A New Kind of Image Edge Detection Based on The Theory of The Adaptive Lifting Wavelet and Morphology

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ABSTRACT
This article describes how in traditional edge detection it is prone to defects such as fuzzy positioning, and noise influence. This article proposes a type of edge detection algorithm which combines lifting wavelet transform and adaptive mathematical morphology, which makes a lifting wavelet to analyze the wood cell image. Then, the high-frequency part is detected by using the algorithm fusing the wavelet packet and the rapid-combining multi-scale wavelet, which controls noise effectively; while for the low frequency part is detected with modified adaptive mathematical morphology, to locate the exact details. The final result will processes the edge of the image using “algebra” algorithm fusion. The example for a wood cell image which illustrates the algorithm is to detect the cell boundary relatively clearly, and effectively suppress the noise.

KEYWORDS
Edge Detection, Improve Wavelet, Morphological Algorithm, Wood Cells

1. INTRODUCTION
The image edge contains most information, it is the important step in image processing and analysis is widely applied to image recognition, computer vision, machine learning and other fields. The traditional edge detection algorithms such as Sobel, Robert, log and Canny etc, the utility model has the advantages of easy implementation, small amount of calculation as well as disadvantages of the relevant direction of edge detection and other reasons of that cannot suit practical demand in anti-noise performance and edge location aspect (Wang, 2011). Wood is one of the most commonly used engineering materials and necessities for human existence. To alleviate the shortage of wood in China, it is essential for us to delve deeply into it and make the reasonable selection of tree species efficiently planting. And characteristics of wood material are determined by the microscopic structure of wood cells. Therefore, it is very important to study microscopic cell of wood. In this paper, wavelet analysis, combined with Morphological and digital image processing technology, provides a new idea for the wood cell image edge detection. The simulation experiments illuminate mathematical morphology method based on wavelet image processing to improve the quality of image edge detection, and effectively segment the images, providing a scientific basis the further study for the wood microscopic cell in this paper. combing with the advantages of fast characteristics of lifting
wavelet transform and of mathematical morphology, the paper starts with frequency division in image using lifting wavelets, and then the high frequency segment of image is carried on an approximation analysis of a wavelet packet in means of the lifting wavelet transform method to locate high-frequency edge information more efficiently. High frequency image is detected by fast Multi-scale wavelet; introducing mathematical morphology theory to image edge detection method for the low frequency of the image Component of edge detection; Finally, the high-frequency and low-frequency image edge fusion using “algebra” algorithm (Lijun, 2015). Two methods combined with detection of image edge is a good complementary to each other, its illustrated that the experiment of wood cells and the classical woman graph is better than that of the conventional operator and spends less time than generally improved algorithm (Akinlar, 2016).

2. MATHEMATICAL MORPHOLOGY FOR IMAGE LOW FREQUENCY EDGE DETECTION

Edge detection method based on mathematical morphology uses structural elements in the form of a certain operator to measure and extract the corresponding shape from image. Through the “on”, “closed” operation can effectively reveal the gray edge of the image, to achieve the aim of image analysis and recognition. Structural elements are actually a gray “form” within a small window, its selection directly have an impact on the effect of image edge extraction.

In general, the window size use $3 \times 3$, $5 \times 5$, $3 \times 7$ and $3 \times 3$ window is fastest, the edge extraction is most sophisticated, so this article chooses $3 \times 3$ planar structure elements (Wu, 2015).

2.1. The Selection of Structural Elements

The selection of structure element of mathematical morphology in the edge detection has played a large role, at the same time a single dimension and the commonly multi-scale comparatively fuzzy.

This paper adopts the structure of four directional $3 \times 3$ for testing. Figure 1 includes the detection of different direction structure of operator, the horizontal and vertical $45^\circ$, $135^\circ$. It respectively is the Q, W, Z, R. the selection of the final structure operator is $B = aQ + \beta W + \lambda Z + \eta R(\alpha, \beta, \lambda, \eta$ is the corresponding weight respectively, $\alpha + \beta + \lambda + \eta = 1$ the closest to the structure of the operator, only 0 or 1).

The weight selective basis of structure operator: firstly, it calculate the gradient for any of pixels $f(x,y)$ in the image, the size of the gradient is $G(i,j) = \sqrt{f_x^2(i,j) + f_y^2(i,j)}$ the direction is, 

$$
\theta(i,j) = \arctan \left( \frac{f_y(i,j)}{f_x(i,j)} \right)
$$

according to the characteristics of the image edge, the direction of their corresponding maximum gradient is a perpendicular to the direction of edge, then selecting the structural elements in corresponding direction to carry out edge detection, the use of this method is different with conventional average sum of all direction, this method greatly reduces the computational

Figure 1. Four direction structure elements

(a) Horizontal

(b) Vertical

(c) $45^\circ$

(d) $135^\circ$
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