SUVmax in 35 cases (42%). Relevant SUVmax increase tended to be most frequent in the basal lung (67%, $\chi 2$ p = 0.072). **Conclusion:** For the SUVmax of small pulmonary nodules, the effect of motion blur can be larger than the recovery effect. Therefore, correction of motion blur is mandatory for SUV quantification of SPNs. Combined motion blur plus recovery correction using an effective FWHM might be appropriate for this purpose.

## 124

### A Novel Energy Mapping Method for Attenuation Map Generation at 511 keV in Computed Tomography based Attenuation Correction

**M. Shirmohammad**[1], M. R. Ay[1], A. Rahmim[2], S. Sarkar[1], H. Zaidi[3]; [1]Department of Medical Physics and Biomedical Engineering, School of Medicine, Medical Sciences/ University of Tehran & Research Center for Science and Technology in Medicine, Medical Sciences/ University of Tehran, Tehran, IRAN, ISLAMIC REPUBLIC OF, [2]Department of Radiology, School of Medicine, Johns Hopkins University, Baltimore, MD, UNITED STATES, [3]Division of Nuclear Medicine, Geneva University Hospital, Geneva, SWITZERLAND.

Computed Tomography (CT) inherently provides a patient-specific measurement of the linear attenuation coefficient at each point in the image. However, the linear attenuation coefficient measured with CT is calculated at the x-ray effective energy rather than at 511 keV. It is therefore necessary to convert the linear attenuation coefficients obtained from the CT scan to those corresponding to 511 keV. Several energy mapping strategies have been developed where the bilinear method is the most commonly used on PET/CT scanners. In this study, we propose a new method based on using quadratic polynomial curve instead of simple bilinear calibration curve. Both quadratic polynomial and bilinear calibration curves were computed using CT images of a cylindrical polyethylene phantom containing 16 cylindrical holes filled with a mixed solution of $K_2HPO_4$ and water with different concentrations. The polynomial calibration curve was derived by fitting a function to sixteen points with 95% confidence bounds. The procedure for generation of attenuation map from CT images using both bilinear and polynomial method was implemented on several clinical studies and compared to the transmission (TX) image derived using Ga-68 radionuclide source acquired on the GE Discovery LS PET/CT scanner. The TX images were used as gold standard in this study. Quantitative analysis showed that the quadratic polynomial calibration curve method always produced μmaps closer to those derived using TX scanning. ROI analysis was performed in different locations of the resultant μmaps and revealed that for both soft tissues and bones, the linear attenuation coefficients obtained by the proposed calibration curve had a lower error compared to the conventional bilinear curve when comparing the results with the reference μmaps. For soft tissues, the relative error of the bilinear method varied from 3 to 12% whereas for it was reduced to 0.7-10% for quadratic polynomial calibration method. Similar results were obtained for bones, except that the relative errors were to some extent higher in comparison to soft tissues (5-30% and 0.7-27% for bilinear and quadratic polynomial curves, respectively). It can be concluded that the proposed quadratic polynomial calibration curve results in more accurate μmap with lower relative error in comparison with TX images. The algorithm is being refined and further validated on a larger PET/CT clinical database.

## 125

### Development of a small field of view gamma camera using a pixelated CdTe detector

**T. Ishitsu**[1], I. Takahashi[1], K. Tsuchiya[1], T. Kawaguchi[2], N. Yamada[2], K. Amemiya[1]; [1]Hitachi, Ltd., Central Research Laboratory, Hitachi-shi, JAPAN, [2]Hitachi, Ltd., Advanced Medical Support Services Division, Hitachi-shi, JAPAN.

