Automated 3D MRI brain tumor segmentation using Optical Scanning Holography based on active contour model

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Automated brain tumor 3D segmentation from magnetic resonance images (MRIs) is required to monitor, diagnose, and treat the disease. manual delineation practices involve anatomical knowledge, are expensive, time-consuming, and inaccurate due to human error. Hence, this paper proposes an efficient and highly accurate method for reconstructing the 3-D brain tumor and estimating its volume from a set of two-dimensional 2-D magnetic resonance (MR) cross-sectional images of the brain. The proposed method involves combining an off-axis optical scan performed by a heterodyne fringe pattern and an MR image display provided by a spatial light modulator. The outgoing In-phase component of the scanned current is collected numerically. Thus, by extracting the In-phase component's maximum, we obtain the tumor's position with a high precession. Concurrently, this position is inputted into an Active Contour Model (ACM) to perform a faster segmentation of the region that corresponds to the tumors. Tumor volume was calculated to facilitate the radiologist's estimate of the cancer stage. All experiments were performed on MR image datasets of brain tumor patients, and satisfactory results were obtained. Therefore, the proposed approach can be implemented in the computer-aided diagnosis CAD system for assisting the radiologist in obtaining the tumor location, volume, and 3D information.

KEYWORDS

Optical Scanning Holography, 3D Segmentation, Brain Tumor Detection, Reconstruction, Active Contour, Magnetic resonance imaging.

Highlights

- We propose a 3D fully-automatic method for brain tumor segmentation from MR sequences.

- We improve the classical optical scanning holography technique in terms of detection.

- We move active contour theory from semi-automatic to automatic status with reliable brain tumor detection.

- Promising results are obtained in the 3D reconstruction of brain tumors.

- Extensive experiments on BraTS 2019 and BraTS 2020 demonstrate our method′s effectiveness.