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PSO-based Medical Image Processing for Kienböck Biomechanical Analysis ⋆

Xiaoyan Jia [a], Jindong Zhang [b,*], Bin Liu [a], Yuehai Pan [a]
Zhigang Liu [a], Kai Liu [a]

[a] *Department of Hand Surgery, The First Hospital, Jilin University, Changchun 130027, China*
[b] *College of Computer Science and Technology, Jilin University, Changchun 130012, China*

Abstract

Through the lunate bone biomechanical analysis can be used for kienböck medical diagnosis and treatment. The pressure sensitive film can reflect intuitively the stress of lunate bone's each point. This paper obtains stress analysis of lunate bone based on PSO (Particle Swarm Optimization) algorithm's image analysis and processing of pressure sensitive film. The paper uses the grayscale function to change a target image into the grayscale image, and uses the PSO algorithm for function optimization to segment image with the original image. Then we obtain remaining achieving gray value, and calculate the pressure. Through the analysis of the experimental data, we obtain the maximum value, minimum value and average value of the pressure. The analysis of processing results showed that the PSO algorithm could segment the image accurately and the remaining larger pixel gray values concentrated in the three fossa of lunate bone. The results verify the accuracy and efficiency of the method.

Keywords: Medical Image Processing; PSO; Kienböck; Biomechanical

1 Introduction

Lunate bone joint contact pressures play a major role in healing kienböck joint injuries, and joint degeneration [1]. But there is not a good method of the joint contact pressure direct measurement. This paper used the pressure sensitive film produced by Fuji Co., Ltd.. Its measuring pressure principle is as follow: when the force presses on the pressure sensitive film, the greater the pressure is, the greater the force effect. And the pink of the film is more concentrated. The pink is heavy which indicates that the large pressure, according to each pixel of color on the pressure sensitive tablets can get the pressure value from the pressure sensitive tablets. We import pressure sensitive images directly input computer, and convert color into gray [2]. And then the gray values are converted to pressure by the formula, so that count stress situation [3]. Because of the ease of implementation, advantages of speed, PSO (Particle Swarm Optimization) algorithms received

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*Corresponding author.
Email address: zhangjindong_100@163.com (Jindong Zhang).

wide attention from international scholars in the field. Shi. Y Dr. analyzed the intermediate variables used in the operation of PSO algorithm, introduced a new variable, which named inertia weight. Other researchers also extended PSO algorithm in changing the speed factor, setting the boundaries and so on [4]. Due to the PSO algorithm is lack of a base of data, computation time is nonlinear. By analysis, Ozcan and Mohan proposed in PSO algorithm, the trajectory of the particle under discrete time condition is sinusoidal [5]. To alleviate the contradiction between convergence rate and convergence quality, Angeline attempted to combine GA algorithm with the PSO algorithm, but optimization capacities on single functions reduced [6]. Many researchers based on PSO algorithm, attempted to introduce other algorithm's optimization techniques to get better results, and obtained good results in varying degrees [7]. Today, the PSO algorithm achieved good results in multi-objective optimization, system optimization and many other topics. These algorithms are applied into bioinformatics, medical, data control, machinery and other industrial [8]. In order to deal with the pressure sensitive film, using an image processing method based on PSO algorithm. PSO algorithm stands for particle swarm optimization algorithm. PSO algorithm has its origins in the study of simple life groups, extension and application of PSO algorithm has been good and in many ways. The image segmentation is one of them. Image segmentation is to extract parts of image characteristics to sort, search, data analysis and so on, is the most fundamental and most important image processing operation. There are three main methods for image segmentation. The threshold algorithm is the simplest and most practical method, such as, Otsu law, the principle of maximum entropy method, minimum error and minimal skew. This paper gained the pressure data of bone joints through using PSO algorithm to optimize the image.

2 PSO-based Medical Image Processing

PSO-based medical image processing is shown in Fig. 1.

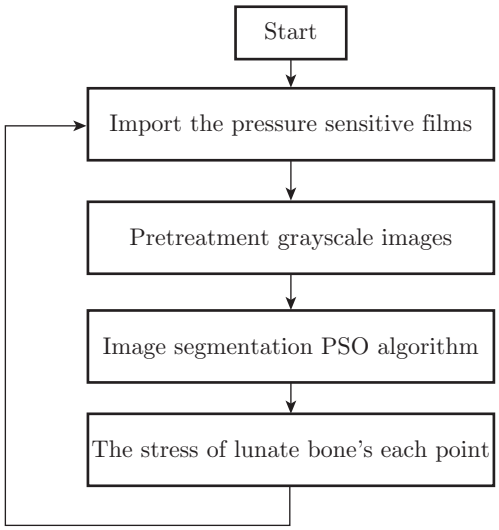

Fig. 1: The process flow chart

The paper uses the method of conversion between RGB and YUV [9], as shown in Eq. (1):

$$Y_{lb} = 0.299 \times R_{lb} + 0.587 \times G_{lb} + 0.114 \times B_{lb} \tag{1}$$