WAVELET-BASED FOREST AREAS CLASSIFICATION BY USING HIGH RESOLUTION IMAGERY

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ABSTRACT:

This paper examines that is extracted certain information in forest areas within high resolution imagery based on wavelet transformation.
First of all, study areas are selected one more species distributed spots refer to forest type map. Next, study area is cut 256 × 256 pixels size because of image processing problem in large volume data.
Prior to wavelet transformation, five texture parameters (contrast, dissimilarity, entropy, homogeneity, Angular Second Moment (ASM)) calculated by using Gray Level Co-occurrence Matrix (GLCM). Five texture images are set that shifting window size is 3×3, distance is 1 pixel, and angle is 45 degrees used. Wavelet function is selected Daubechies 4 wavelet basis functions.
Result is summarized 3 points;
First, Wavelet transformation images derived from contrast, dissimilarity (texture parameters) have on effect on edge elements detection and will have probability used forest road detection.
Second, Wavelet fusion images derived from texture parameters and original image can apply to forest area classification because of clustering in Homogeneous forest type structure.
Third, for grading evaluation in forest fire damaged area, if data fusion of established classification method, GLCM texture extraction concept and wavelet transformation technique effectively applied forest areas (also other areas), will obtain high accuracy result.

KEY WORDS: KOMPSAT EOC, GLCM, Wavelet transformation, classification

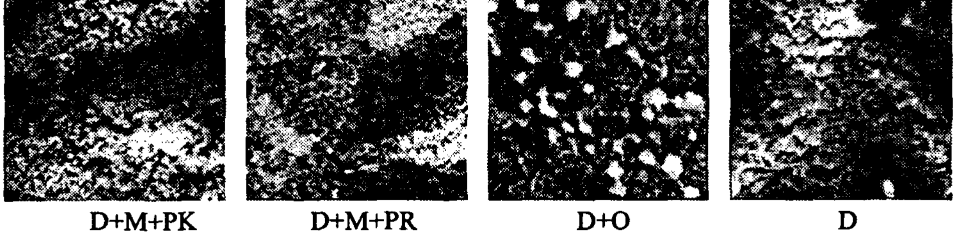
1. INTRODUCTION

Wavelet transformation is used to many fields, especially in signal processing, but nowadays many image processing applications needed wavelet algorithm. Wavelet transformation function is usually used to image compression, image noise removal, edge detection, and so on in image processing fields. This paper examines that is extracted certain information in forest areas within satellite image based on wavelet transformation.

2. METHOD

2.1 Study areas

Ok-Kye areas (belong to Kang Won province) are damaged to forest fire in 2004. Our study is research for these areas.
Training sites are divided into four groups (respectively 256pixel X 256pixel). First group is made up Pinus densiflora, mixed forest, Pinus koraiensis. Second group is made up Pinus densiflora, mixed forest, Pinus rigida. Third group is made up Pinus densiflora, bare soil. Fourth group is made up Pinus densiflora.



D+M+PK D+M+PR D+O D

Figure 1.Training sets in forest fire damaged areas
D: Pinus densiflora, M: mixed forest, PK: Pinus koraiensis, PR: Pinus rigida, O: Bare soil

2.2 GLCM Theory

GLCM texture considers the relation between two pixels at a time, called the reference and the neighbour pixel. In the illustration below, the neighbour pixel is chosen to be the one to the east (right) of each reference pixel. This can also be expressed as a (1, 0) relation: 1 pixel in the x direction, 0 pixels in the y direction. Each pixel within the window becomes the reference pixel in turn, starting in the upper left corner and proceeding to the lower right. Pixels along the right edge have no right hand neighbour, so they are not used for this count (R. M. Haralick et al, 1973).

Table 1.GLCM texture features used

Feature	Expression
ASM	$\sum_{i=0}^{N-1}\sum_{j=0}^{N-1} g^2(i,j)$
Contrast	$\sum_{i=0}^{Ng-1}\sum_{j=0}^{N-1} (i-j)^2 g(i,j)$
Dissimilarity	$\sum_{i=0}^{N-1}\sum_{j=0}^{N-1} g(i,j)\lvert i-j\rvert$
Entropy	$\sum_{i=0}^{Ng-1}\sum_{j=0}^{N-1} (i-j)^2 g(i,j)$
Homogeneity	$\sum_{i=0}^{N-1}\sum_{j=0}^{N-1} \frac{1}{1+(i-j)^2} g(i,j)$

