Helicopter Based Observation of Vegetation

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1. Introduction

Remote sensing is a very effective technology for analyzing forest on a large scale. In recent years, the spatial resolution of satellite mounted sensors has greatly improved and detailed observations can be made. However, in order to identify and characterize vegetation, the resolution of satellite imagery is still not high enough. It is necessary to acquire higher resolution data using e.g. an airplane so that discernment of leaves or crowns is possible.

In this study, vegetation observations using a video camera and a spectroradiometer mounted on a helicopter were planned and carried out at Kanazawa university campus[1]. The video camera was used as a high spatial resolution sensor, and the spectroradiometer was used for synchronous measurement of the spectral reflectance of the area. The target area measured by spectroradiometer was identified by video image. The spectral reflectance of the area was compared with image analysis results.

2. Method and Analysis

Forest observation by helicopter was performed at the campus of Kanazawa university. Figure 1 shows observation of trees by helicopter. The instruments used by this observation are a video camera and a spectroradiometer.

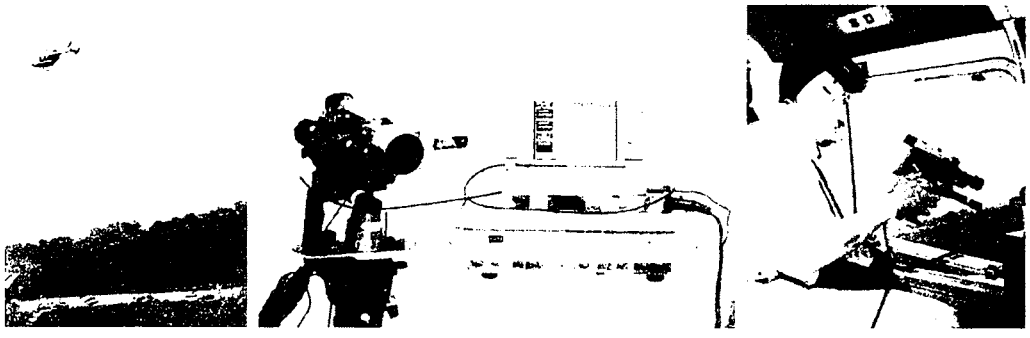
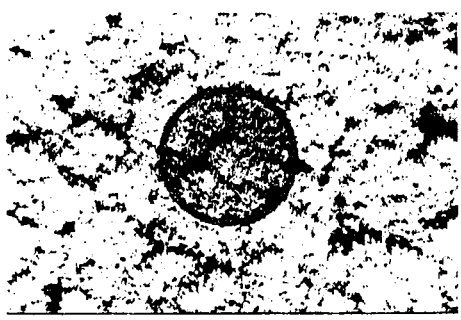


Figure 1: Observation of trees(helicopter, instruments, inside the plane)

A spectroradiometer can measure the reflectance of each separated wavelength. In this study, we used the ASD FieldSpec UV/VNIR. It has a spectral range of 350 - 1050 nm and 512 channels. An angle limiting lens having the field of view of 1 degree was attached to the grip of the spectroradiometer. When the distance to objects is 300 m, the diameter of the target area is 5.2 m. A video camera can record the image of three RGB channels. The image size of each frame was 720 by 480 pixels. The spatial resolution is 3 cm per pixel when the distance is 300 m. The grip of the spectroradiometer with a scope and the video camera were fixed on a metal plate. The scope was adjusted just before observation so that it is at the center of the video frame. Using simultaneously the video camera and the spectroradiometer, the spectrum of a circle area with a diameter of 5.2m of the center in each video frame and the image can be measured synchronously. Figure 2 shows the analysis of image data and spectral data. By image processing in the circle, the dark pixel was counted. The average of intensity in each circle of R, G, B images was computed. Using spectral data, the average reflectance for each of R(630 - 690 nm), G(520 - 600 nm), B(450 - 520 nm) and near infrared(760 - 900 nm) was calculated.

- **Video image**



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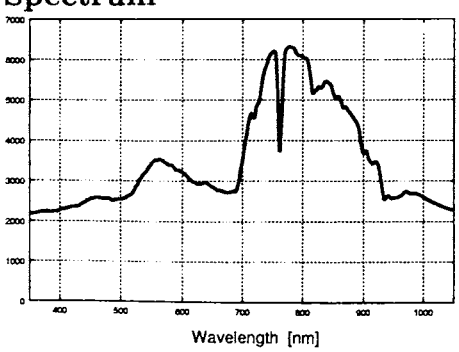
- Shadow rate (dark area)
- Average of intensity in the area for each of:
  - Red
  - Green
  - Blue

- **Spectrum**



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- Average of reflectance
  - NIR: 760 - 900 nm
  - R: 630 - 690 nm
  - G: 520 - 600 nm
  - B: 450 - 520 nm

Figure 2: Analysis of image data and spectral data

3. Results

Figure 3 shows the observation area from the helicopter in November 19, 2000. The altitude was 300 m. There are many species in this forest, mostly deciduous trees with red and yellow leaves.

