A Method For Determining Characteristic Planes And Axes Of Bones And Other Body Parts, And Application To Registration Of Data Sets

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BRIEF DESCRIPTION

The invention is a method for deriving an anatomical coordinate system for a body part (especially bone) to aid in its characterization. The method relies on 3-D digital images of an anatomical object, such as CT- or MR-scans, to objectively, precisely, and reliably identify its geometry in a computationally efficient manner. The invention is a great improvement over the current practice of subjective, user-dependent manual data entry and visualization of bones and organs. The applications for well-defined anatomical coordinate systems include robotic surgeries, models for bone density studies, and construction of statistical anatomical data sets.

FULL DESCRIPTION

It is often necessary to reproducibly identify the geometry (axes and/or planes) characteristic of a body part so that medical procedures or diagnostics can be performed with high precision. In a specific example of a robotic surgery for knee replacement, the robot, while fixed relative to the knee and equipped with the knee's 3-D image from its position's perspective, would use the characteristic planes and axes defined in that image to very precisely make cuts and drill holes. In addition, the characteristic planes and axes can also be used for registration of data sets, which is needed when 3-D imaging, manual sectioning, or other methods of quantifying the 3-D geometry of a body part are performed, and one set of data needs to be related to or compared with one or more other sets; for example, when comparing the right proximal femur in two different patients.

UCI researchers have now developed a reliable method for determining characteristic planes and axes of bones and other anatomical objects from CT or MR scans, which can also be applied to registration of data sets. The process can be used to register a single structure in two different images, or to register two different structures in two different images, by simply aligning the obtained characteristic planes and axes for the desired structures. Once aligned, the images could be used to develop a statistical data base, perform robotic surgery, or evaluate changes in bone density and geometry.

The main advantage of the proposed method is that it overcomes the issue of extensive anatomical variability by appropriately weighting that variability according to the distribution of material within the structure, i.e. the geometry is determined from the entire volume of an object, rather than just the surface. This approach greatly improves reproducibility and precision of the method.

SUGGESTED USES

Robotic surgeries, evaluation of bone density (osteoporosis diagnostics), creation of statistical data bases for medical research, diagnostics, and treatments.

ADVANTAGES

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OTHER INFORMATION

KEYWORDS

Anatomical planes, Anatomical axes, Anatomical symmetry, Bone, Femur, Organ, Image registration, Registration of data sets, CT scan, MR scan, Voxel, Robotic surgery

CATEGORIZED AS

- **Biotechnology**
  - Health
- **Imaging**
  - 3D/Immersive
  - Medical
  - Software
- **Medical**
  - Diagnostics
  - Disease: Cancer

-Remarkable reproducibility for objects with shapes that can be described with anatomical axes and planes (e.g. proximal femur).

-Computational efficiency

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,245,069	01/26/2016	2011-878

STATE OF DEVELOPMENT

The invention has been demonstrated to work for the proximal femur. Can be adapted for uses for analogous applications.

» Disease: Musculoskeletal Disorders

» Disease: Women's Health

» Imaging

» Research Tools

» Screening

» Software

» **Research Tools**

» Other

RELATED CASES

2015-868-0, 2015-515-0, 2011-878-0

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