Automatic Image Registration of Axial Coronal and Sagittal MR Scans

Charles E. Nelson, PhD, Robert L. McLaurin, Jr. MD, and Laurence A. Bales, PhD

Presented at American Association of Physics in Medicine
Philadelphia, PA, July 21-26, 1996
As a Poster Session

A method has been developed which allows for accurate treatment planning directly from MR image sets. The method consists of specific MR image acquisition protocols and a sequential Image Data Entry Algorithm (IDEA). Correct alignment of the image stacks is accomplished by precise orientation with respect to a reproducible frame of reference whose origin is a point deep within the body. **Independent confirmation** of proper registration is provided by the observation that the skin contours generated automatically from the axial slices produce a highly accurate "fit" to the skin surface at each slice in the sagittal and coronal views.

Previous attempts to plan directly from MR images have suffered from a reliance on external fiducial markers. The external fiducials are necessarily located at a significant distance from magnet center where geographic accuracy diminishes rapidly (see linearity testing). Positional distortion of the fiducials is exacerbated by the fact that they are not contained within the relatively homogenous medium of the body being imaged, and are therefore subject to additional apparent displacement introduced by the air/marker interface. The positional distortion of the fiducials on MR images is evident when compared to the "true" position as indicated by CT. In any system dependent on external fiducials, this distortion invalidates the direct use of MR images for treatment planning.

The vastly superior image quality provided by the sagittal and coronal MR images, as compared to nonaxial reconstructions of CT image data, provides enhanced ability to optimize the dose distribution with respect to the tumor target as well as the surrounding normal tissues. The position of isocenter, and therefore all related isodose volumes is defined within the same frame of reference as the images. Since the position of isocenter must always be closer to magnet center than is the skin surface, then distortion must be less than the distortion observed at the skin surface, and is therefore considered negligible.

Our IDEA requires a few minutes more than standard image data entry for 3-D treatment planning; however, it obviates the need for companion CT scans and eliminates the time consuming process of image fusion. It is therefore more cost effective and efficient than existing image fusion processes.