

Chapter 71

Medical Image Enhancement Using Edge Information– Based Methods

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ABSTRACT

Medical image enhancement improves the quality and facilitates diagnosis. This chapter investigates three methods of medical image enhancement by exploiting useful edge information. Since edges have higher perceptual importance, the edge information based enhancement process is always of interest. But determination of edge information is not an easy job. The edge information is obtained from various approaches such as differential hyperbolic function, Haar filters and morphological functions. The effectively determined edge information is used for enhancement process. The retinal image enhancement method given in this chapter improves the visual quality of the vessels in the optic region. X-ray image enhancement method presented here is to increase the visibility of the bones. These algorithms are used to enhance the computer tomography, chest x-ray, retinal, and mammogram images. These images are obtained from standard datasets and experimented. The performance of these enhancement methods are quantitatively evaluated.

INTRODUCTION

Medical Image Processing is an important sub-discipline of biomedical engineering and it enables quantitative analysis and visualization of medical images of numerous modalities. Medical imaging technology allows the people to see the interior portions of the body without really opening too much of the body. The processing of medical images includes advantages such as:

1. It can be reproduced any number of times and retains the originality of the data
2. Powerful tool to display the images
3. Enhancement of images to make them easier for the Physician to interpret

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4. Quantifying changes over time and
5. Quick comparison of images, etc.

The images can be acquired from any of the modalities e.g. radiography, magnetic resonance imaging, nuclear medicine, ultrasound, elastography, tactile imaging, photoacoustic imaging, thermography, conventional tomography, computer-assisted tomography, echocardiography, functional near-infrared spectroscopy, etc. Each image acquired from any modality have their own merits and demerits and sometimes these images are poor in quality. These distortions in the images cause inadequate presentation of interested objects / region, which can result in inaccurate analysis. The main contributions of this chapter includes:

1. Using differential hyperbolic tangent function based edge enhancement in CT, retinal, and mammogram images,
2. Edge enhancement of x-ray Image by Haar Filters,
3. Enhancement of vasculature in optic disc region based on edge information along with morphological operators.

This chapter is organized as follows. The background section reviews various research in the edge detection and image enhancement. It also describes various researches in the enhancement of retinal, mammogram and x-ray images. First section analyzes the hyperbolic filter based CT, retinal and mammogram enhancement algorithm. It also describes an unsharp filter for retinal image enhancement. Second section analyzes the edge enhancement of chest x-ray image by Haar filters. Third section analyzes the enhancement of vasculature in optic disc region based on edge information along with morphological operators. This chapter ends with future research directions of this research and conclusion.

BACKGROUND

Enhancement techniques have been widely used in the field of medical image processing, where the subjective quality of images is important for human interpretation and diagnosis. Image enhancement plays an important role in making important decision based on the image information. The techniques of medical image enhancement are to improve some useful information present in an image, or / and remove or reduce some unwanted information. Various enhancement algorithms have been developed apply on medical images. Image enhancement is a process, so that the enhanced image is more suitable than the original image for a specific application (Gonzalez, & Woods, 2009). Medical image enhancement is necessary if the original is not a good candidate for subsequent processing (Yang, Su, & Sun, 2010; Li, Yanmei, & Hailun, 2010). In many cases, enhancement improves the quality of the image and facilitates diagnosis (Anand, & Gayathri 2015; Anand, & Shantha Selva Kumari, 2013, 2014; Anand, Shantha Selva Kumari, Jeeva, & Thivya, 2013a; 2013b; Sundaram, Ramar, Arumugam, & Prabin, 2011; Li, 2010; Tay, Garson, Acton, & Hossack, 2010; Peng, Yingjun, Biao, Wei, & Deling, 2007).

Image enhancement is the process to improve an image, so that it looks subjectively better (Yu, Kuo, Guei, & Chyou, 2012). However, subjective quality of an image depends largely on the sharpness and explicitness of edges. The lack of sharpness is due to wrong focus of imaging equipment, motion blur, etc. Sharpness is directly related to human sight properties and visibility. Emphasizing the edges there

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