Brain Tumor Segmentation by Generalized Optical Scanning Holography based Active Contour

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Segmentation of tumors using magnetic resonance imaging (MRI) is a time-consuming and error-prone process. Recently, optical methods have opened up a new area to tackle this challenge. This article proposes a new architecture adapting an enhanced framework for optical scanning holography (OSH) technology to detect abnormal tissue regions in MRI. The proposed method combines in-line holography, performed by a heterodyne fringe pattern, and an MR image display assured by a spatial light modulator. The output in-phase component of the scanned current is digitally collected. Hence, extraction of the maximum of the in-phase component gives with a high precession the tumor's position, and simultaneously, this position is applied in an Active Contour Model (ACM) to perform a faster segmentation of the region corresponding to the tumors. Various images of brain tumors from the BRATS database, which tumors have different contrast and shape, are used to test the proposed system. To evaluate the proposed method's results, we investigate different evaluation criteria adapted to tumor tissue detection. Furthermore, in terms of tumor detection and segmentation, the proposed OSH-ACM process has highly performing metrics compared to certain recently published methods. The underlying physics behind the supreme accuracy presented by the OSH-ACM process is the high-precision extraction of abnormal tissue regions by the in-phase component of the scanning current.

KEYWORDS

Optical Scanning Holography (OSH), Brain tumor, Fully automatic detection, Active contour, Segmentation

Highlights

- We present an automatic method for Brain tumor segmentation
- We improve the Optical Scanning Holography in terms of brain tumor detection
- The suggested approach combines an in-line optical scan and an MRI display by an SLM
- The extraction of the In-phase gives an automatic and fast detection of brain tumors
- The famous brain tumors dataset of BraTS is used to test the proposed system