AbstractID: 6743 Title: Combining Measurement and Monte Carlo Methods for Dose Assessment in Flat-Detector CT

Purpose
Dose assessment in flat-detector CT (FD-CT) combining measurements and Monte Carlo (MC) simulations.

Material and Methods
FD-CT scanners provide large irradiation fields of typically 100 mm to 250 mm in the longitudinal direction. In consequence dose assessment according to the current definition of the CTDI would demand larger ionization chambers and phantoms which are not practical. We propose a method which includes a measurement in air or in a phantom with an integrating dosimeter to assess the dose at that point and to combine it with MC simulations to assess 3D dose distributions and integral dose for arbitrary objects and geometries.
For validation purposes measurements were performed on a C-arm system (Siemens Medical Solutions, Forchheim, Germany) equipped with a flat-detector of 40 x 30 cm². Dose was assessed for various tube voltages in cylindrical PMMA phantoms of 16 cm and 32 cm diameter with a varying z-extent from 15 to 60 cm. The MC results were compared to the values obtained with calibrated ionization chambers of 100 mm and 250 mm length and to TLD dose profiles along the complete z-extent of the phantoms. Additionally a comparison to measurements of dose distribution in an anthropomorphic phantom was performed.

Results
The MC simulation was in agreement with the reference TLD measurements to within better than 10%. Standard CTDI phantoms with a z-extent of 15 cm underestimate the dose at the center by up to 20% whereas a z-extent of 300 mm appears to be sufficient for FD-CT. The 100 mm chamber underestimates the measured CTDI value by over 40%. The MC tool can be used to calibrate the measurements with the ionization chamber of 100 mm.

Conclusion
The combination of measurement and validated MC tool appears to be a flexible solution to assess arbitrary dose characteristics.