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MEDICAL IMAGES EDGE DETECTION USING MATHEMATICAL MORPHOLOGY

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Abstract

Medical images edge detection is an important work for object recognition of the human organs and it is an important pre-processing step in medical image segmentation and 3D reconstruction. Conventionally, edge is detected according to some early brought forward algorithms such as gradient-based algorithm and template-based algorithm, but they are not so good for noise medical image edge detection. In this paper, basic mathematical morphological theory and operations are introduced at first, and then a novel mathematical morphological edge detection algorithm is proposed to detect the edge of lungs CT image with salt-and-pepper noise. The experimental results show that the proposed algorithm is more efficient for medical image denoising and edge detection than the usually used template-based edge detection algorithms and general morphological edge detection algorithms.

Keywords- *Medical image, edge detection, mathematical morphology, denoising.*

INTRODUCTIN

Medical images edge detection is an important work for object recognition of the human organs such as lungs and ribs, and it is an essential pre-processing step in medical image segmentation. The work of the edge detection decides the result of the final processed image. Conventionally, edge is detected according to some early brought forward algorithms like Sobel algorithm, Prewitt algorithm and Laplacian of Gaussian operator , but in theory they belong to the high pass filtering, which are not fit for noise medical image edge detection because noise and edge belong to the scope of high frequency. In real world applications, medical images contain object boundaries and object shadows and noise. Therefore, they may be difficult to distinguish the exact edge from noise or trivial geometric features. Mathematical morphology is a new mathematical theory which can be used to process and analyze the images. It provides an alternative approach to image processing based on shape concept stemmed from set theory , not on traditional mathematical modeling and analysis. In the mathematical morphology theory, images are treated as sets, and morphological transformations which derived from Minkowski addition and subtraction are defined to extract features in images. As the performance of classic edge detectors degrades with noise, morphological edge detector has been studied. In this paper, a novel mathematical morphology edge detection algorithm is proposed to detect lungs CT medical image edge. It is a better method for edge information detecting and noise filtering than differential operation, which is sensitive to noise. And it is a better compromise method between noise smoothing and edge orientation, but the computation is more complex than general morphological edge detection algorithms.

MATHEMATICAL MORPHOLOGICAL OPERATION

Mathematical morphology is developed from set theory. It was introduced by a thereon as a technique for analyzing geometric structure of metallic and geologic samples. It was extended to image analysis Based on set theory; mathematical morphology is a very important theory, whose operation must be defined by set arithmetic. Therefore, the image which will be processed by mathematical morphology theory must been changed into set. Mathematical morphology uses structuring element, which is characteristic of certain structure and feature, to measure the shape of image and then carry out

image processing. Based on set theory, mathematical morphology is the operation which transforms from one set to another. The aim of this transformation is to search the special set structure of original set. The transformed set includes the information of the special set structure and the transformation is realized by special structuring element. Therefore, the result is correlative to some characteristics of structuring element. The basic mathematical morphological operators are dilation and erosion and the other morphological operations are the synthesization of the two basic operations. In the following, we introduce some basic mathematical morphological operators of grey-scale images. Erosion is a

Fig.3. Lungs CT image processed by Sobel detector

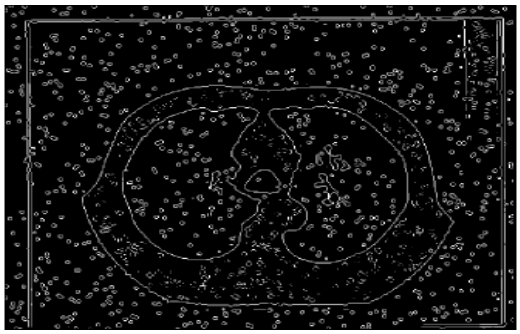
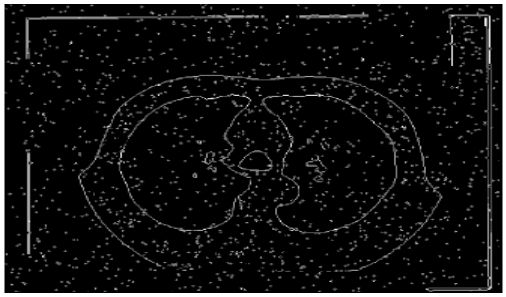


Fig.4. Lungs CT image processed by Morphological Gradient Operation.



transformation of shrinking, which decreases the grey-scale value of the image, while dilation is a transformation of expanding, which increases the grey-scale value of the image. But both

Fig.5. Lungs CT image processed by dilation residue edge detector.

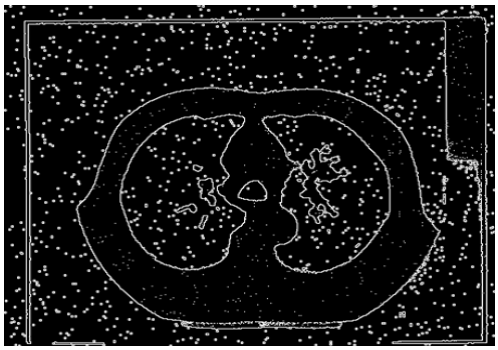


Fig.6. Lungs CT image processed by novel morphological edge detector.

According to the experiment results shown in Fig.2 and Fig.3, Laplacian of Gaussian operator and Sobel edge detector detect the lungs edges successfully, but Sobel edge detector fail to detect the outer edge of body, and both of them can't filter the noise. By Fig.4 and Fig.5, the morphological gradient operation and dilation residue edge detector are succeed in lungs and

body edges detection, and the detected edges are clearer than the edges detected by Laplacian of Gaussian operator and Sobel edge detector. But both of them fail to filter the noise in despite of the latter is better for noise filtering than the former. By Fig.6, the novel morphological edge detector proposed in this paper is succeed in lungs and body edges detection, but more important than template-based edge detection algorithm and general morphological edge detection algorithm mentioned before, it also filters the noise successfully.

CONCLUSION

In this paper, a novel mathematic morphological algorithm is proposed to detect lungs CT medical image edge. The experimental results show that the algorithm is more efficient for medical image denoising and edge detecting than the usually used template-based edge detection algorithms such as Laplacian of Gaussian operator and Sobel edge detector, and general morphological edge detection algorithm such as morphological gradient operation and dilation residue edge detector.

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