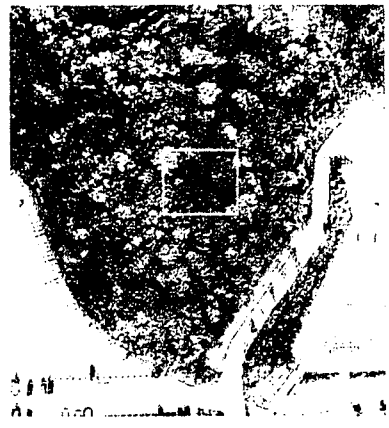

Figure 3: Observation area(November 19, 2000. Altitude of helicopter: 300m)

By image matching technique using video image and the wide image of observation area, the location of the target area of the spectral data was identified. Processed number of frames was 130. In Figure 4, the circles shows the identified area which measured spectrum by spectroradiometer. In Figure 5, upper graph shows the result of shadow rate. Middle graph shows the average of intensity using RGB channel of each video image. Bottom graph shows the average of reflectance of R,G,B and NIR of each spectral data. The characteristic between the intensity of image and the reflectance of the spectrum are similar. These values become small when the rate of shade is large.

Figure 4: Identified location of each spectral data.

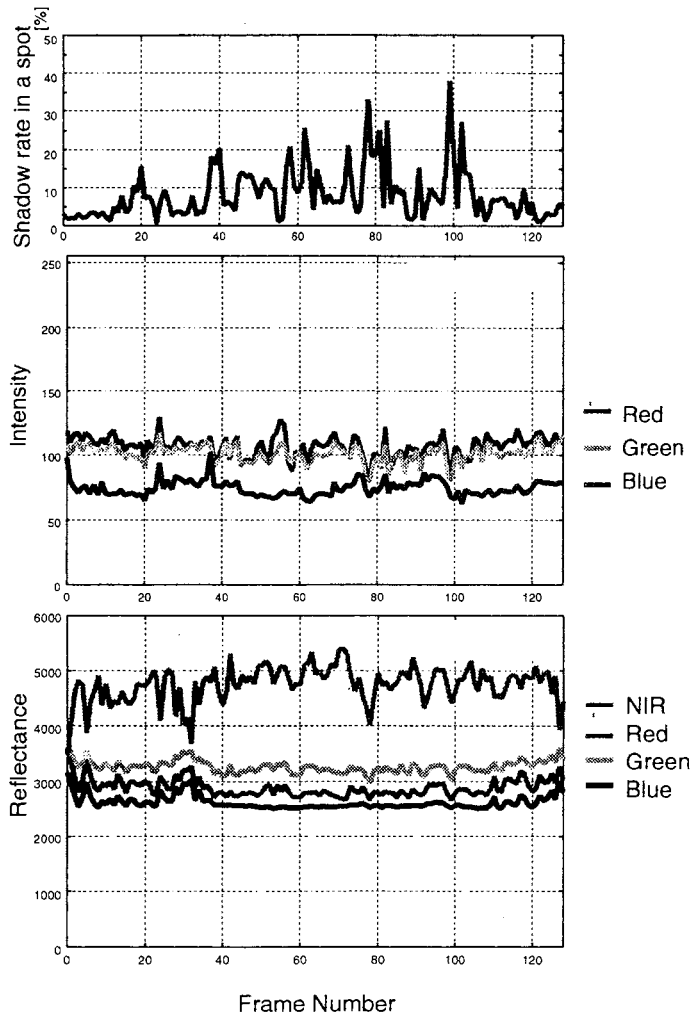

Figure 5: Comparison of image data and spectral data(shadow rate, intensity, reflectance)

4. Conclusion

Vegetation observations using a video camera and a spectroradiometer mounted on a helicopter were planned and carried out at Kanazawa university campus. Using the video camera and the spectroradiometer, the image data and the spectrum data of the same area were synchronously recorded. The spectral reflectance of the area was compared with image analysis results. Texture analysis of the image is left as future work.

References

[1] R. Komura, M. Kubo, and K. Muramoto, "Analysis of relationships between image data and spectrum of vegetation measured from helicopter", Proc. Int. Geosci. Remote Sensing Symp., Sydney, Australia, July 2001.