[Aim] Semiconductor detector gamma cameras have better intrinsic spatial and higher energy resolutions than conventional gamma cameras. In addition they can be positioned close to objects because of the small dead space at the edge of the detector. These features provide a potential for higher lesion detection capability and earlier diagnosis for breast and other cancers. We have developed a mobile, small field of view CdTe gamma camera to image objects such as the breast including the SLNs (Sentinel Lymph Node), and we evaluated its basic performance. [Materials & Methods] The camera consists of a small field of view CdTe detector head (170 x 300 x 100 $mm^3$) with an articulating arm, an operation console and a monitor display on a mobile cart. The detector has 9216 pixelated CdTe elements (1.4 x 1.4 x 5 $mm^3$) and dedicated ASICs are used to read out the signal. It has a 134 x 134 $mm^2$ field of view, and the minimum dead space at the edge of the detector is 10 mm. The detector has a water cooling system with peltier modules, allowing the camera to be used in an operating room and also at room temperature. The camera is stable in time, and can be operated immediately after powering on. A matched collimator with 20 mm hole length is attached to the camera and it is exchangeable. Acquisition software is used to get real-time images, and simultaneously to save event list data for getting post processing images. The system resolution was measured with $^{99m}$Tc at several positions. The camera was also used to take some SLN images before and after surgery. [Result] The basic system properties of the developed camera were measured. The measured system resolutions were 6.4 mm (FWHM) at 10 cm from the surface of the collimator and 3.9 mm at 5 cm, and energy resolution was 6.1% at 140 keV ($^{99m}$Tc). The defective pixels were less than 0.1% of all available pixels. [Conclusion] A mobile, small field of view CdTe gamma camera was developed and its basic physical performance values were evaluated. The camera showed high intrinsic spatial and energy resolutions. It can be used at room temperature and positioned close to objects of interest, such as the breast, including the SLNs. The camera has a potential to image objects with a higher lesion detection capability than conventional gamma cameras.

## 126

### Strip Area Attenuation Compensation for Content Adaptive Singularity-Based Mesh-Domain SPECT Reconstruction

**L. Vogelsang**[1], X. Hu[2], Y. Lu[2], Y. Xu[2], H. Ye[3], D. Feiglin[4], A. Krol[4]; [1]Syracuse University, Dept. of Physics, Syracuse, NY, UNITED STATES, [2]Syracuse University, Dept. of Mathematics, Syracuse, NY, UNITED STATES, [3]Toshiba Research Center, Chicago, IL, UNITED STATES, [4]SUNY Upstate Medical University, Dept. of Radiology, Syracuse, NY, UNITED STATES.

**Aim:** To improve accuracy of attenuation compensation (AC) in mesh-domain expectation maximization (EM) reconstruction. **Materials and methods:** Mesh-domain reconstruction has significant advantages over voxel-domain reconstruction. However, it requires a new approach to AC, as compared to voxel-based reconstruction. Attenuation due to a given mesh element (ME) intersecting the tube-of-response (TOR) for a given detector bin is determined by an effective attenuation coefficient of this element and effective length of photon transit. We provide a new method for AC that more realistically estimates the number of photons removed by ME intersecting TOR . The effective length of photon transit through ME is found by an area preserving transformation of the intersected convex polygon into a rectangle. The effective length of this rectangle, equal to the area of the polygon divided by the TOR width, takes into account the varying distances that a flux of photons would encounter across the intersected ME. We assume that attenuation is piece-wise linear across the mesh-domain. In order to determine the effective attenuation coefficient for the intersected ME, first, linear interpolation of the coefficients at each of the non-intersected ME nodes is used to determine the coefficients at each of the four vertices of the intersected polygon. The effective coefficient is an average of the maximum and minimum values of the coefficients at the four vertices. In general, the sizes of ME are greater than voxels. In order to accurately determine the attenuation from an initial intersected ME, the element is sub-divided into smaller pieces and a geometric series expansion is computed across the sub-elements. **Results:** Comparisons were made between AC performed using the new method and exact analytical calculations. The relative error between the two methods was ~4%, as compared to ~10% relative error obtained using conventional line-element AC approach. **Conclusion:** The proposed approach is a very promising method for incorporating attenuation compensation into the system model for mesh-domain SPECT EM reconstruction.

505 - Sunday, October 12, 2008, 16:30 - 18:00, Hall 13a

## Oncology: Pancreas Adrenal

## 127

### Semi-automated distinction between forms of hyperinsulinism

**R. Maroy**[1], M. Ribeiro[1], P. Delonlay[2], F. Brunelle[2], C. Nihoul-Fekete[2], R. Trébossen[1]; [1]CEA, Orsay, FRANCE, [2]Hospital Necker-Enfants Malades, Paris, FRANCE.

