Performance Characteristics of the Scanning-Beam Digital X-ray (SBDX) Cardiac Imaging System

Michael Speidel

Under the supervision of Professor Michael Van Lysel
At the University of Wisconsin-Madison

December 21, 2003

The SBDX system is a low x-ray dose fluoroscopic system designed for cardiac angiographic applications. The x-ray source has an electron beam that is electromagnetically scanned across a large-area transmission target. A focused multi-hole collimator beyond the target restricts the generated x-rays to a pencil beam directed at a distant small-area detector array. Real-time hardware reconstructs the detector data using digital tomosynthesis. With this method of beam scanning, patient images with low detected scatter are generated at up to 30 frames/second. Through a combination of scatter reduction, high detection efficiency, and reverse geometry, SBDX promises to deliver a several-fold reduction in skin dose relative to a conventional II/TV system. However, due to inherent output limitations, achieving cine-quality images with SBDX is challenging.

This study describes a method for determining the SBDX performance and operating parameters required to achieve image quality comparable to an II/TV system. Measurements of SBDX performance characteristics, such as contrast, noise equivalent quanta (*NEQ*), and modulation transfer function (*MTF*), were made as a function of operating parameter, over a range of clinically relevant phantoms. The results were incorporated into signal-to-noise ratio (SNR) metrics to describe image quality. A preliminary comparison of SBDX and II/TV large-area SNR indicated that contrast and *NEQ* were sufficient for conventional fluoro-quality imaging, but improvements to the detector and source are necessary to achieve cine-quality. Potential design improvements to achieve this goal are discussed.