration phantom is small, the calibration phantom may be placed in different positions and different postures in the scanning channel 6, so that a distribution range of the calibration wires 102 covers a main imaging region or the entire scanning channel. From a perspective of parameter optimization, the more scanning projection data of the calibration wire 102, the larger the distribution range in the scanning channel 6, and the more uniform the distribution interval, the greater a tolerance of the calibration method to data error, and geometric parameters obtained after calibrating the corresponding projection data are also closer to true parameter values, and the effect of the reconstructed three-dimensional image is better.

[0086] In order to describe the scanning process of the scanning system in more detail, the scanning process is described below with reference to FIGS. 9-11.

[0087] FIG. 9 schematically shows a flow chart of a calibration method according to the embodiments of the present disclosure.

[0101] Step S260: step S230 is repeated to obtain a second evaluation result.

[0102] Step S270: the calibration of the scanning system is completed in response to the second evaluation result meeting the preset condition.

[0103] Step S280: the geometric parameter value of the preset system is adjusted according to a reference evaluation result in response to the second evaluation result not meeting the preset condition, and the method is returned to step S230.

[0104] The reference evaluation result is characterized as a comparison value between the first evaluation result and the second evaluation result adjacent to the first evaluation result. Thus, the reference evaluation result is generally a comparison value between evaluation results obtained from two adjacent cycles, such as a comparison value between the second evaluation result and the third evaluation result, a comparison value between the third evaluation result and the fourth evaluation result or the like.

[0105] FIG. 11 schematically shows a flowchart of a calibration method according to the embodiments of the present disclosure.

[0106] As shown in FIG. 11, another embodiment of the present disclosure further discloses a calibration method, including the following steps S310 to S360.

[0107] Step S310: the calibration phantom described above is placed in a scanning channel of a scanning system.

[0108] Step S320: X-ray scanning is performed on the calibration phantom to obtain an imaging result of the calibration phantom, wherein the imaging result may be selected from scanning data, a DR image, a slice image or a three-dimensional reconstruction image.

[0109] Step S330: a numerical model of the calibration phantom is simulated according to a geometric parameter value of a preset system to obtain a simulation result, wherein the simulation result may be selected from a projection domain simulation result, a projection domain parametric simulation result, an image domain simulation result, and an image domain parametric simulation result.

[0110] Specifically, the geometric parameter value of the preset system may be a geometric parameter value of an existing system or a geometric parameter value of an adjusted system.

[0111] The simulation method may be selected from one or more of a pure parameter

Claims

1. A calibration assembly, comprising:

a base; and

a plurality of calibration wires dispersedly connected to the base, wherein an absorption capacity of the calibration wire for X rays is greater than an absorption capacity of the base for X rays.

2. The calibration assembly according to claim 1, further comprising two mounting portions arranged at two opposite ends of the base.

3. The calibration assembly according to claim 1, wherein a diameter of an externally tangent circle of a section of the calibration wire is 0.5 to 5 mm.

4. The calibration assembly according to claim 1, wherein the base forms as a flat plate shape, and the calibration wires are arranged on the base in a length direction.

5. The calibration assembly according to any one of claims 1 to 4, wherein at least one end of the calibration wire protrudes from a side of the base.

6. The calibration assembly according to any one of claims 1 to 4, wherein the base comprises two sub-bases arranged in parallel, and the calibration wire is connected between the two sub-bases.

7. A calibration phantom, comprising:

a supporting frame; and

at least one calibration assembly according to any one of claims 1 to 6, wherein the at least one calibration assembly is connected to an inside of the supporting frame, and an absorption capacity of the calibration wire for X rays is greater than an absorption capacity of the supporting frame for X rays.

8. The calibration phantom according to claim 7, wherein each calibration assembly is connected to the inside of the supporting frame through mounting portions

arranged at two ends of the calibration assembly.

