

Validation of High-Speed Regional Spatial Normalization.

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Regional spatial normalization is an important step in the analysis of 3-D brain images. The goal is to remove anatomical differences by warping each brain image to match corresponding features in a standard brain atlas. Recent algorithms perform this task using high degree-of-freedom deformation fields that promise high-quality normalization., however execution time (256^3 image) can be several days. A more efficient algorithm, Octree Spatial Normalization (OSN), is being developed. The task for octree processing is more nearly related to surface area than volume. Processing time of 15 minutes for 256^3 arrays is possible with the current version.

The capabilities of OSN for deforming, matching, and continuity management were tested in phantoms. Two 256^3 T1-weighted MR images were evaluated for 3-D fit quality. Global spatial normalization provided a reference level with 15% of the brain voxels misregistered, and OSN reduced this fraction to 2.3%. This test was repeated without scaling, and the OSN processing worked equally well with error reduction from 21% to 2.5%.

To test the inverse fit capability of OSN a forward transformed image was inverse transformed and compared with the original brain. The resulting error was less then 2%. The lack of complete match was attributed to the smoothing introduced by trilinear interpolation during the forward and inverse transformed image. These results show that OSN can quickly warp brain images.