# AbstractID: 4740 Title: High Accuracy of Volumetric Image Registration of CT, MR and PET Images

**Purpose:** To test the accuracy of the 3D volumetric image registration technique, the registration has been evaluated against "co-registered" CT phantom images, MR/MR intramodality images and PET/CT images.

**Method and Materials:** The 3D volumetric image registration is voxel-based, using the homogeneous color distribution in the volumetric views of the skin voxel landmarks as the registration criterion and guidance for alignment. The software is built for up-to-4 concurrent imaging modality registration with real-time volumetric manipulation and display (supported by a volume rendering board). Sixteen CT head phantom images are acquired with known spatial shifts, as well as fourteen patient cranial MR/MR (T1/T2/FLAIR) images from the same MR scanner and twenty-five patient cranial PET/CT images from a hybrid scanner.

**Results:** A sub-voxel detection limit (0.1 degree/voxel) is achieved for CT/CT phantom image registration as the alignment is indicated by the color homogeneity of the aligned skin voxels, which represents a new dimension for monitoring the image registration. For the MR/MR image registration, it is found that 71% of the "co-registered" images acquired from the same scanner within 5 minutes of each other exhibit a misalignment, caused by voluntary patient movement. The "distance" deviations ($\sum(X_i^2)^{1/2}$) between the co-registered and voxel-registered images are 0.2°±0.4° and 0.5±0.5 voxels. For the PET/CT image registration, 88% images have detectable misalignment due to higher probability of patient movement during longer scan time (<10 minutes) and the deviations are determined to be 0.4°±0.5° and 0.9±0.5 voxels. These movement-induced misalignments can be corrected using the 3D volumetric image registration technique.

**Conclusion:** The 3D volumetric image registration technique has sub-degree/sub-voxel accuracy in CT, MR and PET image registration. It can successfully detect misalignments in the co-registered images visually and should be applied to correct the image misalignment caused by voluntary patient movement.

**Conflict of Interest (only if applicable):** None.