Objective performance evaluation methods adapted to helical and multislice CT scanners

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Since its introduction in the early 1970's, Computed Tomography (CT) has evolved into an important imaging tool for a continually increasing variety of clinical applications. This growth is due to dramatic improvements in image quality and acquisition speed over the last sixteen years. These improvements have come from important technical developments that include sub-second gantry rotation times, helical scanning, multislice acquisition, and tube current modulation.

The procedures for performing CT scanner evaluations have been in existence since the 1970's, but most are based on single-slice, axial scan geometry. These procedures are not adequate for the evaluation of modern, helical multislice scanners that use fundamentally different acquisition geometries, have many types of acquisition modes available, and are capable of generating huge numbers of images in a short period of time. Properly evaluating the image quality of these scanners is usually too difficult and time-consuming using the more traditional test methods. Computer analysis methods are needed to analyze the large number of images generated during a CT scanner evaluation. Subjecting these images to objective image evaluation methods will provide a much more thorough evaluation of image quality compared to subjective methods, and can do so in a shorter amount of time.

This dissertation describes the development of objective analysis methods and improved phantom designs that more accurately and efficiently evaluate the image quality in helical multislice CT scanners. The new tools are appropriate for routine quality assurance, for acceptance testing of new equipment, and for optimizing techniques for novel clinical applications. Furthermore, using these methods we have found deficiencies and errors in the design of specific CT scanner models and also significant problems in the performance of individual scanner.