Hybrid Emission Tomography System and Methods

Tech ID: 33181 / UC Case 2023-926-0

BACKGROUND

Common nuclear imaging techniques include computed tomography (CT), single photon emission CT (SPECT), and positron emission tomography (PET). PET differs from other nuclear imaging techniques in that it can visualize both functional and biological activities, including detection of metabolism within human tissues. PET is especially good for imaging patients with cancer, or brain or heart conditions. At low energies, when positrons collide with electrons near the radionuclide decay, Gamma rays (annihilation photons) are created. Gammas originating from the same electron-positron annihilation are generated exclusively in an entangled Bell state. Gammas which do not share an annihilation origin event, such as randoms, are not entangled. Additionally, a gamma which undergoes an internal scatter becomes decoherent (unentangled) from its pair, such as the gammas found in the scattered coincidence pairs. Scattered and random events degrade the image quality. Recently, quantum-based techniques utilizing entanglement of annihilation photons has been recognized as one approach to address scatter and random and to optimize the signal to noise (SNR) ratio.

TECHNOLOGY DESCRIPTION

To help solve challenges with PET with a focus on positron range and sensitivity of detection, investigators at UC Santa Cruz (UCSC) have developed a new hybrid emission tomography approach that uniquely detects and analyzes annihilation photons and gamma rays. UCSC's customized cadmium zinc telluride (CZT) cross-strip detector and tailored quantum-entanglement analysis techniques removes scatter and random to increase SNR ratio. By simultaneously detecting 511 keV photon pairs originating at the site of positron-electron annihilation and singly-emitted high-energy gamma rays emitted directly from the radionuclide, UCSC research results have shown this to have a correcting influence in 3D reconstructions that consider the data jointly. Preliminary data suggests this approach may surpass the 1.2–1.5 mm spatial resolution limits inherent in radioisotope imaging based on detection of positron annihilation photons alone.

APPLICATIONS

- Medical imaging
- Surgical guidance
- Therapy guidance
- Research tooling

ADVANTAGES

INTELLECTUAL PROPERTY INFORMATION

Patent Pending

RELATED MATERIALS

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OTHER INFORMATION

CATEGORIZED AS

- **Imaging**
  - Medical
- **Medical**
  - Imaging
  - Research Tools
  - Software
- **Sensors & Instrumentation**
  - Medical
  - Position sensors

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