2.3 Wavelet transformation

Wavelets are functions generated from one single function Ψ by dilations and translations. The basic idea of the wavelet transform is to represent any arbitrary function as a superposition of wavelets. Any such superposition decomposes the given function into different scale levels where each level is further decomposed with a resolution adapted to that level.

$$Wf(a,b) = \int f(x)\frac{1}{\sqrt{a}}\psi\left(\frac{x-b}{a}\right)dx \qquad (1)$$

The discrete wavelet transform (DWT) is identical to a hierarchical sub band system where the sub-bands are logarithmically spaced in frequency and represent an octave-band decomposition. By applying DWT, the image is actually divided i.e., decomposed into four sub-bands and critically sub-sampled as shown in Figure 2(a). These four sub-bands arise from separate applications of vertical and horizontal filters. The sub-bands labelled LH1, HL1 and HH1 represent the finest scale wavelet coefficients i.e., detail images while the sub-band LL1 corresponds to coarse level coefficients i.e., approximation image. To obtain the next coarse level of wavelet coefficients, the sub-band LL1 alone is further decomposed and critically sampled. This results in two level wavelet decomposition as shown in Figure 2(b). Similarly, to obtain further decomposition, LL2 will be used. This process continues until some final scale is reached (Arivazhagan S. and Ganesan L., 2003).

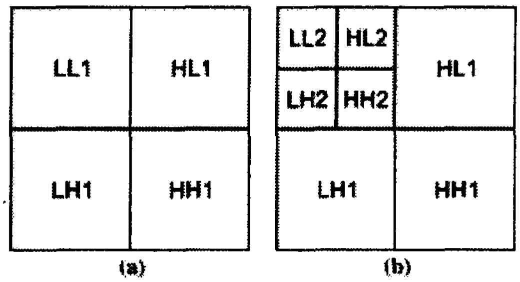


Figure 2.Image decomposition :(a)one level, (b)two level.

