sterile water for injection. This wash was yellow in color and had a clearly visible insoluble contaminant. Following filtration of the sample through a 0.1 micron polycarbonate membrane filter, a metal-like precipitate was observed. The membrane containing this precipitate was vacuum coated with graphite and analyzed by SEM and EDX.

The average composition of the sample by EDX was predominantly silver with traces of Si, S, and Cl. Carbon and oxygen from the bare membrane were also detected. SEM at magnification of up to 10,000 showed the presence of a fine crystalline material of partially formed octahedra with an elemental composition of silver only. In addition, traces of particles composed of silver sulfide (Ag_2S), magnesium/ silicon/ aluminum and metallic Al were also observed.

These results indicate that, under the irradiation conditions used in the production of fluoride, silver from window material can subsequently crystallize in a form that can easily be washed from the target. This phenomenon may contribute to target aging and subsequent failure. Also, particulate contaminants originating from other system components as well as the environment can be detected in target solutions. The importance of periodic testing of target solutions and final membrane filtration in the production of PET radiopharmaceuticals is emphasized by these findings.

Instrumentation and Data Analysis: PET: Analysis III

8:30–10:00 **Session 47** **Room: 203**

Moderator: Richard E. Carson, PhD
Comoderator: Paul E. Kinahan, PhD

No. 274

CO-REGISTRATION METHODS FOR THREE-DIMENSIONAL FUNCTIONAL BRAIN IMAGES: PERFORMANCE EVALUATION AND APPLICATION. R.A. Koeppe , S. Minoshima, and J.A. Fessler. Division of Nuclear Medicine, University of Michigan, Ann Arbor, MI.

Co-registration of two or more functional brain image sets to a common orientation benefits data analysis for a variety of applications. We propose an automated co-registration method with which both the same as well as different types of functional images can be registered to a common orientation without the use of fiducial markers or a rigid frame. The method consists of a similarity measurement and an iterative 6-dimensional search (i.e., Powell's algorithm). Previously, conventional similarity criteria such as the sum of absolute or squared differences or the correlation coefficient between image sets has been shown to be less robust when the two sets are dissimilar. Venot (1984) proposed a sign change criterion (SSC) for registration of dissimilar images, and Mintun (1990) applied the criterion to PET image registration. Alternatively, we propose a new criterion that maximizes the number of corresponding pixels of the two image sets that have an absolute difference which is smaller than a certain percentage (typically 10%) of the average value of the two pixels. We compared these two criteria with the three more conventional criteria 1) minimization of the sum of absolute differences, 2) sum of squared differences and 3) maximization of the correlation coefficient using both simulated and phantom data, in addition to several clinical human data sets.

The simulation and phantom data shows the SSC and newly proposed method to be superior in terms of accuracy of realignment to the three more conventional criteria, particularly with dissimilar images. The SSC method was sensitive to resliicing and requires the two images sets to have similar noise properties. The new criterion can be adapted by differences in noise and tracer distribution of images by changing the percent difference threshold (5-15%). We implemented the new criterion using 3 clinical data sets, 1) 16 FDG - CBF (Alzheimer's disease), 2) 19 CBF - CBF (balloon occlusion), and 3) 5 IBVM (first day) - (second day) SPECT muscarinic receptor studies (normal). No visible rim artifacts were detected in any of the groups.

We conclude that newly proposed criterion is the most widely versatile method for similar as well as dissimilar image sets.

No. 275

Frame-to-Frame Registration for Movement Correction of FDOPA Dynamic Studies D.C. Yu, S.C. Huang, K.P. Lin, L. Baxter, WP. Melega, M.E. Phelps, Division of Nuclear Medicine and Biophysics, UCLA School of Medicine

Patient movement during a 2-hour long dynamic FDOPA study affects the measured kinetics, adds variability to the estimated model parameters and degrades the quality of parametric images. This study investigates the effectiveness of using a frame-to-frame registration to correct for the patient movement in FDOPA kinetic studies, which have drastically different tracer distributions between early and late images. The use of expectation maximization (EM) reconstructed images to improve the registration was also studied and compared with results from the filtered-backprojected (FBP) images.

