ABSTRACT

Automatic measurement of CT number linearity was developed using the GE QA CT phantom and the AAPM CT Performance Phantom Model 610. This study aimed to develop an automated system for CT number linearity assessment, compare and validate the automated measurements against manual measurements, and investigate the effect of tube voltage variations on CT number and image noise for each phantom material. The study utilized images from the CT number linearity module of both phantoms acquired at tube voltages of 80, 100, 120, and 140 kVp, while maintaining a constant tube current of 160 mA. Automated measurements were performed using MATLAB R2013a. Segmentation was first applied to the CT number linearity module images to determine the centroid of each phantom. Subsequently, one reference object within the module was segmented to identify its centroid. Using the centroids of the phantom and the reference object, rotational and translational transformations were performed to determine the locations of the remaining measurement objects through a template-matching approach. The GE QA CT phantom consisted of acrylic, water, and air inserts, whereas the AAPM CT Performance Phantom Model 610 contained acrylic, water, air, polyethylene, polystyrene, nylon, and polycarbonate inserts. A region of interest (ROI) was automatically placed on each insert identified through template matching to obtain CT number and noise measurements. Manual measurements were performed using MicroDicom Viewer to validate the automated method. Statistical analysis using a paired sample t-test was conducted to evaluate the differences between manual and automated measurements. The results demonstrated that there were no statistically significant differences between the automated and manual methods for both the GE QA CT phantom and the AAPM CT Performance Phantom Model 610 (p-value > 0.05). The relationship between material density and CT number exhibited excellent linearity, with R-square values approaching unity, thereby satisfying the acceptance criteria for CT number linearity testing. Furthermore, variations in tube voltage influenced the increase in CT number values for higher-density materials, such as acrylic, polyethylene, polystyrene, polycarbonate, and nylon. In contrast, lower-density materials, such as water and air, exhibited relatively stable CT number values despite changes in tube voltage.

***Kata Kunci** : segmentation, template matching, CT number, p-value, R-square*