**Objectives:** Congenital hyperinsulinism is the most common cause of hypoglycemia in early infancy. The disease has two forms: one diffuse that affects all of the pancreas and a focal form. Up to recently, the differential diagnosis between the two forms was very aggressive. It has been shown that [$^{18}$F]fluoro-DOPA and PET allow this differential diagnosis. The aim of this work is to evaluate the benefits of an automated method for the diagnosis. **Methods:** The method is based on the LMA method [1], Fifteen subjects were included in this methodology study. 15 static 18F-DOPA PET images of infants affected either with the focal (12 cases) or with the diffuse (3 cases) form of hyperinsulinism. Most of the focal lesions are located in the pancreas head (10 cases), but some affect the pancreas tail (2 cases). Histology allowed the distinction between the two forms and thus provides a gold standard for our identification method. LMA segments the PET images into homogeneous regions, and then merge the regions according to their mean activity concentration. The focal lesions are expected not to merge with the rest of the pancreas, while the whole pancreas affected with a diffuse form should be associated to one unique region. **Results:** The method provided within few minutes a correct segmentation of all appearing organs on all image. The lesions were segmented for 14 images over the 15. The unique failure concerned a focal lesion connected to the left kidney, which also presents a high activity. There was no ambiguity between the two lesion forms for the 14 correctly segmented lesions: the focal forms appeared as round hot spots, while for the diffuse forms, the whole pancreas was delineated as one region. **Conclusion:** We have developed a fast and reliable method that provides an automated segmentation of the focal lesions, together with a semi-automated (a visual assessment of the segmentation is mandatory) identification of the hyperinsulinism form. [1] Maroy *et al.*, "Segmentation of Rodent Whole-Body Dynamic PET Images: an unsupervised method based on voxel dynamics", 2008, under press.

## 128

### 18F-FDOPA PET and Detection of Neuroendocrine Tumors

S. Kauhanen[1], **M. P. Seppänen**[1], H. Minn[1], M. Välimäki[2], T. Sane[2], P. Korsoff[3], J. Saltevo[4], P. Salmela[5], J. Ovaska[1], P. Nuutila[1]; [1]Turku University Central Hospital, Turku, FINLAND, [2]Helsinki University Hospital, Helsinki, FINLAND, [3]Satakunta Central Hospital, Pori, FINLAND, [4]Jyväskylä Central Hospital, Jyväskylä, FINLAND, [5]Oulu University Hospital, Oulu, FINLAND.

**Objectives:** [$^{18}$F]DOPA PET is a promising new method in localizing and staging neuroendocrine tumors (NETs) from various organs. The current study was set up to determine the potential of [$^{18}$F]DOPA PET in primary and secondary diagnosis of NETs. **Design:** This retrospective study included 92 consecutive patients imaged with PET-CT and PET using [$^{18}$F]DOPA at our national PET centre. The diagnostic accuracy of the PET studies was assessed by comparing the histopathological reports and clinical follow-up. Patients were referred for PET scanning in most cases due to negative and inconclusive findings in conventional imaging methods. **Results:** The overall accuracy of [$^{18}$F]DOPA PET was 89%. For primary diagnosis of NET (n=47) the accuracy of [$^{18}$F]DOPA PET was 87%, and for secondary diagnostics (n=56) 91%. In organ-region -specific analysis, the sensitivity was 100% and specificity 90% in the primary diagnosis of pheochromocytoma (n=25) and metastasis were found in all cases with recurrent disease (n=5). The accuracy for NET of gastrointestinal (GI) tract was 83% in primary (n=6) and 90% in secondary diagnosis (n=20) when tumors of the pancreas were excluded. Furthermore, the sensitivity and specificity to detect pancreaticoduodenal NETs (n=14) were 80% and 77%, respectively. For NETs located in the head-neck-thoracic region (n=19), the overall accuracy of [$^{18}$F]DOPA PET was 89% including 12 cases of recurrent medullary thyroid cancer (MTC) with a sensitivity of 90% and a specificity of 100%. **Conclusions:** In patients with suspected NET but negative initial conventional