

### Purpose:

To characterize the imaging performance of a pixelated gamma camera (Ergo, Digirad) for 99mTc-scintimammography.

### Methods:

The 31x40cm<sup>2</sup> Ergo detector consists of 6mm thick 3.31x3.24mm<sup>2</sup> CsI(Tl) crystals coupled to silicon photodiodes. The sensitivity and resolution was measured according to NEMA NU1-2007. Scintimammography performance was evaluated as hot tumor detection capabilities. We acquired images of different 99mTc-spheres (inner diameters 3.95, 4.95, 6.23, 7.86, 9.89, 12.43mm) suspended in a 6.6cm thick 500mL 99mTc-water bath. Images were acquired at tumor depths of 1.7 and 3.7mm with different sphere-to-background ratios (SBR: 5.0, 8.0, 10.1, 12.5, 18.8) for 10min acquisition using low-energy collimation (LEHR). Acquisitions for 10, 5, 2.5, 1.25min were performed at SBR=5 where the 99mTc-activity concentration (uCi/mL) in spheres/background was 34/6.8. The sphere-CNR was estimated as:

$$\text{Sphere-CNR} = (\text{SphereCounts\_Max} - \text{BackgroundCounts\_Mean}) / \text{BackgroundNoise}$$

BackgroundNoise was the average standard deviation of 10 different 9-pixel ROIs distributed across the image. BackgroundNoise was modeled as a power-law function of

BackgroundCounts\_Mean and used to predict the sphere-CNR at different activity levels and acquisition times. A preliminary visual assessment of sphere visibility was used to establish the threshold-CNR for detection.

### Results:

The sensitivity and resolution at 10cm using LEHR was measured to be 128cpm/uCi and 7.5mm. BackgroundNoise was found to vary as  $\text{BackgroundCounts\_Mean}^{-0.67}$  suggesting a Poisson noise dominated imaging system. Threshold-CNR of ~8 corresponded to visible spheres. For SBR=5, depth=3.7cm, acquisition=10min, the measured sphere-CNR for diameters 6.23, 7.86, 9.89, 12.43mm were 12.1, 15.9, 22.8, 33, respectively; that decreased to <3, 6.6, 10.1, 14.6 for acquisition=2.5min. The CNR predicted by the power-law model for BackgroundNoise was in good agreement (differences of 9-26%) with measured sphere-CNR at lower acquisition times.

### Conclusions:

The Ergo system is suitable for 99mTc-scintimammography with predictable performance at different imaging conditions. Small tumors (<1cm) could be visualized at a range of SBR under tested conditions.