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Construction of Ortho Image for Efficient Forest Management Using UAS

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Abstract

In this study, we use the UAS to acquire ortho image on the pine trees infected by the pine wilt disease and suggest how to use the information. Through the study, we would produce the ortho image of the target area and could effectively acquire the position and quantity of pine trees infected by the pine wilt disease. In addition, we suggested the effective method of accessing the infected trees using the handheld GNNS and we expect that this method would be a good boost in forest management and the decision making process. If the related information is entered into the database through the periodic shooting, it would be possible to monitor the changes in the forest. Also if the forest management is conducted using the UAS, the efficiency would be greatly enhanced for the work of the identification and quantifying the infected trees.

Keywords: UAS, Ortho Image, Forest Management, Pine Wilt Disease

1 Introduction

The spatial information is the information on the position of natural objects and artificial objects and the information required to make decision using them [1].

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The typical examples of spatial information include the map and navigation. With the development of information and technology, it creates a lot of values when it is used to make maps or is merged with the advanced information technology [2]. Recently, the spatial information is the foundation of creating the next generation industries like the individual navigation and U-Health and is also used in various fields including the government's national land planning, urban planning, large scale disaster measures, security and national safety plan, public facility management, cultural heritage preservation, and analysis of commercial area [3]. In this study, we suggest the use of the spatial information acquired by using the advanced technologies to the forest management, especially in the prevention of pine wilt diseases.

The forest in Korea is made of 41% of conifers, 27% broad-leaved trees and 29% mixed trees and looks like susceptible to wild fire and forest diseases [4]. In 2011, the area suffered from the pine wilt disease was about 5,000ha, requiring the fund of 22.2 billion Won for management. In addition, the pine wilt diseases has been concentrated on a certain area and the damages from the disease has gone up [5].

To prevent the pine wilt diseases, the government has surveyed the affected area taking into consideration the physiological characteristics of the pine wilt disease and conducted the chemical and physical control (such as removing the infected trees) [6]. But, as the access to the affected area is difficult for disease control as well as surveying of the affected area, the site survey requires a lot of labor [7].

Accordingly, the rapid understanding of the infected trees with the regular monitoring of the affected area through the scientific and objective method is a must to make the objective evaluation on the possible future breakup and effect. So, in this study, we used the UAV equipped with various sensors to get the spatial information on the infected trees and suggested how to use the information. The spatial information would be helpful to save the time and money in preventing the pine wilt diseases and would be the data on which the new policy and budget can be prepared.

2 Data Acquisition and Processing

2.1 Composition of UAV

For this study, we used UX5 of Trimble, equipped with various sensors to acquire the spatial information for forest management. UX5 is made of GPS, digital camera, radio antenna, and pilot tube and other sensors. We used the digital camera of Sony NEX-5R which was calibrated for the photographic survey. As the camera was equipped with the sensor of APS (Advanced Photo System)-C type which is similar to DSLR, the high sensitivity/low noise image shooting was

possible. In addition, the radio antenna is designed to transmit the flight data such as speed, altitude and coordinate wireless to the radio modem on the ground controller. In addition, the pitot tube was to monitor the speed and altitude of aircraft by measuring the difference between pressures in the holes made in the front and sides. [8].

2.2 Data acquisition and processing

For this study, a part of Geojedo Island was selected as a target area as that area was reported to having been infected with the pine wilt disease. The spatial information was acquired using the UAV. 715 aerial images were shot and the 3D model was generated using the adjacent two photos with 80% longitudinal overlap and 80% lateral overlap. Fig. 2 shows the target area.

Fig. 2. Study Area

Aerial images are imported to data processing module of TBC(Trimble Business Center) along with their locations, orientations, and camera calibrations. Geometric errors in the raw images from an UAV are significant as a result of the dynamic platform from which they are captured and the imprecision in the UAV's position and orientation sensors. To correct for errors in the positions and orientations of the aerial images, we used photogrammetric methods to adjust the photo stations. This is done in data processing module first as an adjustment with tie points. This module automatically finds tie points in all available stations based on state of the art computer vision algorithms, and then the TBC adjusts the stations simultaneously for a best fit. Automatically matched photo tie points are distributed densely over the complete project, even in challenging low-texture terrain. We generated the 10cm grade ortho image through the data processing using TBC. Fig. 3 shows the ortho image of the target area.

