

AbstractID: 1570 Title: Image registration technique based on point landmarks and voxel similarity measures for Gamma Knife radiosurgery treatment planning.

For patients undergoing repeated Gamma Knife radiosurgery, there is a need to correlate the current imaging information from CT and/or MRI studies with older studies, often available only in a hardcopy form. We have developed an image registration technique allowing for image registration based either on point landmarks or on voxel-intensity information. The former registration approach is fast and accurate for well-defined point landmarks. If the point landmarks are ill-defined, the images are registered by optimization of voxel similarity measures. The voxel-based registration relies either on minimization of intensity variation or maximization of mutual information. If only hardcopy images of past studies are available they can be scanned, converted to image stacks and compared to current MRI/CT studies. The present technique has been implemented within image-processing framework of NIH public domain software "ImageJ". It has been used to register MRI, and/or MRA images and to transform shot coordinates between consecutive radiosurgical treatments of large AVMs. It was also used to correlate the imaging information for repeated radiosurgery for recurring meningiomas and brain metastases. Five or more landmarks were used in the landmark-based registration in order to reduce errors due to the misalignment of the landmarks. For MRI slices with $0.5 \times 0.5 \times 1.0 \text{ mm}^3$ voxels the registration accuracy was within 1 mm range for careful selection and placement of the landmarks. The voxel-based registration was robust and its accuracy was also within 1 mm range when compared to the point-based registration using fiducial cage markers.