Chapter 28
Medical Image Zooming by Using Rational Bicubic Ball Function

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ABSTRACT

This chapter deals with image processing in the specific area of image zooming via interpolation. The authors employ bivariate rational cubic ball function defined on rectangular meshes. These bivariate spline have six free parameters that can be used to alter the shape of the surface without needed to change the data. It also can be used to refine the resolution of the image. In order to cater the image zomming, they propose an efficient algorithm by including image downscaling and upscaling procedures. To measure the effectiveness of the proposed scheme, they compare the performance based on the value of peak signal-to-noise ratio (PSNR) and root mean square error (RMSE). Comparison with existing schemes such as nearest neighbour (NN), bilinear (BL), bicubic (BC), bicubic Hermite (BH), and existing scheme Karim and Saaban (KS) have been made in detail. From all numerical results, the proposed scheme gave higher PSNR value and smaller RMSE value for all tested images.

1. INTRODUCTION

The technology of image processing in medical field is vigorously grow in the industry as the demand increases from time to time. Foremost among them have been explored the digital medical imaging modalities for past two decades. For instance, the technology in film scanners, ultrasound, Magnetic Resonance Imaging (MRI), Computed Tomography (CT), Positron Emission Tomography (PET), Single Positron Emission Computed Tomography (SPECT), Digital Subtraction Angiography (DSA), and Magnetic Source Imaging (MSI) etc. These modalities constitute about 30% of the radiologic imaging examinations and 70% of examinations on skull, chest, breast, abdomen and bone which has been done in conventional x-rays and digital luminescent radiography (Wong, 2012). The image within the patient's body have different kind of film digitizers such as, laser scanner, solid-state camera, drumscanner, and video camera that capable to convert X-ray films into digital format for image processing. Therefore, image zooming on the selected parts are important especially when the expert want to detect any anomalies at the body paertss. Usually in imaze zooming, a two-dimensional (2-D) specifically grayscale medical image such as X-ray film with a size of 256 x 256 bits are employed as a tested image.

Image zooming is one of application in image interpolation. It is process of magnifying or reducing the size of the image and interpolation activity takes place during the process. Usually medical digital images produced have low resolution images due to the nature of the acquisition. Moreover, when the medical image is zoomed at certain part will cause the reduction of resolution if its done without interpolation. There are numbers of studies proposed a method and solution to improve the visual and objective quality of a medical image such as image upscaling, image zooming and image rotation. From the previous works, spline is the most common method for image interpolation that used to attain high quality of medical images. For example, Gao et al. (2008) proposed trigonometric spline with control parameters for medical image interpolation. Another study, they introduced the bivariate rational spline to interpolate medical image in respective activity such resizing, zooming and enhancement (Gao et al., 2008; Gao et al., 2009; Zhang et al., 2009; Zhang et al., 2012). Meanwhile, in Pal (2016), the authors has studied the zooming operation based on the principle of analog clock and utilizing the combination point and eighbourhood in image processing.

Table 1 summariz some related literature review including our recent study i.e. Zulkifli et al. (2019). Meanwhile Table 1 shows some abbreviations used in this study.

The main objective of the current study is to develop an efficient algorithm to zooming some medical images such as CT scan, MRI and thermal camera. To achieve this, we utilized the rational bicubic Ball with six parameters initiated by Zulkifli et al. (2019). The main different between the present study and the one in Zulkifli et al. (2019) is that, is this study we have extend their algorithm i.e. image upscaling for medical image zooming.

The remainder of chapter is organized as follows. Section 2 and 3 in respective discussing the construction of rational bi-cubic Ball initiated by Zulkifli et al. (2019) and Image Quality Assessment (IQA) as measurement of performance evaluation. Section 4 presents an algorithm used for implementation of the proposed scheme. Followed by results and discussion in Section 5 with overall summary of the scheme in conclusion explained in Section 6.

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