A Cone-Beam CT Scanner Based Upon a Flat-Panel Imager: Effects of Image Lag

Spatial and temporal imaging characteristics of an amorphous silicon flat-panel imager (FPI) were investigated in terms relevant to application of such devices in cone-beam computed tomography (CBCT) and other imaging modalities. Specifically, issues of image lag (including the magnitude, spatial uniformity, frequency characteristics, and dependence upon exposure and frame time) were investigated. First-frame lag was 2-10%, depending upon incident exposure and was spatially nonuniform to a slight degree; second, third, and fourth-frame lag were 1%, 0.5%, and 0.3%, respectively (at 25% sensor saturation). Image lag was also analyzed in terms of the temporal-frequency-dependent transfer function derived from the Fourier transform of the radiation response, allowing a quantitative description of system components contributing to lag. The contrast of objects as a function of time following an exposure (30 min or longer) was measured in order to examine long-term image persistence ("ghosts"); two techniques of reducing ghost images were tested. These results pose important considerations for application of FPIs in CBCT, since image lag can cause significant artifacts in tomographic reconstructions. The effects of image lag in CBCT were examined in volumetric reconstructions obtained with an FPI for various objects and readout conditions. Two lag artifacts were identified: a "comet" resulting from signal carryover between projections, and a "streak" resulting from signal buildup during the first few projections. Procedural and algorithmic methods of reducing the lag artifacts were examined. (Supported by U.S. Army PCRP-97020 and Elekta Oncology Systems)