Chapter 24
Grey Wolf Optimization-Based Segmentation Approach for Abdomen CT Liver Images

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ABSTRACT

In the recent days, a great deal of researches is interested in segmentation of different organs in medical images. Segmentation of liver is as an initial phase in liver diagnosis, it is also a challenging task due to its similarity with other organs intensity values. This paper aims to propose a grey wolf optimization based approach for segmenting liver from the abdomen CT images. The proposed approach combines three parts to achieve this goal. It combines the usage of grey wolf optimization, statistical image of liver, simple region growing and Mean shift clustering technique. The initial cleaned image is passed to Grey Wolf (GW) optimization technique. It calculated the centroids of a predefined number of clusters. According to each pixel intensity value in the image, the pixel is labeled by the number of the nearest cluster. A binary statistical image of liver is used to extract the potential area that liver might exist in. It is multiplied by the clustered image to get an initial segmented liver. Then region growing (RG) is used to enhance the segmented liver. Finally, mean shift clustering technique is applied to extract the regions of interest in the segmented liver. A set of 38 images, taken in pre-contrast phase, was used for liver segmentation and testing the proposed approach. For evaluation, similarity index measure is used to validate the success of the proposed approach. The experimental results of the proposed approach showed that the overall accuracy offered by the proposed approach, results in 94.08% accuracy.

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INTRODUCTION

The complexity of medical images rises from the similar intensity values and vague neighboring boundaries. It is motivation for computer researchers to dig for new methods that improves the accuracy of the segmented images. Liver is an important organ in human body with special characteristics that complicates the process of segmentation. It has different shapes in different CT images of the same patient (Sayed et al., 2015). Also, the intensity values of liver are similar to the intensity values of other organs as spleen, stomach, flesh and muscles. Also, the falciform ligament is another difficulty that divides the liver into two regions. This paper focuses on liver segmentation in CT images using a method of bio-inspired optimization technique. The observation of nature and swarms has inspired the creation of different meta-heuristic algorithms. In spite of the simplicity of the behavior of the swarms' individuals, the amazing co-ordination between swarm members presents a wonderful structured social organization. Researchers have been tracing the steps of swarms' behavior to find some sophisticated methods in order to try to mimic their intelligent individual behavior. This is used to create new algorithms to solve complicated optimization problems.

Grey wolf optimization technique, is a swarm inspired algorithm that focuses on the amazing collective behavior of pack's members. GWO mimics the capabilities of wolves organized behavior to attack a prey, depending on the coordination of the distributed members' behavior. The main idea is to mimic their behavior of finding, encircling and hunting the prey.

In the literature, the bio-inspired algorithms include Particle Swarm Optimization (PSO) (Mandal, Chatterjee, & Maitra, 2014; D. Kaur, & Y. Kaur, 2014), Ant Colony Optimization (ACO) (Liang, & Yin, 2013; Dorigoa, & Blum, 2005), Fish Swarm Optimization (FSO) (Xian-hua, & Yuan-qing, 2013; Reza, 2014), Bacterial Foraging Optimization algorithm (BFOA) (Ben, & Karnan, 2012). Glowworm Swarm Optimization (GSO) (Luo, Ouyang, Chen, & Zhou, 2014; Wang, Han, & Shen, 2014), Firefly Optimization algorithm (FOA) (Sunny, & Pratheba, 2014; Madhava, Rajinikanth, & Latha, 2014), and Artificial Bee Colony (ABC) (Karaboga, & Basturk, 2007; Karaboga, & Akay, 2009). In fact, swarm intelligence has various types of algorithms inspired by nature. The next lines will describe some of these swarms and their applications. Linag Y. et al, combined the Ant Colony Optimization algorithm (ACO) and Otsu with expectation and maximization algorithm to get multilevel threshold to be able to segment the objects which have complex structure. They combined the parametric EM with the non-parametric ACO (Liang, & Yin, 2013). Sankari L. combined the Glowworm swarm optimization (GSO) algorithm with Expectation-Maximization (EM) algorithm to handle the problem of the maxima in EM. GSO clusters the image to find the initial seed points and pass it to EM algorithm for segmentation (Sankari, 2014). Amrinder S. et al., used Bacterial foraging optimization algorithm (BFOA), which is inspired by a special type of bacteria called Escherichia coli. BFOA has an advantage of needing no thresholding in the process of image segmentation. It also reduces the computational complexity of segmentation process (Amrinder, & Sonika, 2014). Abdalla. M. et al., combined simple region growing (RG) technique with Artificial Bee Colony optimization technique (ABC). The efficiency of RG is improved when using ABC as a clustering technique (Abdalla et al., 2015). Duraisamy, S. et al, implemented Particle swarm optimization (PSO) for multi-level thresholding in image segmentation. PSO provided the optimal solutions as multi thresholds to maximize the objective functions of Otsu and Kapur (Duraisamy, & Kayalvizhi, 2010). Also, Eric et al., implemented ABC optimization technique to find out image threshold for image segmentation (Eric et al., 2010). Sivaramakrishnan et al., combined ABC algorithm with