

Calcaneus Benign Tumor Detection Using Canny Edge Detector

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Abstract: - Tumors and tumor-like lesions of the foot are rare. Computed tomography and Magnetic resonance imaging are the most effective method for the early detection of foot and ankle tumors. Researchers have been developing various methods to detect benign tumor. Many image segmentation techniques are available in the literature. Computer Aided Diagnosing (CAD) system has been proposed in this paper for detection of calcaneus benign cancer by the analysis of Computed Tomography (CT) images. Canny edge detection algorithms are the most commonly used techniques in image processing for edge detection. Canny edge detector is evaluated in this paper.

The used Computed Tomography images are obtained from Faculty of Medicine, Bezmialem Foundation University. We used “.dicom” medical image standard format. We used male patient's foot CT images computer (65 slices). He was born in 1996.

The used parameters are detector collimation of 64x2mm, scanning thickness of 2mm, pixel sizes of 512x512 in radiometric resolution of 16 bits' gray levels.

The image implemented processing steps: (i) calculating the horizontal & vertical gradient, (ii) determining gradient magnitude and gradient direction, (iii) applying non-maximal suppression, (iv) computing high and low thresholds, (v) hysteresis thresholding are applied to the multi-detector computed tomography to detect the benign bone tumor.

In this study, automatic edge-based digital image processing techniques were applied to detect of bone tumor. We detect the tumor, segment the tumor and calculate the area of the tumor. We proposed canny segmentation method that enables users to quickly and efficiently segment benign tumors in MDCT of foot.

The purpose of our study was to detect the calcaneus tumor of the foot and it was the simplest and less time consuming process. is a sample of the format of your full paper.

Key-Words: - Medical Image Processing, Segmentation, Canny, Calcaneus Tumor, CT

1 Introduction

Tumors and tumor-like lesions of the foot and ankle are rare [1, 2]. Several diagnosis methods have been proposed for tumor detection. MR and CT imaging methods are commonly used for diagnosis [3]. However, these imaging and diagnosis systems are not sufficient alone to meet accurate and reliable results. Second opinion is essential to avoid inadequacies and additional requirements of imaging systems and technicians and physicians failures. Therefore Computer Aided Diagnosing (CAD) is proposed for diagnosis and treatment [4]. Edge detection can be used in many field such as in medical field. Canny has proposed a new method of edge detecting [5, 6], which is the best one to step-type edge which is influenced by noise. Canny edge detection algorithms are the most commonly used

techniques in image processing for edge detection. Canny edge detector is evaluated in this paper.

In this study, most convenient segmentation method has been searched to detect benign tumors of the calcaneus in CT images. Matlab platform has been used for benign tumor segmentation.

The study steps: 1. Introduction, 2. Segmentation, 3. Bone tumor, 4. Methods, 5. Conclusions.

2 Segmentation

Segmentation is the most important part in image processing [7]. Image segmentation is the process clustering or dividing an image into multiple homogeneous regions and simplifying and obtaining searched object from original image [8].

Image segmentation algorithms generally are based on one of two properties of intensity values: similarity and discontinuity. Edge detection is by far

the most common approach for detecting meaningful discontinuities in gray scale [9]. Edge detection defines object boundaries within images and basically it is an image segmentation technique. The edges and corners in images can be found by detecting sharply changes of image brightness or discontinuities [8].

Segmentation can be classified as follows:

- Region Based
- Edge Based
- Pixel Based
- Feature Based Clustering
- Model Based

We used canny edge detection algorithms in this paper.

The Canny Edge Detection procedure is described in the flowchart (Figure 1).

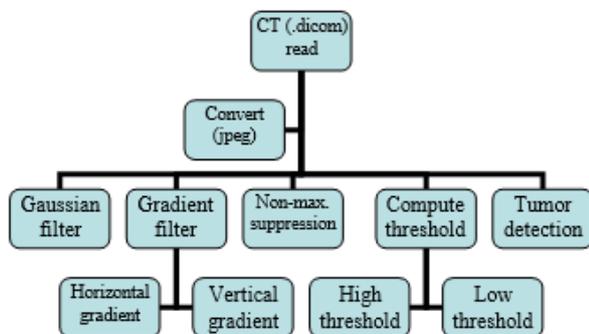


Fig 1. Canny edge detection flowchart

Algorithm:

1. Convolve with gradient filters (at multiple scales);

$$\vec{R}(\vec{X}) \equiv (R_x(\vec{x}), R_y(\vec{x})) = \nabla G(\vec{x}; \sigma^2) * I(\vec{x}) \tag{1}$$

2. Compute response magnitude;

$$S(\vec{X}) = \sqrt{(R_x^2(\vec{x}) + R_y^2(\vec{x}))} \tag{2}$$

3. Compute local edge orientation (represented by unit normal);

$$\vec{n}(\vec{x}) = \begin{cases} (R_x(\vec{x}), R_y(\vec{x})) / S(\vec{X}), & \text{if } S(\vec{X}) > \text{threshold} \\ 0, & \text{otherwise} \end{cases} \tag{3}$$

4. Peak detection (non-maximum suppression along edge normal).

5. Non-maximum suppression through scale, and hysteresis thresholding along edges [10].

You can see [6] for algorithm details.

