

NISTTech

DIMENSIONAL REFERENCE FOR TOMOGRAPHY

Inexpensive dimensional reference phantom for medical CT and MRI

Description

This invention is an inexpensive dimensional reference phantom for medical Computed Tomography (CT) and Magnetic Resonance Imaging (MRI). CT and MRI scans provide anatomical images of the body that can be used to measure a patient's response to cancer therapy by measuring changes in tumor size. The NIST phantom reduces measurement errors due to variations in the observation conditions.

For CT imaging, the NIST phantom consists of a set of 3 spheres for 2D (a 1D version requires 2 spheres; a 3D version requires 4 spheres) spaced by precise plastic spacers. The sizing reference phantom is placed adjacent to a patient during scanning. The Difference between the centroids of the spheres gives an accurate scale of length permitting a precise determination of tumor size.

For MRI, the NIST phantom serves as a dimensional reference using either "positive space" or "negative space." In either case, several spheres are spaced by known distances and the centroids of the spheres are found. The "positive space" implementation is a direct adaptation of the previous CT invention described above. For the "negative space" implementations, a structure with well-defined definitions is placed in a box of water. To enhance contrast, an appropriate contrast-enhancing agent such as the chelate diethylenetriaminepentaacetic acid (DTPA) with Gd³⁺ is added.

Images



Device used to correctly scale CT and MRI images

Applications

- **Cancer treatment**
Allows doctors to know the precise size of tumors
- **CT and MRI's**
Scales objects (tumors or growths) in 1D, 2D, and 3D CT and MRI images

Advantages

- **Reduced Errors**
Maintains an accurate size of a tumor even if the images are taken at different scales
- **Inexpensive**
Affordable and reusable
- **Simple**
Extremely simple to use, just place beside the patient during the scan
- **Compact**
The Phantom is roughly 3.5 cm long

Abstract

The invention is a system for obtaining a dimensional reference within a CT image. The system consists of a set of 3 spheres (for 2D; a 3D version would require 4 spheres) with a precise spacing. The material of the spheres is chosen to have x-ray absorption properties somewhat near bone. (In terms of Hounsfield units, about +500 HU to +1200 HU is useful; on this scale, bone is +1000 HU, water is 0 HU, and air is -1000 HU. Said otherwise, the attenuation

length of the material should be about 2/3 to 40% of water.) The spheres need to be precisely round on the scale of a CT pixel which is typically 0.33 mm. We have found reasonably priced commercial spheres with tolerances of 0.0254 mm.

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Citations

1. Z.H. Levine; S. Grantham, A.P. Reeves, D.S. Sawyer, D.F. Yankelevitz. A low-cost fiducial reference phantom for computed tomography. Journal of Research of the National Institute of Standards and Technology. Nov-Dec 2008.

References

- US Patent #7,967,507 issued 06/28/2011, expires 03/05/2029
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Status of Availability

active patent and available for licensing

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