An Application of Detecting Cryptomeria Damage by Squirrels Using Aerial Images

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Abstract. The study proposed an application to detect cryptomeria trees which had been damaged by squirrels from an aerial image. Each pixel of the aerial image is classified into damaged tree pixels or healthy pixels by super vector machine (SVM) developed in this paper. The application achieves about 82.24% true positive rate (TPR) in detecting damaged trees and about 1.30% false positive rate (FPR). It is a smart tool for monitoring smart forests.

Keywords: Aerial images · Cryptomeria squirrel damage · Image classification

1 Introduction

Xitou is a forest area in the center of Taiwan which is managed by Taiwan University. The area of Xitou is about 2500 ha. The altitude of Xitou is between 600 and 2000 m high. There are a lot of valuable plant's in Xitou, including a lot of Cryptomeria. However, the bark of the cryptomeria is often eaten by Formosan Giant Flying Squirrel or Callosciurus erythraeus. Cryptomeria bark is not a natural part of the diet of the Formosan Giant Flying Squirrel. However, the population of squirrels in the area has exceeded the natural food supply due to excess feeding by tourists. As they lack natural food sources they have started to eat the Cryptomeria bark. When the bark of the Cryptomeria is eaten by the squirrel, the top canopy of the trees displays a green to pink color change in the leaves, and in latter stages turn white. The pink or white canopy is the target detected in this study. Burges [1] analyses that SVM has been used for pattern recognition many different fields. Especially, aerial image become great important for earth observation [2], recently. This study follows a suggestion from a previous study to use Super Vector Machine (SVM) to identify target trees from the aerial image take in Xitou.

C.-Y. Chang et al. (Eds.): ICS 2018, CCIS 1013, pp. 186–189, 2019.
https://doi.org/10.1007/978-981-13-9190-3_19

2 Methods

2.1 Supervised Learning

A support vector machine (SVM) is a supervised learning algorithm. It constructs an optimal hyperplane as a decision surface such that the margin of separation between the two classes in the data is maximized. In this study, pixels selected from RGB images are 3-dimensional feature space for the input data. Two classes of training data are selected. One is the pixels from the damaged trees which are the target pixels, the other is healthy pixels. These training data is processed to find the optimal decision surface as the classifier. Figure 1 shows two test sample images with the resolution 400 × 400 pixels. Each one image contains several damaged areas in the upper canopy. In this study, SVM training using linear kernel. The training result obtained 8 × 3 support vectors and other parameters shown in the appendix.

(a) (b)

Fig. 1. Two test sample images.

2.2 Classifications

Figure 2 shows the detected target pixels shown on the two right hand images. Pixels transformed by using the SVM classifier into a rage of negative to positive values. The transformed pixels with a positive value are considered as target pixels, these target pixels are shown colored yellow.

3 Experimental Results

3.1 Sub Samples Testing

There are two images used for classification. Each image with 400 × 400 pixel size. Tables 1 and 2 shows the experimental results. Total number of pixels for each image are 160,000 pixels. Each pixel is classified as a target pixel or a non-target pixel. The true positive (TP) number achieves 18,574 and 10,642 pixels for image no. 1 and 2 respectively. The true positive rate achieves 87.14% and 77.34%.

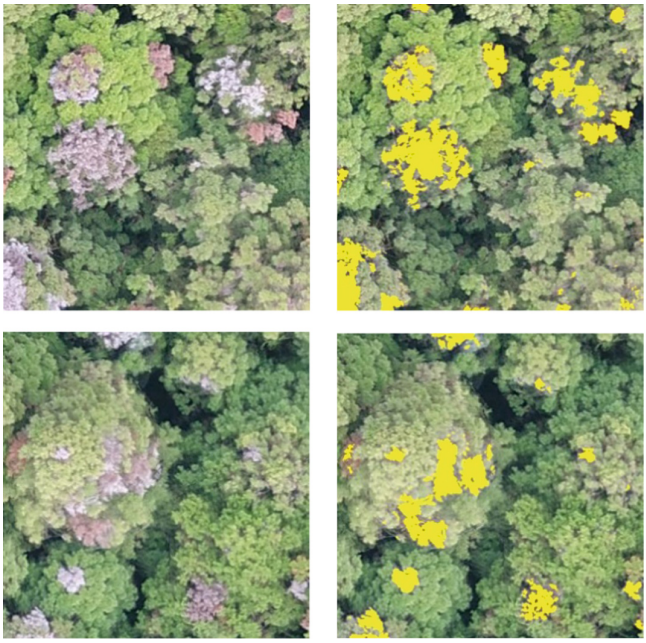

Fig. 2. Two SVM resulted images, the left two images are the original images and the right two images are corresponding SVM resulted images. (Color figure online)

The average rate is 82.24%. The true negative rate (TNR) achieves 98.44% and 98.97%, the average rate is 98.70%.

Table 1. The detected pixel counts.

Image no	Positive pixels	Negative pixels	TP	TN	FP	FN
1	21314	138686	18574	136521	2165	2740
2	13760	146240	10642	144735	1505	3118

Table 2. The precision of detecting rate.

Image no	TPR	TNR	FPR	FNR
1	87.14%	98.44%	1.56%	12.86%
2	77.34%	98.97%	1.03%	22.66%
Average	82.24%	98.70%	1.30%	17.76%

3.2 Whole Image

The whole image is processed by SVM is shown in Fig. 3b.

(a) (b)

Fig. 3. The whole image classification. (a) is the original image. (b) is the SVM transformed image.

4 Conclusions and Discussions

SVM is a good choice for the classification and identification of squirrel damaged cryptomeria using an aerial image. The red to white colors of damaged cryptomeria provides a stark contrast with its healthy green color. Therefore, SVM is easily used to identify individual damaged trees in the forest. The aerial image is obtained at a lower cost and higher resolution then a satellite image. It is a smart tool for forest management.

References

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