APPLICATION OF GENERIC DECT BASED ON COMPLETE CT-SETUP SIMULATIONS

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ABSTRACT

BACKGROUND

In a Computed Tomography (CT) image two materials with a different composition can have very similar gray values, making them practically indistinguishable. However, since the mass attenuation coefficient of a chemical element is uniquely dependent on the incident photon energy, scans performed at different energies can provide supplementary information to allow a distinction in such situation. Similarly, scanning energies can be carefully chosen to selectively visualize a specific material. This principle is applied in Dual Energy CT (DECT) and K-edge imaging.

METHOD

The use of polychromatic X-ray spectra in combination with energy-integrating detectors with an energy dependent efficiency, which is mostly the case in laboratory based CT scanners, greatly complicates the application of DECT methods. Moreover, due to beam hardening the spectrum will be significantly altered as the X-ray beam propagates through an object, and this is dependent on sample size, composition and shape. To optimize DECT for a wide variety of samples, simulations are required of the generated spectrum, the interaction in the sample and the detector efficiency.

RESULTS

A simulation program will be presented, which takes all these variables into account. The detected linear attenuation coefficient of the materials in a sample, which correlates with the gray value in the CT image, can be calculated using different scanning parameters such as tube voltage, beam filtration and detector type as input. The X-ray spectra and response characteristics of the detectors used in this program were obtained with Monte-Carlo simulations.
Furthermore, a practical application of K-edge imaging on a corrosion cast will be presented.

CONCLUSIONS

The presented program allows a complete CT-setup simulation, which is very useful to optimize imaging techniques, such as the application of DECT for a wide variety of samples.

Index Terms— *X-ray computed tomography; Modeling of image formation*