AbstractID: 7562 Title: An Evaluation of Noise in Radiotracer Emission Imaging Using Flat-Panel Detectors

Purpose: Single Photon Emission Computed Tomography (SPECT) onboard radiation therapy machines could enable the use of functional and molecular imaging in guiding the therapy beam and in monitoring disease. Costs and spatial constraints of onboard SPECT might be minimized if SPECT could be accomplished using the same flat-panel detectors (FPDs) employed for onboard transmission imaging. This may require some re-engineering of FPDs, and it is therefore important to understand the emission imaging performance of present-day FPDs. Here we evaluate the electronic and offset-and-gain (OG) noise of current FPDs relative to the quantum noise characteristic of SPECT imaging.

Method and Materials: A standard SPECT collimator was placed over a FPD. A flat circular radiotracer phantom was constructed with an outer region of 18 μCi/ml and a smaller inner region of 53 μCi/ml. (Typical human dose is 1 μCi/ml.) The phantom was placed on the collimator/FPD. Large low-frequency variations in FPD response were removed by fitting each region (no activity, low activity, high activity) of the emission image with low-order polynomials. Noise (standard deviation) was computed within each region as a function of number of acquisition frames, enabling separate estimates of electronic, OG, and quantum noise.

Results: Electronic and quantum noise were comparable at 12 times the radiotracer doses typical of human SPECT imaging. For the particular OG correction considered, OG noise exceeded quantum noise after about 8 seconds (4 frames) of acquisition.

Conclusion: For the FPD considered, electronic noise is about an order of magnitude above the quantum noise that would arise from radiotracer concentrations typical of human imaging. OG noise is also significant. These conclusions should be considered in the context of other aspects of FPD design. For example, thicker scintillators could boost emission-imaging signal, thereby alleviating requirements on noise reduction.

Conflict of Interest (only if applicable):