Abstract ID: 17035 Title: Average cross sectional dose for a CT phantom through fourth order and implications for 180° + fan angle acquisition

Purpose:To determine spatial average dose over the central plane of a cylindrical phantom through the 4th order from three measurements and also to determine spatial average dose for an arbitrary angle of irradiation. This has general applicability but is especially important for those cone beam CT installations where the irradiation angle is restricted to less than a full rotation.

Methods:Assuming a uniform cylindrical cylinder and cylindrically symmetric conditions of irradiation, the dose distribution can be described using a radial function. Because of symmetry, the function must be even and thus when expanded as a polynomial can only have terms with even powers of the radial coordinate. Expanding to the fourth power and integrating leaves us with an expression for average dose which we have compared to our own measurements and Monte Carlo calculations.

Application to cone-beam CT presents a difficulty because oftentimes less than a full rotation is used during the irradiation process.

Results: The results show that there is often an improvement over the use of a second order function; however, the additional complexity requires dose measurements at three radii instead of two.

Though these results apply to all CT phantom measurements, sub full-rotation acquisitions common in cone beam CT violate the symmetry in the irradiation pattern. However, we are interested only in the average dose and not the details of the dose distribution throughout the cross sectional area. With this restriction, we provide a proof along with recommended methodology that allows for the determination of average dose even if it is not possible to perform a full gantry rotation.

Conclusions: The accuracy of phantom calculations has been extended to fourth order but at the expense of an additional measurement. The validity is extended to partial rotations.