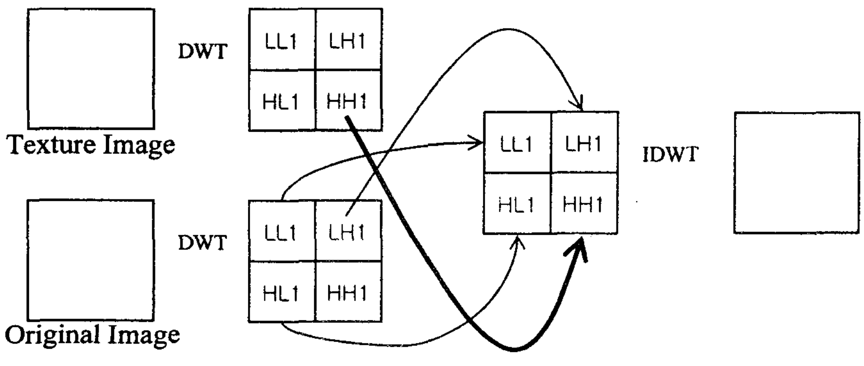


Figure 3. Wavelet-based image fusion

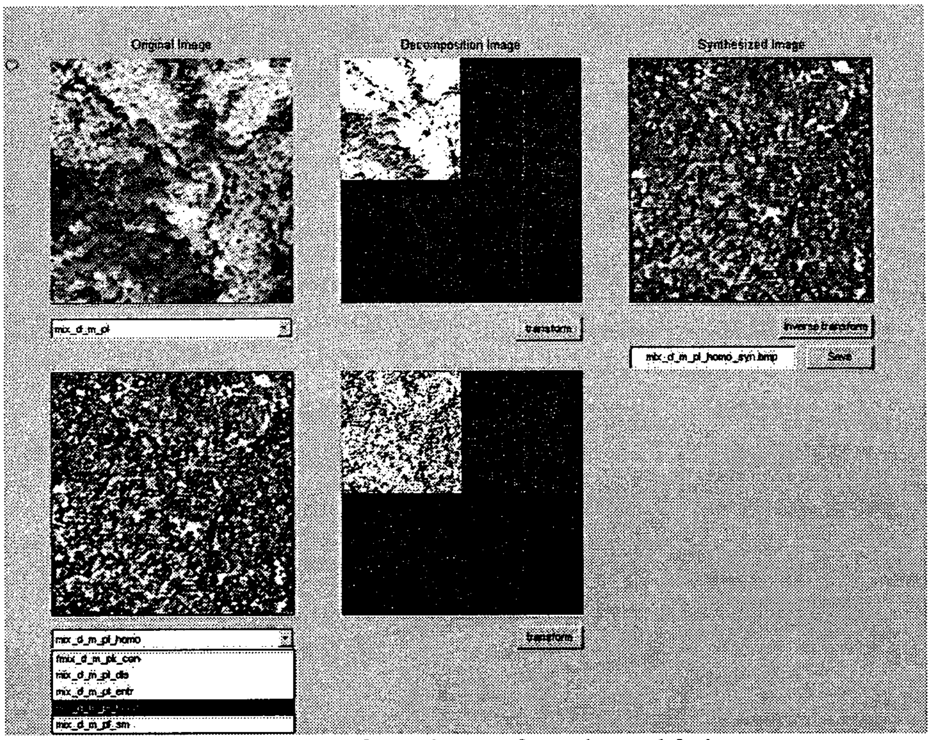


Figure 4.GUI of wavelet transformation and fusion

3. RESULTS and DISSCUSSION

Contrast and Dissimilarity texture images are similar results by visual interpretation. Those results are good for detection of crown parts. Dissimilarity texture images are included detail information more than Contrast ones.
Wavelet transformation images derived from contrast, dissimilarity (texture parameters) have on effect on edge elements detection and will have probability used forest road detection.
Entropy texture images are shown up lower value of homogeneity objects and then appeared lower intensity. It is mainly detected area of forest fired spots and homogeneity tree species. Homogeneity texture images are similar pattern, but it is apparently discriminated edge parts.

For merging GLCM texture image and wavelet transformation image, image decomposition and fusion function is developed by Graphical User Interface (GUI) of Matlab 7.0 version. And used Daubechies 4 wavelet function among of wavelet basic function (Figure 4).
Wavelet fusion images derived from texture parameters and original image can apply to forest area classification because of clustering in Homogeneous forest type structure For grading evaluation in forest fire damaged area, if data fusion of established classification method, GLCM texture extraction concept and wavelet transformation technique effectively applied forest area (also other areas), will obtain high accuracy result.

Future works are needed study of application variety of wavelet basic functions and verify those results.

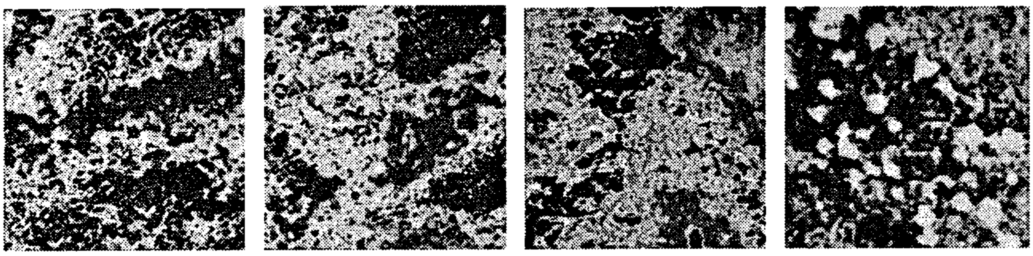


Figure 5.Pseudo color map of training sets area

forest fire area (Severe)	forest fire area (middle)
forest fire area (light)	pinus densiflora
mixed forest	broad-leaved tree
bare soil	shade area

4. CONCLUSIONS

Wavelet transformation is used to many fields, especially in signal processing, but nowadays many image processing applications needed wavelet algorithm. Wavelet transformation function is usually used to image compression, image noise removal, edge detection, and so on in image processing fields.
This paper examines that is extracted certain information in forest areas within satellite image based on wavelet transformation.
First of all, study areas are selected eight areas that are one more species distributed spots refer to forest type map. Next, study area is cut 256 × 256 pixels size because of image processing problem in large volume data.

Prior to wavelet transformation, five texture parameters (contrast, dissimilarity, entropy, homogeneity, Angular Second Moment (ASM)) calculated by using Gray Level Co-occurrence Matrix (GLCM). Five texture images are set that shifting window size is 3×3, distance is 1 pixel, and angle is 45 degrees used. Wavelet function is selected Daubechies 4 wavelet basis functions and embodied by Matlab 7.0 version.

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5. ACKNOWLEDGEMENTS

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