

Brain MRI Tumor Segmentation with Lateral Ventricles Deformation Estimation

Introduction

- Automatic segmentation of MR images of tumor affected brain presents a significant computational challenge.
- Lateral ventricles deformation caused by the compression from brain tumor is estimated and used as an additional feature into brain MRI segmentation methods to improve segmentation results.

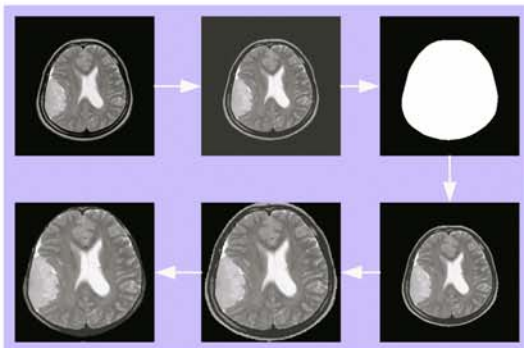
Background

- Brain tumor MR images are full of artefacts impairing the accuracy of the results from automatic tumor segmentation methods.
- Lateral ventricles are among the major normal structures in the brain which stand out due to their relatively large volume and sharp boundary.
- Lateral ventricles will normally be deformed due to the compression from primary brain tumor.
- Pattern recognition methods are suitable and widely used for multi-spectral MRI segmentation.



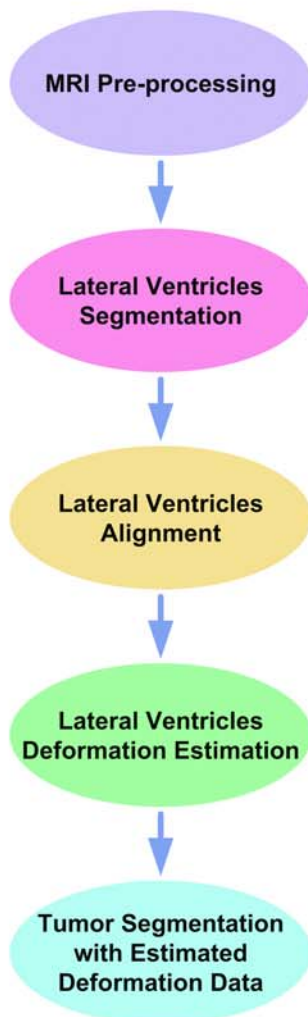
MRI Pre-processing

- Standardizing intensity through histogram matching approach.
- Extracting brain using the brain mask composed of Otsu's method and morphological de-noise operations.
- Centering and resizing image using dimension and size of the extracted brain.
- Removing skull using combined morphological erosion operations.



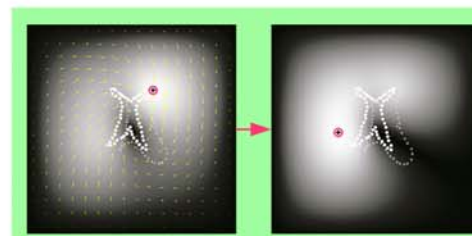
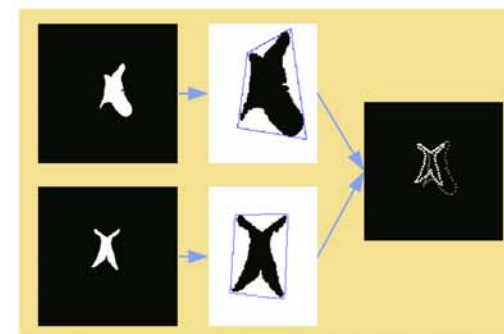
Lateral Ventricles Segmentation

- Segmenting CSF tissue using modified Fuzzy C-Means method which automatically optimizes input feature weights.
- Identifying CSF cluster using based on intensity properties of T1- and T2-weighted MRI.
- Extracting lateral ventricles using a manually created general mask.



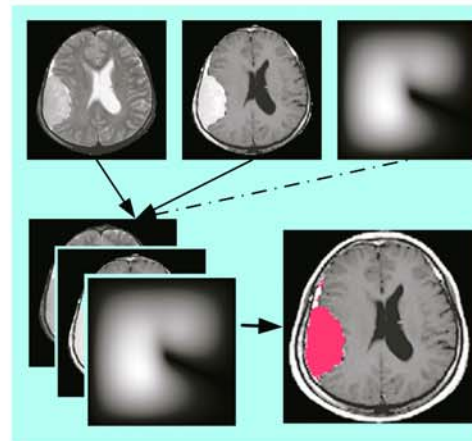
Lateral Ventricles Alignment

- Finding key control points by selecting four corners on the boundary by a quadrilateral polygon bounding box.
- Finding intermediate control points between two adjacent key control points.
- Aligning target and template lateral ventricles by linking corresponding control points.



Lateral Ventricles Deformation Estimation

- Determining the Thin Plate Spline (TPS) interpolation function.
- Applying the TPS function to image pixels.
- Calculating displacement vectors between coordinates of each pixel of an image before and after applying interpolation function.
- Adjusting the displacement data by vector direction.



Tumor Segmentation with Estimated Deformation Data

- Using deformation estimation data as an additional feature in both supervised and unsupervised segmentation methods.
- Validating the segmentation by reference to features without deformation.

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