

## **Dual-energy X-ray CT with Fast-kVp Switch**

**Purpose:** Dual-energy (DE) CT has received much attention in recent years. There are various approaches to the data acquisition, differing in terms of the simultaneity, geometric alignment, data collection efficiency and completeness, and flexibility. We present a fast-kVp switching (FKS) method in combination with advanced image generation process, and demonstrate the efficacy of our approach with phantom and clinical results.

**Methods and Materials:** In FKS, the input to the x-ray tube is rapidly changed between two kVp-settings in adjacent views. To ensure the signal fidelity, x-ray generator was redesigned to minimize its input impedance, new scintillating material was developed to reduce the primary speed to a small fraction of a millisecond, and the data acquisition system was designed to sample up to 7Hz frequency. To take full advantage of the co-registered dual-energy projections, advanced algorithms were developed to enable projection-space pre-processing, calibration, reconstruction, and spectral image displays. These techniques allow the production of mono-energetic CT images, as well as different material decomposed images.

**Results:** Phantom experiments and computer simulations show that because of the near simultaneous data acquisition in terms of timing and orientation, mis-registration due to patient motion is kept to a minimized. FKS also allows the projection-space processing of the dual-energy signals and results in a significant improvement in terms of beam-hardening artifacts. Advanced algorithms allow superb noise suppression in the mono-energetic images as well as material-decomposed images. Clinical studies demonstrate the importance of beam-hardening reduction, metal artifact reduction, and the accuracy of material decomposition.

**Conclusion:** We present a fast-kVp switching approach to the dual-energy data acquisition and advanced algorithms to the dual-energy reconstruction. Phantom and clinical experiments have demonstrated that such approach provides superior image quality and clinical utility.