UNIVERSITI TEKNOLOGI MARA

ABSORBING MARKOV CHAIN SALIENCY BASED VARIATIONAL SELECTIVE ACTIVE CONTOUR MODEL FOR GRAYSCALE AND VECTOR-VALUED IMAGES

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Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science
(Mathematics)

College of Computing, Informatics and Mathematics

March 2024

ABSTRACT

Image segmentation plays a crucial role in various fields, including medical image analysis, pattern recognition, computer vision and biometric identification where accurate delineation of desired objects by the image segmentation model is essential. The well-known image segmentation model namely variational Active Contour (AC) model is capable in partitioning or segmenting objects in an input image effectively. To partition or segment a specific object in an input image, the selective type of AC model segmentation approach is preferable as compared to the global type of AC model. However, when it comes to segment grayscale or vector-valued (color) images with inhomogeneous intensity, the existing selective AC models often yield unsatisfactory results. To address this issue, two studies namely Study 1 and Study 2 are designed in this research which aim to propose a new variational selective AC model for grayscale and vector-valued images respectively by integrating the saliency image map and the local image fitting concepts. By leveraging the saliency image map via Absorbing Markov Chain approach, the model enhances the focus on desired objects while suppressing the influence of intensity inhomogeneity. In addition, the presence of the local image fitting helps in dealing with intensity inhomogeneity problem by effectively capturing local image characteristics. The first proposed model resulted from Study 1 termed the Saliency-based Selective Segmentation (SBSS) model is formulated to segment grayscale images while to segment vector-valued images, the second model termed Saliency-based Selective Segmentation Color (SBSSC) resulted from Study 2 is proposed. To solve the models iteratively, the Euler Lagrange (EL) equation in both studies and their associated forms gradient descent equations are derived in finite difference framework. Each of the proposed model from both studies is evaluated using 30 sets of test images and the segmentation results were computed in the MATLAB software. The numerical results have shown that both proposed models surpassed the other existing models from each study as indicated by the average accuracy and error metrics and average Dice and Jaccard coefficients. The average accuracy metric value of the proposed model for Study 1 and Study 2 is 98.68% and 98.57% compared to the existing models. In addition, the Dice and Jaccard average coefficient values are about 93.67% and 88.17% for Study 1 and 92.02% and 86.12% for Study 2, respectively, compared to the competing models.

ACKNOWLEDGEMENT

Firstly, I am deeply grateful to Allah for granting me the opportunity to pursue my Master's Degree and for guiding me through this challenging journey to successful completion.

I extend my heartfelt thanks to my supervisor, Dr. Abdul Kadir Jumaat and my co-supervisor, PM Rohana Embong for their unwavering support and guidance throughout my academic pursuit.

Additionally, I am indebted to the Research Management Centre (RMC) at UiTM for providing financial assistance through the research grant that supported me during my studies. I am so thankful to my colleagues and friends for their invaluable assistance with my project.

Lastly, I dedicate this thesis to my parents, the greatest individuals in my life, whose vision and determination to educate me have led to this moment of triumph. Alhamdulillah.

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CHAPTER ONE
INTRODUCTION

1.1   Overview

In this chapter, the introduction of the new variational selective segmentation formulation of the Active Contour (AC) models driven by saliency images for the grayscale and vector-valued images will be discussed. Additionally, this chapter also discusses the issues that exist with current segmentation methods and how this study intends to address them. The significance, scope and limitation of the study will be presented in this chapter as well.

1.2   Background of Study

Digital image processing is the manipulation of images with the aid of digital computers in order to enhance the image's quality for human visual perception. Previous to the advent of digital image processing, the newspaper industry relied primarily on it to improve the appearance of images or transforming grayscale images into vector-valued (color) images. Since the invention of digital computers, digital image processing has garnered tremendous interest in various applications such as in the field of medical imaging, video processing, remote sensing, weather prediction and fingerprint recognition (Tyagi, 2018). The amount of information that people receive from an image is visual in nature. Mathematically, a digital image is a two-dimensional visual illustration denoted as $I(x, y)$ of a three-dimensional scene, a person or an object where x and y indicate the coordinate of the picture elements (pixels) in an image. Each pixel has a different intensity and brightness that differentiates it from other neighborhoods. Since each pixel is expressed by numerical values, the image can be categorized into three types which are binary, grayscale and vector-valued images (Dumka et al., 2020). In this study, we primarily work on grayscale and vector-valued digital images only as they are widely appearing in our daily life.

Grayscale digital images are the images that contain only shades of grey and no color. The image is usually 8-bit image with each pixel is having 256 combinations of shades of grey. Vector valued images are basically digital images with colors. Each

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