

AbstractID: 3115 Title: Automatic Detection and Sizing of Metastatic Brain Tumors Using 3D Template Matching

Purpose

The prognosis of patients with brain metastases is generally poor, but is improved with early detection and treatment with stereotactic radiosurgery as performed routinely at our institution. To achieve the earliest possible detection of subclinical lesions requires frequent screenings and use of high resolution volumetric imaging. This results in an ever-increasing workload for the radiologist, predisposing an increased tendency for reading error, especially for small nodules. We have developed a novel small tumor detection algorithm based on 3D template matching that also quantifies nodule size and hence growth between scanning sessions.

Methods

Post-contrast, coronal, SPGR, T1-weighted MRI datasets (voxel size 0.43x0.43x2.5 mm) were acquired. Autoextraction of bone and other non-brain tissue from the brain volumes was accomplished using morphological operations. Spherical tumor appearance models were created to match the expected geometry of the small tumors of interest and accounting for offsets due to the cut of MRI sampling planes. A 3D normalized cross-correlation coefficient (NCCC) between the brain volume and spherical templates was calculated using a fast frequency domain algorithm. Volumes of nodules were determined using both voxel-based measurements and by modeling each as an ellipsoid.

Results

Spherical templates were optimized for values of the radius, padding, and thresholding parameters. The data collected shows that a 100% tumor detection rate can be achieved with a true positive to false positive ratio of 4.5 with the cerebellum cropped out and 1.25 with the cerebellum present. Growth of the nodules over 11 months was automatically quantified, as well as detection of 1 new lesion.

Conclusions

Our results demonstrate that the 3D template-matching method can be an effective, fast and accurate tool for automated detection of tumors in brain MRIs. Strategic integration of results from multiple templates can further minimize the false positive rate while maintaining a 100% detection rate.