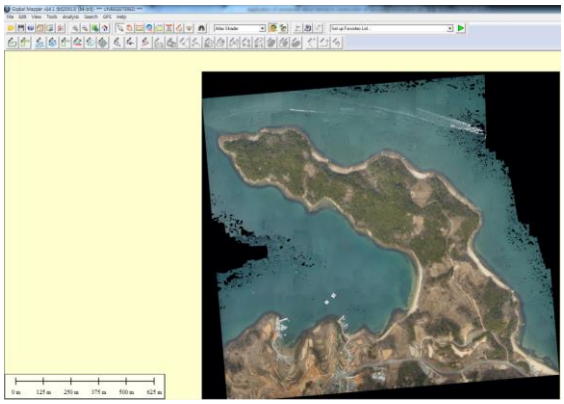

Fig. 3. Ortho Image

3 Application of Geospatial Information for Forest Management

In this study, to evaluate the possibility of forest management using the spatial information, we used the ortho images acquired from UX5 to identify the location and quantity of the infected trees. Fig. 4 shows the infected trees visually identified in the ortho image..

Fig. 4. Ortho Image

As shown in Fig. 4, we identified the location and quantity of the trees infected by the pine wilt diseases using the high resolution ortho image. The information on the position of the infected trees can be used for basic data for future control of the diseases while the information on the quantity of the infected trees was accurate and would contribute to the preparation of the control plan. For

identifying the affected trees, we used the image classification technique and automatically identified the infected trees. For the identification of the infected trees, we used the supervised classification method using ENVI software and conducted the image classification for a part of target area. As for the classification method, we used the maximum likelihood method in the supervised method and the training set for the classification was composed of 4 elements such as water, bare ground, tree and damaged tree.

Fig. 5 shows the identification result of infected trees through the supervised classification of the images.

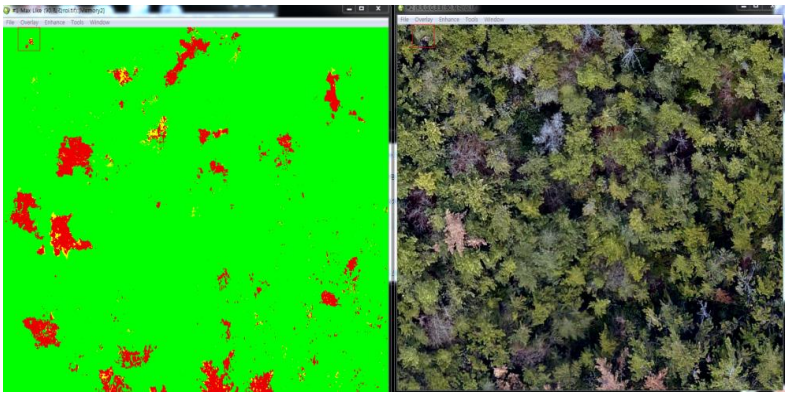

Fig. 5. Result of Classification

We can notice that the number of infected trees through the supervisedclassi fication is more than that through the visual identification. It looks like that this result is caused by the fact that some broad-leaved trees having their leaves fallen and the bare ground are wrongly classified as the infected tree because the classification method uses only the color of tree to identify the infected trees. If the classification is made through the object based classification taking into account the crown of trees and colors using the 5cm grade GSD image, the result would be improved.

4 Conclusion

In this study, we suggested the method of using the UAV equipped with various sensors to acquire the spatial information on the trees infected by the pine wilt disease. We made the following conclusions.

1. Using the UAV equipped with various sensors, we could acquire the images of the target area and use the automated data processing system to produce the DSM and ortho image.

2. Using the ortho image, we could effectively identify the location and quantity of the trees infected by the pine wilt diseases.

3. If the periodic image taking is conducted and the data is entered into database, we could monitor the change in the forest. In the future, if the study on the object based classification is conducted using the color and crown of trees, the efficiency in identifying the location and quantity of the infected trees would be greatly improved.

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