Method for geometric calibration of cone-beam tomography equipment and equipment implementing that method

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Invention

The purpose of the present invention is to provide a **method for geometric calibration of a cone-beam tomography equipment, in particular CT or pinhole-SPECT, that derives the misalignment parameters from the scan data of a generic object**, thus without resorting to specific test-objects or dummies. The proposed method for geometric calibration does not require dedicated calibration sessions and can be implemented during **ordinary work sessions** (geometric calibration method integrated into the scanning process).

Tomography equipment (shown in Figure 1. (10)) comprises a detector (11), a focal point (12) from which a cone of radiation (13) departs and invests the detector (11), passing through a tomography object body (14) rotating about an axis (15).

With the equipment (10) whose geometric calibration is to be obtained, the following phases are performed: acquisition (21) of raw planar data (23); processing (22) of the raw planar data (23) to obtain processed planar data (24); analysis (25) of the processed planar data (24) according to geometric deviations that define the actual position of the detection plane with respect to the nominal position with respect to the focal point and the axis of rotation. This is followed by a reconstruction step (26), which produces a tomographic image (27) from the processed images (24), using the values of the misalignment parameters calculated in the previous step (25).

Unlike known techniques, the proposed invention allows therefore to **derive misalignment parameters from the scan data of a generic object**, without resorting to specific test-objects or dummies and during ordinary working sessions, thus allowing a geometric calibration integrated in the scanning process.