9. The calibration phantom according to claim 7 or 8, wherein the supporting frame is set as a substantially hexahedral box; and

wherein at least one calibration assembly is arranged in a length direction of the supporting frame.

10. The calibration phantom according to claim 9, wherein projections of calibration wires of each calibration assembly in a height direction and/or a length direction of the supporting frame do not coincide with each other.

11. The calibration phantom according to claim 10, wherein projections of at least two calibration assemblies arranged in the length direction of the supporting frame in the length direction do not coincide with each other.

12. The calibration phantom according to claim 11, wherein projections of the at least two calibration assemblies arranged in the length direction of the supporting frame in the height direction do not coincide with each other.

13. The calibration phantom according to claim 10, wherein projections of at least two calibration assemblies in a transverse direction of the supporting frame intersect with each other, and projections of the at least two calibration assemblies in the length direction of the supporting frame do not coincide with each other.

14. A calibration method, comprising:

placing the calibration phantom according to any one of claims 7 to 13 in a scanning channel of a scanning system;

performing X-ray scanning on the calibration phantom to obtain an imaging result of the calibration phantom;

evaluating the imaging result according to a preset evaluation method to obtain a first evaluation result;

completing a calibration of the scanning system in response to the first evaluation result meeting a preset condition; and

adjusting, in response to the first evaluation result not meeting the preset condition, a geometric parameter value of a preset system according to the first evaluation result, and repeating the step of evaluating the imaging result according to a preset evaluation method.

15. The method according to claim 14, wherein after the step of adjusting, in response to the first evaluation result not meeting the preset condition, a geometric parameter value of a preset system according to the first evaluation result, and repeating the step of evaluating the imaging result according to a preset evaluation method, the method further comprises:

evaluating the imaging result according to the preset evaluation method to obtain a second evaluation result;

completing the calibration of the scanning system in response to the second evaluation result meeting the preset condition; and

adjusting, in response to the second evaluation result not meeting the preset condition, the geometric parameter value of the preset system according to a reference evaluation result, and repeating the step of evaluating the imaging result according to the preset evaluation method, wherein the reference evaluation result is characterized as a comparison value between the first evaluation result and the second evaluation result adjacent to the first evaluation result.

16. The method according to claim 14, wherein after the step of performing X-ray scanning on the calibration phantom to obtain an imaging result of the calibration phantom, the method further comprises:

simulating a numerical model of the calibration phantom according to the geometric parameter value of the preset system to obtain a simulation result;

comparing the simulation result with the imaging result to obtain a comparison data;

completing the calibration of the scanning system in response to the comparison data meeting the preset condition; and

adjusting, in response to the comparison data not meeting the preset condition, the geometric parameter value of the preset system according to the comparison data, and repeating the step of simulating a numerical model of the calibration phantom according to the

geometric parameter value of the preset system.

17. The method according to any one of claims 14 to 16, wherein a length direction of the calibration phantom is perpendicular to a scanning direction of the calibration phantom.

18. The method according to any one of claims 14 to 16, wherein the performing X-ray scanning on the calibration phantom comprises:

scanning the calibration phantom once in response to a size of the calibration phantom being close to a size of the scanning channel of the scanning system; and

changing a position of the calibration phantom in the scanning channel and scanning the calibration phantom for a plurality of times in response to the size of the calibration phantom being smaller than the size of the scanning channel of the scanning system.

19. The method according to any one of claims 14 to 16, wherein the parameter comprises: a relative position and a posture between a light source and a detector in the scanning system; and

wherein the imaging result comprises one or more of a scanning data, a DR image, a slice image and a three-dimensional reconstructed image.

20. The method according to claim 16, wherein the simulation method in the step of simulating the imaging result of the calibration phantom according to the geometric parameter value of the preset system comprises one or more of a pure parameter fitting method, a DR modeling projection simulation and a CT reconstructed projection simulation; and

wherein the simulation result comprises one or more of a projection domain simulation result, a projection domain parametric simulation result, an image domain simulation result and an image domain parametric simulation result.