FastSPECT III: A Dedicated Rodent-Brain SPECT Imager

We have completed system integration of a dedicated small-animal brain SPECT system for imaging of the amyloid β protein (Aβ) plaques characteristic of Alzheimer's disease (AD). The application of molecular imaging techniques, the combination of a targeted tracer with an imaging modality sensitive to signal from single molecules, should make it possible to detect very small plaques during the early stages of the disease and allow the monitoring of response to experimental therapies.

FastSPECT III represents the first stationary SPECT imager developed using high-resolution CCD-based gamma cameras called BazookaSPECT. Twenty BazookaSPECT detectors acquire projections of a spherical field of view with pinholes selected for desired resolution and sensitivity. Novel aperture and pinhole fabrication techniques were employed to produce custom imaging apertures With real-time processing capabilities of graphics processing units (GPUs) and multi-core processors, the twenty cameras acquire and process data at 200 frames per second; ~10^9 pixels per second are processed. The twenty cameras also provide a system space-bandwidth product ~2×10^6.

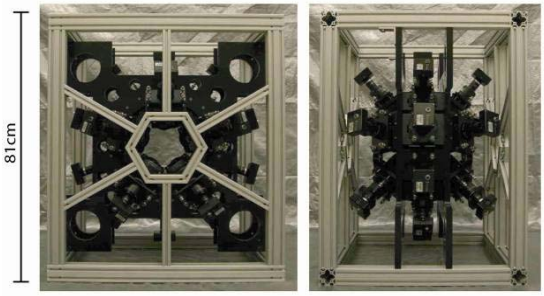

Figure 1. Front and side views of the FastSPECT III imaging system. A central ring of ten and two outer rings of five BazookaSPECT detectors focus at a common field of view.

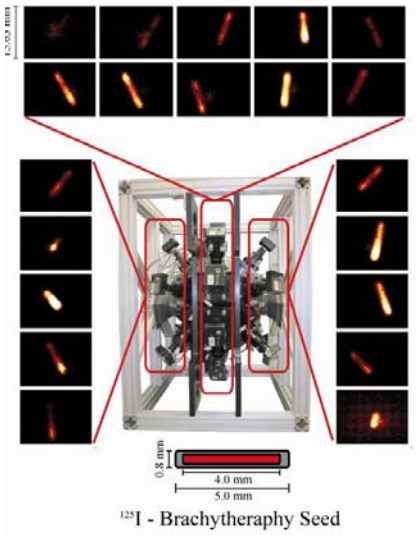

Figure 2. FastSPECT III preliminary projection images of a ^{125}I brachytherapy seed having an activity of 793 μCi. Acquisition time was 300 seconds and projection images were acquired using 0.5 mm diameter pinholes

Figure 3. FastSPECT III imaging aperture fabricated using 3D rapid-prototyping printers and casting techniques. Top: platinum pinhole inserts made by lostwax casting methods; Middle: (left) cold-cast tungsten composite aperture with pinhole inserts; (right) complete imaging aperture; Bottom: imaging aperture installed in FastSPECT III.

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