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CALIBRATION OF A DEDICATED SOFTWARE FOR 3D RENDERING

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ABSTRACT

With the increasing use of 3D reconstruction techniques, to assist in diagnosis, dedicated programs are being widely used. For this they must be calibrated in order to encounter the values of the real volumes of the human tissues. The purpose of this work is to indicate correction and calibration values for true volumes, read in a 3D reconstruction system dedicated, using DICOM images of Computed Tomography. This work utilized a PMMA thorax phantom associated with the DICOM image and the volume found by a program of a tomograph. The physical volume of the PMMA phantom found was 10359.0 cm³. For the volumes found according to the structures of interest, the values are 11005.5 cm³, 10249.3 cm³ and 10205.1 cm³ and the correction values are -6.2%, +1.1% e +1.5% respectively for tissues: pulmonary, bony and soft tissues. The procedure performed can be used for calibration in other 3D reconstruction programs, observing the necessary corrections and the methodology used.

1. INTRODUCTION

With the increase of computational tools for 3D reconstruction in order to assist in the diagnosis or even improve the planning of therapies, some computer programs were developed based on the images generated in computed tomography (CT). In this way, it became necessary to the knowledge of these tools and how they represent in accuracy in view, measurement and produce more realistic information possible.

For precise measurements in changes in the size and development of the craniofacial tissues, bone tissues and tegumentary tissues, computed tomography images and their respective generations of 3D reconstruction, require that the computer systems are calibrated [1].

Experimental and computational processes are widely used for this purpose; to this end the computer programs have become important for the impossibility of planning measures and improvement in those situations where no measures may be used "in-vivo" of patients, nor surgical procedures of recognition [1, 2]. Validation of different programs for specific conditions of exposure of patients is crucial to the reliability of your use as well as the treatment [3]. In this way the verification of accuracy of the results, indicated by the programs, coming up with the need and ability to provide their data in order to use them for medical applications and development of research in this area [4, 5]. When using the reconstruction program, to meet tissue volumes, are needed these fixes checks results, thus ensuring a better accuracy on the information.

One of the alternatives of validation of the reconstruction programs and read volumes of tissues is the realization of comparison with known test objects such as the head, abdomen and phantom chest whose material is the polymethylmethacrylate (PMMA) that are used to determine the Dose index for Computed Tomography examinations (CDTI) [6, 7] or the Catphan® [8] that contain Teflon, PMMA, low density polyethylene (LDPE) and air.

This work combines the calibration of imaging systems to use these mechanisms in diagnostic radiology. The radiologist can apply the fixes needed to determine the dimensions of human structures, which are fundamental to evaluate the type of tissue investigated.

Based on these scopes, and formulations of investigations, this work aims to generate values of volumes of a PMMA phantom scanned by a multislice tomograph. The objective is to also carry out the reconstruction that phantom in a program dedicated to meet your volume, indicating correction values of measures between a phantom PMMA and a program dedicated to 3D reconstruction.

2. MATERIALS AND METHODS

For the development of this work was used a chest phantom of PMMA, Ø = 32 cm and 13 cm length with five holes of Ø = 1.3 cm, including 5 billets of the same material (Fig. 1) to acquire axial slices and produce DICOM images of your volume in a Tomograph Aquilion 64 rows of the Toshiba®. The fixed protocol used was 120 kVp, rotation of the tube of 0.5 second, speed of displacement of the table *versus* the tube rotation (spiral pitch) of 0.828 and 500 mA current.

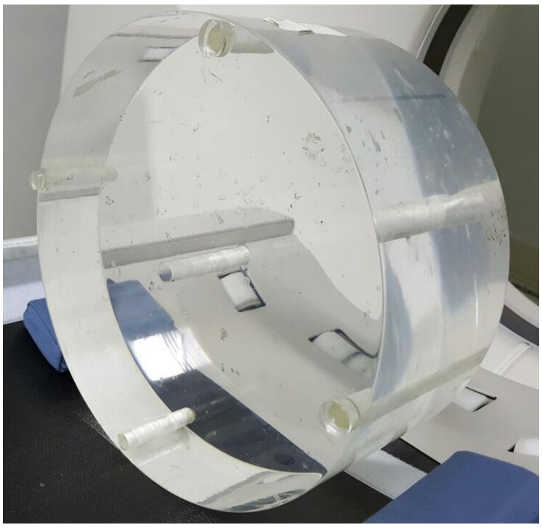

Figure 1: Phantom of PMMA.

These cuts were used to build the OSIRIX [9], v.5.7 32-bit, the volumes of phantom, associated with each structure of interest (windows): lung, bone and soft tissue.

To determine the physical volume phantom of PMMA and research options of calibration, correction values were generated images from Phantom with billets according to Eq. 1 as follows:

$$V_{phantom} = (\pi r^2 \times h)_{total} \tag{1}$$

where $V_{phantom}$ is the total volume phantom with the volumes of the five holes and h is the length of the phantom.

OSIRIX is a visualization and image navigation software designed for displaying and analyzing medical images. The program is specifically designed to handle multimodal imaging data, combining anatomical, metabolic, and showing dynamic images such as cardiac movements or functional metabolic studies. Designed by a team of radiologists provides an intuitive and easy-to-use user interface, tailored for those unfamiliar with complex image manipulation and processing techniques. The OSIRIX software package runs as a standalone application and works with your own image database automatically updated when new images are downloaded from the Picture Archiving and Communication System (PACS) using a DICOM interface or can be copied manually from offline media or from other network sources. The visualization software provides all the basic functions of image manipulation like: zoom, pan, intensity adjustment, filtering, multiplanar reformatting, slice thickness adjustment, volume rendering. The software is particularly suitable for large hospitals and academic environments where clinical conferences, interdisciplinary discussions and successive imaging sessions are often part of the complex workflow or patient management and decision making. OsiriX software is distributed free of charge as an open source software under the free software GNU licensing scheme [10].

3. RESULTS AND DISCUSSIONS

The physical volume phantom is PMMA 10359.0 cm^3 (with billets) and the volumes generated by the program OSIRIX are: 11005.5 cm^3 (with billets), 10249.3 cm^3 (with billets), 10205.1 cm^3 (with billets) respectively for the windows of the tissues: lung, bone and soft tissue. With this, the values of corrections applied to OSIRIX software are -6.2% +1.1% and +1.5%, respectively to the tissues: lung, bone and soft tissue.

4. CONCLUSIONS

For determination of volumes of the pulmonary tissue, bone and soft, rebuilt in OSIRIX program, one realizes that there are differences in relation to the determined by phantom of PMMA, with always values below the phantom, indicating that the method employed is confident taking into consideration the values of corrections. The values of corrections should be taken into consideration by the radiologist to determine, for example, a volume of a human body.

According to this research should be inserted the corrections values when used volumetric reconstruction in computer program OSIRIX and mainly in the management program of Toshiba® tomograph.

This method of comparison and calibration for 3D reconstruction system, sizing of tissue volumes, can be adopted in other CT machines with dedicated programs, both to assist in diagnoses as to produce better precision system of measures.

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