

Computed Tomography (CT) is entering its fifth decade as a clinical modality, however the methods by which medical physicists assess image quality on CT images remain identical to those established in the first decade of CT. Prior to the Digital Imaging Communication in Medicine (DICOM) standard and the widespread use of Picture Archiving and Communication Systems (PACS), subjective visual evaluation was necessary for image quality assessment because the only output of the CT system was a film image. Current access to digital CT images suggests that more quantitative metrics can be used. CT dosimetry methods have been static over several decades as well. The increased clinical utilization of CT, combined with improvements in modern dosimetry hardware and increased sophistication in scanner acquisition modes provides motivation for a renewed approach to CT dosimetry, as well. A number of AAPM Task Groups (TG) have focused on the development of new methods for CT dosimetry (e.g. TG111, TG200, TG204). In addition, the International Commission on Radiological Units and Measurement (ICRU) will be publishing new recommendations for both dosimetry and quantitative assessment of image quality in CT next year. In this presentation, a number of new techniques for both image quality assessment and estimation of radiation dose in CT will be discussed.

Image Quality: The Modulation Transfer Function (MTF) in both the x-y and z dimensions is recommended for the assessment of spatial resolution, consistent with modern image science practice. The three dimensional Noise Power Spectrum (NPS) is recommended for the assessment of image noise. For this assessment, a cylindrical polyethylene phantom is scanned and the dose to the center of the phantom is adjusted to a standard level (10 mGy), and the NPS is then computed from homogeneous regions of the phantom at this standard dose setting. These methods will allow medical physicists to make quantitative image quality comparisons between CT scanner types and models, and also optimize CT protocols for a number of imaging procedures. The use of mathematically-rigorous quantitative techniques will reduce the subjectivity associated with visual assessment methods and thus allow higher precision in image quality measurement.

CT dosimetry: TG111 updated the traditional $CTDI_{vol}$ approach to include the dose consequences of scans longer than 100 mm in length. Pending ICRU recommendations include the TG111 measurement geometry but include a real time probe which results in substantially fewer measurements and a more complete assessment. TG204 deals with conversion factors to adjust dose estimates for patients of different size.

Overall, the transition from historically qualitatively CT image assessment to quantitative metrics, grounded in state-of-the-art image science techniques, should enable more meaningful CT scanner comparisons at the local, regional, and international levels.

Educational Objectives:

1. Ongoing activities of the AAPM and ICRU related to CT
2. Anticipated new methods for assessing image quality in CT
3. Anticipated new techniques for estimating dose in CT