Dynamic FDOPA images were obtained with a scanning sequence of 6x0.5 min, 4x3 min, 5x10 min, 3x20 min and with a Siemens 831 scanner (15 slices; 10 cm axial field-of-view). Images were reconstructed by FBP (Hanning filter 0.6) and EM (20 iterations) All frames were registered with respect to the last frame (ie, frame 18 as the reference). A registration program based on least residual sum of squares was used for image registration. Frame-to-frame registration was applied to two studies, one with large movement (a cocaine abuser) and one with little movement (normal volunteer) during the scanning. For each study, striatal kinetics from 6 ROIs drawn on 3 consecutive slices were obtained and fitted with a FDOPA kinetic model. Noise-free brain phantom data mimicked the normal FDOPA dynamic distribution were simulated and reconstructed with EM and FBP to examine their difference for providing regional tissue kinetics. The kinetics from EM was found little different from that of FBP, though EM kinetics are systematically lower in early frames and higher in late frames (15-18). After the frame-to-frame registration, all ROI kinetics of the study with large movement showed a smaller fluctuations and have a much lower residual sum of squares (54% lower for EM; 31% for FBP) when fitted with FDOPA model. The estimated model parameters were significantly changed after the registration (13-74%). As expected, registration of the second study did not show significant frame-to-frame movement. Overall, the use of EM reconstructed images for registration gave more reliable and consistent results than the use of FBP images.

In conclusion, our results indicate that the frame-to-frame registration can reduce the error caused by subject movement in dynamic FDOPA studies. The use of EM reconstruction of dynamic FDOPA images can give more reliable registration and improve movement correction.

No. 276

A CORRECTION STRATEGY FOR HEAD MOVEMENT DURING BRAIN IMAGING M. V. Green, J. Seidel, S. Stein, C. Kertzman, T. Zeffiro, and K. M. Kempner. National Institutes of Health, Bethesda, MD.

Head movement was monitored continously with an electromagnetic spatial tracking device for 40 minutes in each of 13 supine normal volunteers studied twice, once with head movement restrained by a thermoplastic face mask and again with no restraint. In each session, the position of a transducer attached to the forehead was determined every 2.5 seconds giving rise to some 1000 position measurements for each study. Each such data record was then used to drive a standard mathematical "head" through exactly the same set of displacements observed in that subject. At each new position, the location of each of 9 point sources embedded in a transverse plane fixed in this head was computed and the displacement of these sources about their mean position summarized in units of movement FWHM in mm. Population mean FWHMs were computed from each position data record in two different ways: for cumulative time intervals of increasing length, 0-5 min, 0-10 min, etc., and for consecutive 5 minute intervals treated independently. Cumulative FWHMs increased continously with time and were largest for the 40 min measurement period (max. 4 mm without restraint, 2.5 mm with restraint). In contrast, FWHMs from consecutive 5 min intervals did not increase with time, were typically less than 1 mm and were not appreciably different with or without head restraint. The largest component of head movement thus arises from a slow drift in mean head position rather than from increasingly large random motions about a stable mean head position. These data imply that the effects of head movement may be minimized by segmenting an image data collection into a sequence of short images, spatially aligning these images (with one of several recently reported alignment algorithms), and then summing these images together to produce a movement corrected image.

No. 277

A 305-MEMBER MRI-BASED STEREOTACTIC ATLAS FOR CBF ACTIVATION STUDIES A.C. Evans and D.L. Collins
Montréal Neurological Institute, Montréal,Québec

Blood flow (CBF) subtraction studies of cognitive activation with PET usually involve transformation of the 3-D image data into a standardized anatomical coordinate space (Talairach and Tournoux, 1988). The Talairach atlas consists of single sections at 4mm intervals obtained post-mortem from a single brain, that of a right-handed 60-yr old European female. This atlas is of limited application for the majority of CBF activation studies which are performed with young healthy volunteers. To obtain anatomical reference data more relevant to our subject population, we combined thinly-sliced MRI data from over 300 subjects to generate a population-mean intensity map.

We constructed this average 3-D brain volume from MRI data (64 2mm-thick planes T_1 sequence) acquired from 305 young healthy volunteers