Chapter 5
GPU-Based Level Set Method for MRI Brain Tumor Segmentation using Modified Probabilistic Clustering

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ABSTRACT

The level set method (LSM) has been widely used in image segmentation due to its intrinsic nature which allows handling complex shapes and topological changes easily. We propose a new level set algorithm, which is based on probabilistic c mean objective function which incorporates intensity inhomogeneity in image and robust to noise. The computational complexity of the proposed LSM is greatly reduced by using highly parallelizable lattice Boltzmann method (LBM). So the proposed algorithm is effective and highly parallelizable. The proposed LSM is implemented using Experimental results demonstrate the performance of the proposed method.

RESEARCH OBJECTIVE

The goals of the research are to

1. The accurate segmentation of brain tumor with different size and shape in presence of intensity inhomogeneity and noise.
2. Automatic segmentation of brain tumor with high speed.

DOI: 10.4018/978-1-5225-0140-4.ch005

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INTRODUCTION

Accurate image segmentation plays a vital role for anatomic structures inspection, disease identification as well as tracking of its progress in the field of biomedical image processing. It is also used for surgical planning and simulation. Now a day's Image processing is used to identify the brain tumor. According to the WHO, more than 500,000 people undergo brain tumor treatment in a year. Tumors may appear at different places with distinct intensity. It may differ in size, shape, and location. There are two major types of brain tumor: First one is called benign type which does not spread and second one is known as Malignant which spread from any part of the body to the brain. Since brain are very complicated structure, therefore a precise segmentation is needed for detecting tumors, edema and necrosis tissue. Based on MRI technique, the study of the main cerebral tissues such as white matter, gray matter and CSF is carried out. In such studies, segmentation step is required whose aim is partitioning the intracranial volume into potentially overlapping parts such as WM, GM and CSF. MR images are one of the common ways to visualize brain structure. MRI image segmentation is very helpful for research and clinical study. The MRI scan is more reliable than CT scan for diagnosis because it does not affect the human body as it does not use any kind of radiation. MRI shares a common advantage with CT of high spatial resolution images but without ionizing radiation exposure. It possesses good contrast resolution for different tissues.

Various techniques related to brain tumor inspection are proposed by many researchers in recent past. The domain of automated inspection for brain tumor is found to be populated mostly by level set image Segmentation. The level set technique is a general framework for tracking dynamic interfaces and shapes. It was first developed as a way to model fluid boundaries, such as a flame front. In computer vision and pattern recognition the level set method (LSM) had been widely used for segmentation. The attractive advantage of the LSM is its ability to extract complex contours and to automatically handle topological changes, such as splitting and merging (S. Balla-Arabe, et al. 2013). The LSM belongs to the active contours model (ACMs) which is based on the Eulerian framework, i.e., the geometric representation of the active contour instead of the parametric representation which is based on the Lagrangian framework.

A huge literature is devoted to brain segmentation from MRI data. Simulated charged fluid framework governed by Poisson's equation as a deformable model is used by Chang and Valentino (H Chang and D. Valentino, et al. 2006). in order to perform general segmentation. Later Chang et al. proposed a new deformable model CFM for T2MRI brain tumor segmentation. Ho et al. (H Chang and D. Valentino, et al. 2008) introduced an improved method in which blobby-shaped brain tumors are automatically segmented in MR images (S. Ho, et al. 2006). A knowledge-based detection and segmentation algorithm based on registered brain model for finding abnormal tissues is proposed by Prastawa et al. (M. Prastawa, et al. 2004). Edema with tumor in unusual region can be determined by MR images. Geometric active contour was applied to detect the outlier pixel in normal brain tumor. Region–based deformation model is described by Li et al. (C. Li, et al. 2008) for segmenting the MRI of brain. Both data fitting energy i.e. contour and two fitting functions are addressed by Li et al. For energy minimization, a curve evolution equation was derived from regularization term which is included in the level set formulation. To ensure accurate computation, the regularity of the level set function was preserved intrinsically by the level set regularization term while avoiding expensive initialization of the evolving level set function. A local intensity clustering property and a local clustering function for neighborhood points is proposed by Li et al. (C. Li, et al. 2007:16). Integrating the local clustering criterion over neighborhood center, they define energy functional which was converted to level set formulation. This minimization of the energy was

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