Chapter 38
Active Contour Model for Medical Applications

Ritam Saha
Tripura University, India

Mrinal Kanti Bhowmik
Tripura University, India

ABSTRACT

Recent developments in medical imaging techniques have brought an entirely new research field. Medical images are frequently corrupted by inherent noise and artifacts that could make it difficult to extract accurate information, and hence compromising the quality of clinical examination. So accurate detection is one of the major problems for medical image segmentation. Snakes or Active contour method have gained wide attention in medical image segmentation for a long time. A Snake is an energy-minimizing spline that controlled by an external energy and influenced by image energy that pull it towards features such as lines and edges. One of the key difficulties with traditional active contour algorithms is a large capture range problem. The contribution of this paper is that to in-depth analysis of the existing different contour models and implementation of techniques with minor improvements that to solve the large capture range problem. The experiment results of this model attain high accuracy detection and outperform the classical snake model in terms of efficiency and robustness.

INTRODUCTION

Medical image processing application has swiftly increased in recent years. Physicians and scientists make use of medical imaging techniques to visualize anatomic structures or mappings of physiological functions non-invasively with increased accuracy and precision. These tools influence areas including diagnosis, radiotherapy, surgical planning, and tracking of disease progress. The advent of various methods has provided physicians with powerful, non-invasive ways for studying the internal anatomic structures and physiological processes of the human body. The advances in imaging techniques also bring the benefit of providing better diagnosis and treatment options to many clinical applications. To facilitate visualization, manipulation, and especially quantitative analysis of medical images, methods

DOI: 10.4018/978-1-5225-0058-2.ch038

are needed for the repeatable, accurate, and efficient localization and delineation of objects of interest from given medical images. Medical image processing and analysis covers a broad range of research topics, including image acquisition, formation, reconstruction, segmentation, filtering, enhancement, compression, and visualization.

With the rising availability of relatively economical computational resources like Computed Tomography (CT) Scan, Magnetic Resonance Imaging (MRI), Doppler ultrasound has all been necessary to the radiologists of imaging tools toward ever more consistent detection and diagnosis of disease. This is an actual time-consuming process that can take days to estimate a set of images from one patient. Furthermore, the boundary determination is made more challenging when the images are of poor class and the boundaries are difficult to see in the image. Medical images are often corrupted by inherent noise and artifacts that could make it difficult to extract accurate information, and hence compromising the quality of pathological examination. One of the challenging issues is the intensity in homogeneity, which can be observed as a relative variation of the intensity of the object to be detected. The boundary detection acting as a major role in the segmentation of medical applications such as abnormality detection, treatment progress monitoring and surgical planning.

Parametric Active Contour Model (PACM) was elaborated by Kass *et al.* (Kass, Witkin, & Terzopoulos, 1988) as a snake or active contour. After that, it has been effectively applied to a different category of problems in computer vision and medical image analysis such as motion tracking, edge and contours detection and segmentation. Snakes are also found to be practically useful in medical image segmentations. Examples include automated analysis of nerve cell images, lung segmentation (Ray, Acton, Altes, De Lange, & Brookeman, 2003) from magnetic resonance images, shape descriptions of fluid-filled regions from optical coherence tomography images of the retina (Ray, Acton, Altes, De Lange, & Brookeman, 2003), and detection of rolling leukocyte within in trivial microscopy. The main plus point of snake models, compared with conventional edge detection approaches are that they incorporate spatially and image information for the extraction of the smooth border of the region of interest. Initial points are estimation of the desired boundary is given, and the curve deforms to obtain the most favorable shape. Thus, isolated artifacts are ignored when they hamper with the smoothness of the curve.

The contributions of this chapter are listed here. An in-depth analysis of the existing different contour models is presented in this chapter. This chapter also includes the mathematical modeling of Active Contour Model with minor improvements of changes in the active contour model. Achieved improvements are tested on a large number of image sets.

LITERATURE REVIEW

Accuracy of medical image segmentation is a vital step in contouring during medical diagnosis. During this process, accurate Boundary detection is a key part. Edge-based boundary detection approaches rely on the edges found in images. These edges represent the location of the discontinuities in gray level, color, texture, etc. Edge-based methods uses the information previously achieved by the edges in the image. Prewitt (J. Prewitt, 1970), Sobel (I. Sobel, 1978), and Canny (J.F. Canny, 1983) are the most famous ones. However, general image features like the image noisiness, image blurriness, image texture or other anomalies, as non-uniform scene illumination, edge detection techniques fails to achieving proper results. Broken edges in the source image fragments may not be detected accurately. Because edges are not always connected and are not always showing the objects boundaries, the images that result from

Related Content