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Methods for Improved Tomographic Image Reconstruction

Researchers in the Molecular Imaging Instrumentation Laboratory at Stanford University have developed methods to improve the image quality of tomographic image reconstruction, including positron emission tomography (PET). The system combines the information from both coincidence photon pairs and single photons. It then employs a modified projector function to reconstruct the image. Because single photon events (which cannot be used by current PET systems) typically comprise >90% of events recorded in a PET system, this technique will increase the statistics of the data set to improve the quality of the image produced.

Stage of Research
The methods and software have been tested by Monte Carlo simulation and shown to improve the image signal-to-noise ratio ten-fold in the background and 20% or better in the target location with equal contrast and contrast recovery and no loss in spatial resolution.

Ongoing Research
The inventors are continuing to develop and build twoa PET systems fromso that the method may be tested with experimentalreal data.

Applications

- **Medical imaging:**
  - PET
    - Variety of clinical indications, including cancer staging and monitoring therapy
    - Combine measurements of PET insert systems that employ detectors of different sizes.
  - Small animal PET or SPECT systems.

    - Hand held molecular imaging systems
    - Simultaneous measurements of PET and SPECT (single photon emission computed tomography)
    - PET/CT systems

Advantages

- **High quality image** - increased statistics of the data set could improve:
    - signal-to-noise ratio
    - resolution
    - contrast and contrast recovery
    - quantification
    - and reduce scan time or injected dose to the patient
- **Cost effective** - could potentially reduce scan times, increasing patient throughput and decreasing the cost per scan.
- **Lower radioactive dosage or scan time** - a substantially higher count sensitivity PET instrument could potentially require lower radioactive dosage delivered to the patient per scan or, alternatively reduce the scan time for equivalent image count statistics.

Publications

- U.S. Issued Patent No. 7,968,850
- AMK Foudray, G Chinn, CS Levin "Incident Photon Direction Calculation Using Bayesian Estimation for High Energy Photon Detector," *Nuclear Science Symposium Conference Record*, 2006. IEEE, 2006.
- G Chinn, AMK Foudray, CS Levin, "A Method to Include Single Photon Events in Image Reconstruction for a 1 mm Resolution PET System," *Nuclear Science Symposium Conference Record*, 2006. IEEE, 2006.
- Chinn G, Levin CS. "A maximum NEC criterion for Compton collimation to accurately identify true coincidences in PET." IEEE Trans Med Imaging. 2011; 30 (7): 1341-52.

Patents

- Published Application: 20090072156

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