Drawings
& pictures

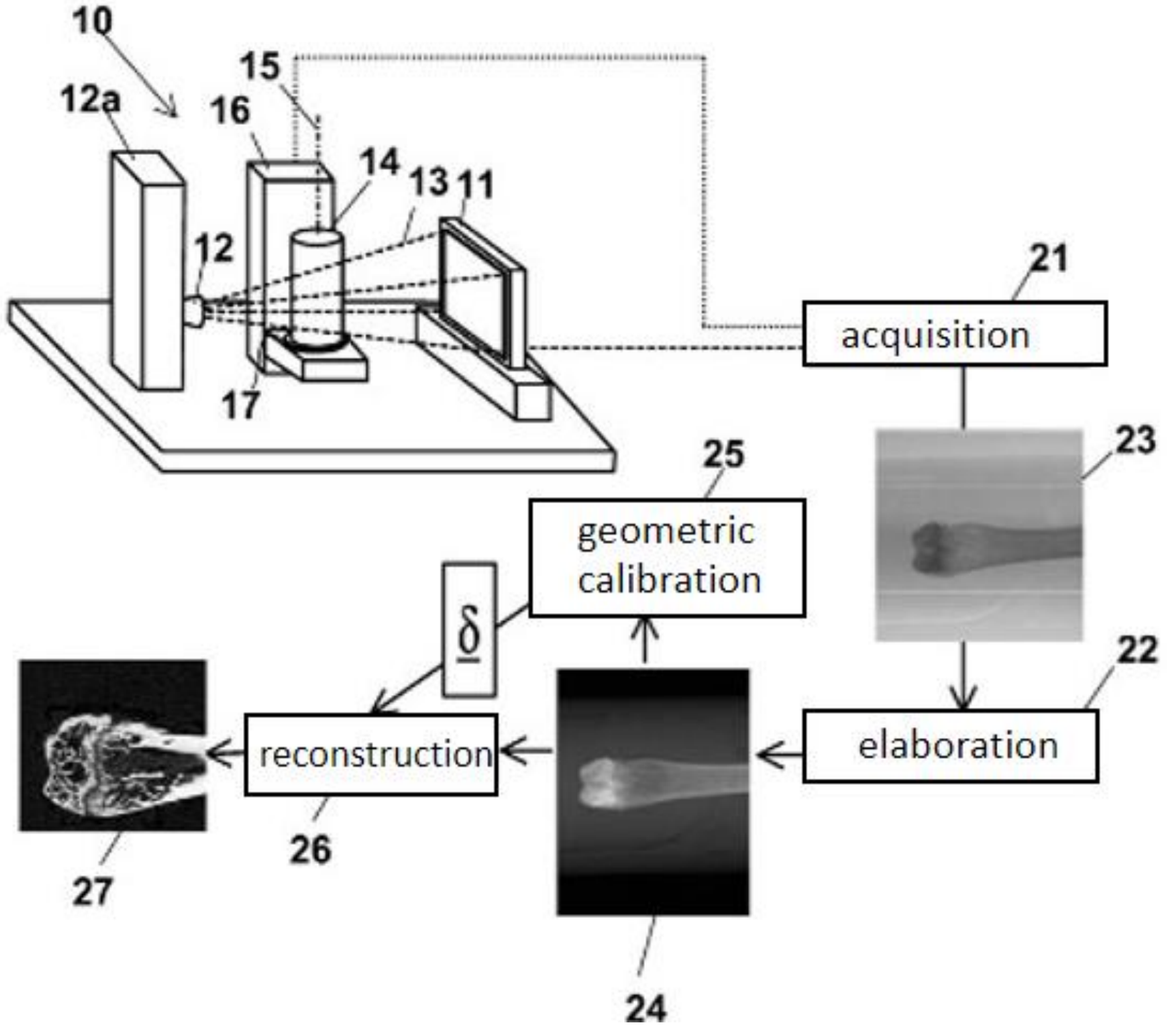

Figure 1. *The tomography apparatus (10) comprises a detector (11), a focal point (12) from which a cone of radiation (13) departs and invests the detector (11) passing through a tomography object body (14) rotatable about an axis (15).*
With the equipment (10) whose geometric calibration is to be obtained, the following phases are carried out: acquisition (21) of raw planar data (23); processing (22) of the raw planar data (23) to obtain processed planar data (24); analysis (25) of the processed planar data (24) as a function of geometric deviations that define the actual position of the detection plane with respect to the nominal position with respect to the focal point and the axis of rotation. This is followed by a reconstruction step (26), which produces a tomographic image (27) from the processed images (24), using the values of the misalignment parameters calculated in the previous step (25).

Industrial applications

The industrial applicability of the proposed technology certainly concerns the manufacturers of:

- biomedical equipment for **clinical and preclinical imaging**;
- equipment for **non-destructive investigations of materials and electronic and mechanical components**.
- equipment for **non-destructive investigations in the conservation of cultural heritage**.

All known methods of geometric calibration for cone-beam tomography equipment **require the use of dummies**, so they can o**nly be used in specific geometric calibration sessions, separate from the working sessions**, resulting in a reduction in the productivity of the equipment, i.e., the number of useful sessions it can perform in working time.

As a result of the progressive misalignment that occurs between one geometric calibration and the next, tomography is progressively less accurate, this loss of accuracy being greater the less frequent the calibration steps are. It should also be noted that the use of a geometric calibration session is required when a modification of the scanning geometry is made, for example, to increase magnification and/or change the size of the field of view.

Possible developments

Recently produced cone-beam tomography equipment can make use of detectors characterized by an increasingly higher spatial resolution, due to the evolution of the respective technologies. However, this can translate into a higher spatial resolution of the tomography only on condition that **adequately precise and accurate geometric calibration methods and means are available.** In particular, misalignments of the same order of magnitude of the sampling step or detector pixels unacceptably reduce the quality of the images obtained.

It is, therefore, an object of the present invention to provide a method for geometrically calibrating a cone-beam tomography apparatus that derives misalignment parameters from the scan data of a generic object, without therefore resorting to:

- specific test objects or mannequins.
- dedicated calibration sessions, but which can be implemented during ordinary working sessions (geometric calibration method integrated in the scanning process
- appreciable loss of tomographic image quality due to progressive misalignments (self-aligned geometric calibration method).

Future partnerships with **biomedical equipment manufacturers** and **Medical Centers** could increase the potential and applications of the technique.

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