AbstractID: 8312 Title: The use of dual-energy CT images for Monte Carlo treatment planning: material extraction and metal artifact reduction

Purpose: To investigate the feasibility of dual-energy CT-based material extraction (DECT) for Monte Carlo (MC) dose calculations, to evaluate metal streaking artifact reduction using DECT and to propose a novel scanning technique for motion artifacts reduction. **Method and Materials:** A phantom with 17 tissue equivalent materials was scanned at two tube voltages. The accuracy of mass density (ρ) extraction using DECT (ρ_{dual}) compared to the standard single-energy CT technique (ρ_{single}) and the accuracy of the effective atomic number (Z) extraction was evaluated. A comparison of ρ_{single} and ρ_{dual} for a canine subject was made. The DECT extraction was also used on a prostate phantom and a patient with brachytherapy seeds in order to evaluate metal streaking artifact reduction. Moreover, a novel scanning technique with a moving copper filter is proposed. An optimal filter thickness is found and a MC simulation of DECT is performed. **Results:** The mean error on the relative electron density (ρ_e) and Z extraction is 1.8% and 3.2%. The improvement in ρ_{dual} compared to the standard ρ_{single} is significant, especially in soft bone materials where the ρ assignment error decreases from 8-10% to less than 2% when the DECT technique is used. Similar conclusions are drawn from the canine study where the comparison showed large differences (up to 12%) in bone marrow. The metal streaking artifacts caused by the brachytherapy seeds in the prostate phantom and the patient were significantly reduced. A 2 mm copper filter thickness was found to be optimal for the novel scanning technique. MC simulations of a CT scanner confirmed that with this filtration materials can be extracted with an accuracy of 1.8% in ρ_e and 3.6% in Z. **Conclusion:** The dual-energy CT technique results in improved tissue extraction and reduced metal artifacts, and is therefore a useful tool for MC dose calculations.