In the presented study, canny edge detector has been used to obtain tumor segments and their boundaries.

3 Bone Tumor

The bone tumors can be divided into two groups, namely primary and secondary (metastatic) tumors [11] and they are rarely encountered [1, 2]. The general classification of bone tumors is given by [12] as below :

- Benign bone tumors
- Benign/aggressive bone tumors
- Malignant bone tumors

4 Methods

Computed Tomography images are obtained from Faculty of Medicine, Bezmialem Vakif University. Digital medical image format is DICOM (Digital Imaging and Communications in Medicine). We used male patient's foot CT images computer (65 slices), he was born in 1996. Figure 2 shows the CT slices in the window.

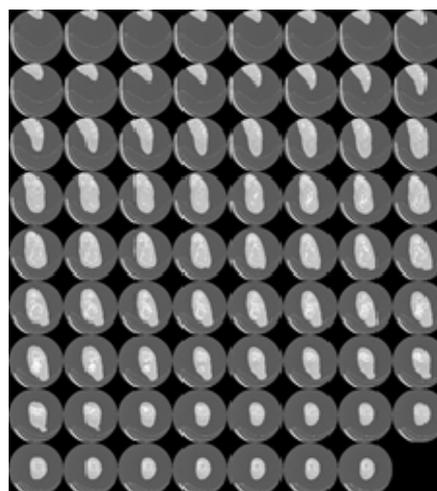


Fig. 2 CT Images (Slices)



Fig. 3 Foot and calcaneus anatomy

The used parameters are detector collimation of 64x2mm, scanning thickness of 2mm, pixel sizes of 512x512 in radiometric resolution of 16 bits' gray levels. The axial images in Digital Imaging and Communications in Medicine format were first transferred into a personal computer.

Proposed Algorithm;

- Step 1: BT (.dicom) image read
- Step 2: Calculating the horizontal & vertical gradient
- Step 3: Determining gradient magnitude and gradient direction
- Step 4: Applying non-maximal suppression
- Step 5: Computing high and low thresholds
- Step 6: Hysteresis thresholding
- Step 7: Output

Figure 4 shows the CT raw data in the window, Fig. 5 shows canny edge segmentation in the below window (tumor detection).

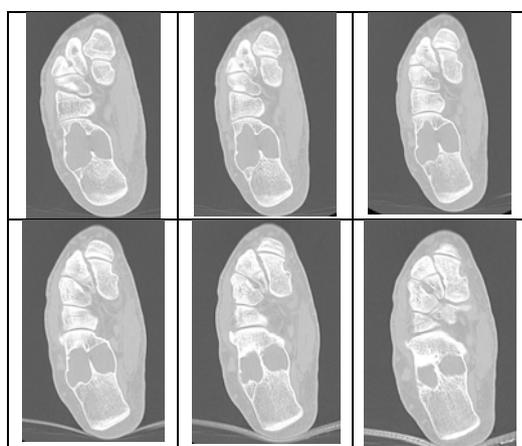


Fig.4 CT raw data

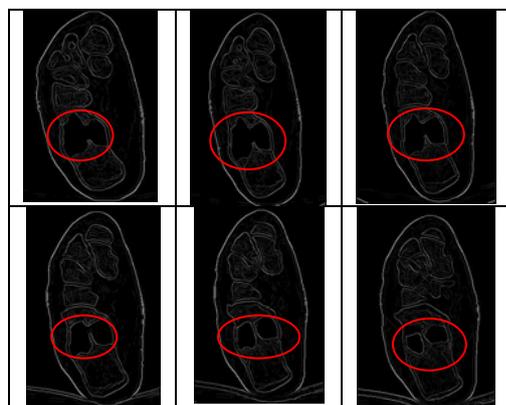


Fig. 5 Canny edge detection

Matlab was used in this study to process and to detect tumor. We detect the tumor, segment the tumor and tumor-like lesion. We proposed canny edge-based segmentation method that enables users to quickly and efficiently segment benign tumors in MDCT of foot.

5 Conclusion

This paper proposes edge-based segmentation method for automatic calcaneus tumor segmentation on CT images. We proposed canny edge detector method that enables users to quickly and efficiently segment benign tumors in MDCT of foot.

Canny edge detection algorithm is one of the best algorithms since it provides more accurate edge detection values for applying searching algorithm in our work.

In this work, we have used canny edge detection algorithm for extracting the edge for the medical images. We are also planning a further similar study on different bones' tumor.

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