Cedric Kalies: Designation of body regions for paediatric CT examinations using ImageJ

Abstract

For the purpose of exact organ dose dosimetry, this work describes an automatic approach for the assignation of body regions in CT examinations of paediatric patients.

Several approaches have been tested. This work describes a method that rely on the ratios of areas have to each other. A lung for example has a higher ratio of air area to body area as a human head. After figuring out the ratios for each body region (head, brain, face, neck, lung, abdomen, pelvis and limbs), we assigned other images to our pre-defined body regions based on their ratios. The software reports as well if the automatic approach has failed.

First, the image is segmented in body area, air within the body area and bone area. For this task, we rely on the Hounsfield Units (HU) of the image. These values tell the level of attenuation of the X-rays, when penetrating the body. Air (-1000 HU) for example has almost no significant attenuation to the X-rays beam, but bones (500 – 1500 HU) instead have a much higher one. A window of suitable HUs for each type of material of the human body was defined (body, bone and air). These windows have then threshold to different Regions of Interest (ROI).

It is possible that other parts of the image which are not belonging the body (the table, etc.) also gets segmented. To avoid this, we used a set of individual median and blur filters to de-scope those areas. Furthermore we defined the largest region of body as the main region and removed all ROIs which are beside this region, because they cannot belong to the body. The ROIs were coloured, named and stored back on the DICOM image. After repeating this procedure for body, bone and air rules, they have been applied to define the exact body location of this slice within a reference patient in the corresponding age group.

To validate the developed approach and the associated rules, we used a set of 253 examinations. A radiologist has mapped these series to the reference patient, our “gold standard”. We now compared our calculated start and end values with this gold standard.

We consider a variance of +/- 3 cm to the gold standard as expectable. Results which are ‘partly matched’ have only the start or end value in the correct area. Results which are 'no match' are not within the 3 cm limit. We also detect but do not map limbs because there are no have an important organ dose.

The current result with 253 examinations (300 series) is the following:

full match: 200 series (66.67%), no result possible: 54 (18%), partly match: 13 (4.33%) limbs detected: 14 (4.67%), no match: 19 (6.33%).

We are convinced that the about 75% success rate can still be improved.

Keywords

organ dose, body region, Hounsfield, CT, dosimeter

Administrative data

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