AbstractID: 13771 Title: Portable Dual-Energy Imaging with a Wireless DR Detector: Optimal Technique and Material Decomposition for High-Performance ICU Imaging

Purpose: Although bedside imaging is among the most common radiographic exams (e.g., line and catheter placement in the ICU), poor image quality often challenges even conspicuous tasks. We hypothesize that dual-energy (DE) imaging using a novel wireless detector (with form factor equivalent to a film cassette) improves the conspicuity of interventional devices through material decomposition. This work optimizes the system configuration, acquisition techniques, and decomposition techniques for this novel bedside imaging technology.

Method and Materials: A mobile x-ray system was integrated with a wireless DR detector (DRX-1) to permit DE image acquisition. Preliminary experimentation involved a benchtop and phantoms simulating bedside imaging. The contrast-to-noise ratio (CNR) was evaluated in DE images for common ICU imaging tasks. Measurements were performed as a function of antiscatter grid ratio (from gridless to 12:1), kVp pair (kVpLow = 40-90 kVp and kVpHigh = 90-140 kVp), and added filtration. Image quality was further improved by implementing linear and nonlinear noise-reduction algorithms. Expert radiologists assessed DR and DE imaging task performance in anthropomorphic phantoms implanted with interventional tools.

Results: DE imaging significantly boosted conspicuity of interventional devices in bedside imaging tasks. Antiscatter grids increased CNR by ~50% without dose increase. Optimal kVp pair was [50/90] kVp, with lower techniques distinct from previous studies attributed to high x-ray scatter in bedside configurations. Optimal filters were identified, with ~0.2 mm Ag or Sn found optimal for the fixed-filter scenario. Noise-reduction algorithms preserved CNR at reduced imaging dose and indicate distinct processing for soft-tissue and metal decomposition. Qualitative reader studies show a dramatic boost in conspicuity for DE imaging compared to DR.

Conclusion: Advances in portable DR enable superior bedside imaging through advanced DE imaging functionality. Optimization of DE imaging and decomposition techniques render interventional tools conspicuous compared to DR without increasing patient dose.

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