AbstractID: 9675 Title: A General Three-Material Quantification Method using Dual-Energy CT Imaging

Purpose: To propose a general method to quantify the density, atomic number, and mass fraction of three materials using only two energies levels (kVp settings), and evaluate its performance with quantitative simulations. **Method and Materials:** It is well known that dual-energy CT can accurately quantify the density and atomic number for two materials in a two-material object. This is possible because the dual-energy CT technique provides two spectrally different measurements. For an object with three constituents, an additional measurement is required to solve the dual-energy equations that now have three unknown values. Under certain conditions, a third physical measurement is not needed to solve for the three unknowns. One such solution is to assume that each material has a constant volume when mixed together, which provides an additional equation regarding the mixture's density. However, the constant volume assumption is not always true. Here, we calculate the mixture's density based on the mass attenuation coefficient, which can be expressed using the effective atomic number and density of the mixture. Then, we use the calculated density of the mixture to solve for the mass fractions of the three materials. To evaluate this method, we made numerical simulations using different densities of hydroxyapatite (HA: $Ca_5(PO_4)_3OH$). The developed algorithm is applied to the images and the chemical elements Ca, P, and H_2O are quantified. **Results:** The numerical simulation results indicate that the proposed method can accurately calculate the effective atomic number, density, and mass fractions of the constituents of a mixture for up to three different materials. **Conclusion:** The proposed algorithm is a general material-decomposition method for dual-energy CT. The number of materials which can be quantified is up to three. **Conflict of Interest:** CHM and ANP: Research grants from Siemens Medical Solutions.