

Chapter 2

Efficient Color Image Segmentation by a Parallel Optimized (ParaOptiMUSIG) Activation Function

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ABSTRACT

The optimized class responses from the image content has been applied to generate the optimized version of MUSIG (OptiMUSIG) activation function for a multilayer self organizing neural network architecture to effectively segment multilevel gray level intensity images. This chapter depicts the parallel version of the OptiMUSIG (ParaOptiMUSIG) activation function with the optimized class responses for the individual features with a parallel self-organizing neural network architecture to segment true color images. A genetic algorithm-based optimization technique has been employed to yield the optimized class responses in parallel. Comparison of the proposed method with the existing non-optimized method is applied on two real life true color images and is demonstrated with the help of three standard objective functions as they are employed to measure the quality of the segmented images. Results evolved by the ParaOptiMUSIG activation function are superior enough in comparison with the conventional nonoptimized MUSIG activation applied separately on the color gamut.

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INTRODUCTION

Segmentation has a pivotal role in different areas ranging from statistics, computer science, engineering, biology to social sciences and economics. Segmentation means the act of partitioning of patterns into disjoint groups or segments such that similar patterns will belong to the same segment while dissimilar patterns will belong to different segments. These similar groups are also referred as clusters. The purpose of segmentation is to detect relevant and meaningful data by means of removal of redundancy embedded therein. Some of the basic criteria of segmentation are based on the variety of data representation, proximity measurement between data elements and grouping of data elements. Some metrics are responsible for the determination of similarity or dissimilarity of patterns. The problem of segmentation can be analytically presented as follows (Das, 2008; Lucchese, 2001): suppose that a d -dimensional pattern \mathbf{x} is denoted as $\mathbf{x} = (x_1, x_2, \dots, x_d)$, where d denotes the number of features to represent the pattern. The pattern set consists of n elements and it is presented as $P = \{\mathbf{x}_1, \mathbf{x}_2, \dots, \mathbf{x}_n\}$ in which the i^{th} pattern in this set is denoted as $\mathbf{x}_i = (x_{i,1}, x_{i,2}, \dots, x_{i,d})$. Based on some features, the process of segmentation comprises in determining the segments S_1, S_2, \dots, S_K such that every \mathbf{x}_n belongs to one of these segments and no \mathbf{x}_n belongs to two regions at the same time, i. e. $\bigcup_{i=1}^K S_i = P$ and $S_i \cap S_j = \phi \forall i \neq j$ (Das, 2008). Different techniques have been applied to segment the set of patterns using all of the aforementioned properties.

Image segmentation is one of the major application areas of segmentation as it is a process of segregating an image space into multiple non-overlapping meaningful homogeneous regions i. e. pixels of each region are homogeneous to each other with respect to some characteristics whereas the union of any two regions is not. It plays a key role in image analysis and pattern recognition and

also has other application areas like, machine vision, biometric measurements, medical imaging etc. for the purpose of detecting, recognition or tracking of objects (Das, 2008; Tao, 2007). Color images comprises much more information than the gray level images as color image expresses much more image features than gray scale images (Cheng, 2001). Hence, more complicated segmentation techniques are required to deal with color images as the underlying data exhibits information in primary color components and their admixtures. Nonlinearity in the representation of colors in the color spectrum is another challenge in the processing of color images. In fact, each pixel of color image is characterized either by information in three primary color components, viz., red (R), green (G) and blue (B) or by a number of combinations of R, G, B chromatic components. Thus, processing and understanding of a color image amounts to processing of all the combinations of the primary color components in a true color image. In recent years, it has been detected that color image segmentation has become one of the major investigation areas due to demanding needs.

Review of Literature

Different image segmentation techniques are basically classified into two categories, viz. classical algorithm based approaches and soft computing techniques based approaches (Bhattacharyya, 2011a). Several classical approaches of image segmentation and analysis have been reported in the literature (Gonzalez, 2002; Chen, 2001). Classical image segmentation approaches can be generally relegated into three major categories, i. e., feature space based segmentation, image domain based segmentation and graph based segmentation. In feature space based techniques, image segmentation is achieved by capturing the global characteristics of the image through the selection and calculation of the image features, viz. gray level, color level, texture, to name a few (Gonzalez, 2002; Jacobs, 2000). Histogram thresh-

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