62 - Development of scintillation detectors based on avalanche microchannel photodiodes

Poster session : detection modules and electronics - Wednesday 10 May 2006 14:00

Presenter: Dr. STOYKOV, Alexey (Paul Scherrer Institut)

Avalanche Microchannel PhotoDiodes (AMPDs) are solid state photodetectors with high internal gain and density of independent channels up to 10^4/mm^2. They are potential substitutes for photomultiplier tubes in a wide variety of applications in nuclear physics and nuclear medicine. The use of AMPDs is most promising when fine segmentation of the detectors and their operation in high magnetic fields is required. Here we present our ongoing developments of AMPDs and scintillation detectors based on them focusing on position sensitive and fast timing detectors to be used in high magnetic fields and gamma detectors for positron emission tomography. The research work is supported in part by the INTAS grant 04-78-6839.

63 - Assessment of the impact of x-ray tube voltage on quantitative analysis of neurological PET when using CT-based attenuation correction

Poster session : Imaging systems, Molecular Imaging - Thursday 11 May 2006 14:00

Presenter: Dr. AY, mohammad reza (Department of Medical Physics, Tehran University of Medical Sciences, Tehran, Iran and Division of Nuclear Medicine, Geneva University Hospital, Geneva, Switzerland)

The advent of dual-modality PET/CT imaging had great impact on improving the value of diagnostic PET in localizing, evaluating and therapeutic monitoring of head and neck cancer and equally valuable for other localizations that are difficult to pinpoint. In addition, the use of CT images for CT-based attenuation correction (CTAC) of PET data decreases overall scanning time and creates a noise-free attenuation map (μmap). The most common CTAC procedure requires a bi-linear calibration curve acquired under standard imaging conditions to convert the patient's CT image from low effective CT energy into an attenuation map at 511 keV. Given that different tube voltages are used in current PET/CT scanning protocols depending on patients size and the region under study, this work was designed to provide answers to the legitimate question of the clinician or physicist: "what is the magnitude of error due to acquiring CT at e.g. 80 kVp when the calibration curve would be the manufacturer's standard of 120 or 140 kVp?" and vice versa, that is, acquiring CT images at specific tube voltages and varying the voltage for derivation of calibration curves. The impact of using a single calibration curve on the accuracy of CTAC for images acquired at different tube voltages was investigated through quantitative analysis of created μmaps, generated attenuation correction factors and reconstructed neurological PET emission data using experimental anthropomorphic phantom and clinical studies. For CT images acquired at 80 and 140 kVp, an average relative difference of -2.9% and 0.7% with the images acquired at 120 kVp, respectively, was observed between absolute activity concentrations in five regions of the anthropomorphic striatal phantom when CT images are converted using a single calibration curve derived at 120 kVp. Likewise, an average relative difference of 1.9% and -0.6% was observed when CT images are acquired at 120 kVp and CTAC uses calibration curves derived at 80 and 140 kVp, respectively. It was concluded that using a single calibration curve derived under standard scanning conditions during the CTAC procedure to images acquired at different tube voltages does not affect significantly the visual qualitative interpretation and quantitative analysis of neurological PET emission images. The same behaviour was observed when calibration curves are derived at different tube voltages and used for conversion of CT images acquired at fixed tube voltage. These results might contribute to alleviate the quality assurance procedures required for daily operation of PET/CT scanners in a clinical environment.

64 - Measured and Simulated Specifications of the Lausanne ClearPET Scanner Demonstrator

Poster Session :Simulation, Modeling, Reconstruction - Tuesday 09 May 2006 14:00

Presenter: REY, Martin (LPHE, EPFL)

Positron Emission Tomography (PET) applied to small animal imaging is a potentially important tool in developing new drugs and imaging gene expression. The Crystal Clear Collaboration (CCC) is developing a new family of small animal PET scanners called ClearPET, which are based on LSO/LuYAP Depth-Of-Interaction (DOI) sensitive detector modules. In parallel, GATE, a new Monte Carlo simulator based on Geant4 was developed to help in the design of the ClearPET prototypes. Measurements obtained with the partial ring Lausanne ClearPET scanner demonstrator are presented and compared against GATE simulations. For the present architecture, a maximum single event count rate of 1.34 Mcps is measured. This corresponds to a coincidence count rate of approximatively 31k cps. The random coincidences are estimated by delaying single events and the scattered ones by comparison with GATE simulations. Good agreements are observed between measured and simulated data. Count rate performance, including NEC curves, are determined and extrapolated for a full ring ClearPET design using GATE Monte Carlo simulations. A Mini-Derenzo phantom was also simulated with the aim to study the effect of depth-of-interaction (DOI) on image quality. Results are compared for different scanner designs corresponding to a full-ring ClearPET design with two crystal layers or only one crystal layer. As expected, image quality improves significantly with DOI both in terms of signal-to-noise ration and contrast.