ANALYSIS OF MIDDLE PULSE DATA BY LIDAR IN THE FOREST

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ABSTRACT:

About 2/3 of Japanese land is covered with the forest. The forest has many functions, such as security of the source of a river or prevention of soil erosion. In addition, in recent years the role of the forest as the absorption source of the greenhouse gas attracts attention. However, because of the fall of wood price and the aging of worker, it is one of the social problems that the forests which are not managed well has been increased. As such forests cause earth and sand outflow and fallen trees, it is necessary to improve with precedence. We tried the analysis of pulse data by the LIDAR to extract those forests effectively.

1. TEST FIELD

We selected the forest owned by the Tokyo University of Agriculture, in Okutama.

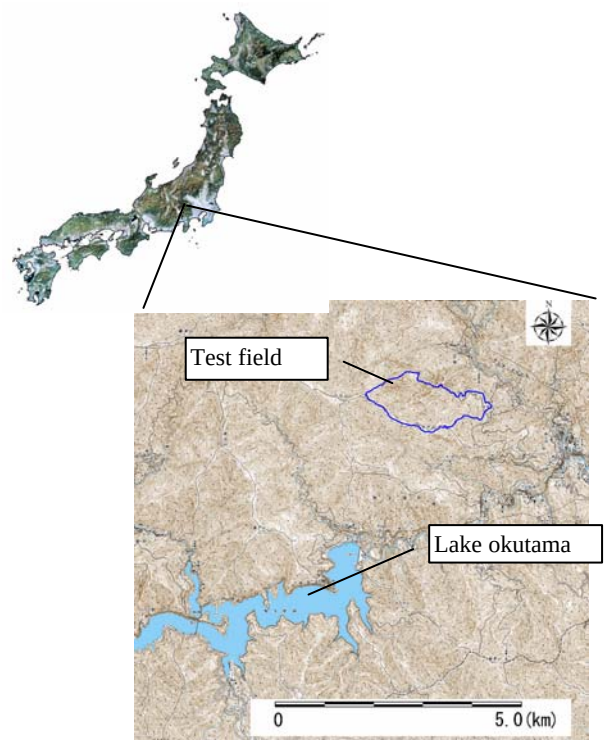


Figure 1. Test field

2. SPECIFICATIONS OF SURVEY BY LIDAR

Table 1 shows specifications and the day of survey.

Contents	Specifications
LIDAR	ALTM3100DC
Flight height (AGL)	1,000m
Speed	250km/h
Pulse frequency	70,000Hz
Scan frequency	35Hz
Scan angle	±20°
Data interval	About 0.8m
Day	June 5, 2006
Course	3 lines

Table 1. Specifications and the day

Figure 2 shows flight line.

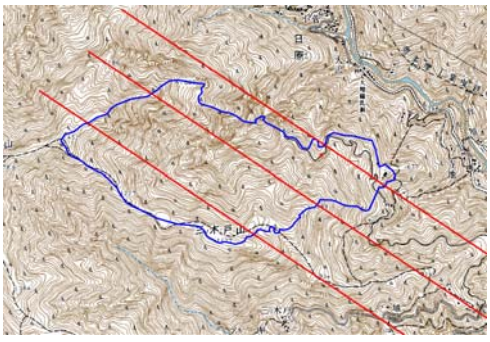


Figure 2. Flight line

3. WORKFLOW

Figure 3 shows the workflow of this study.

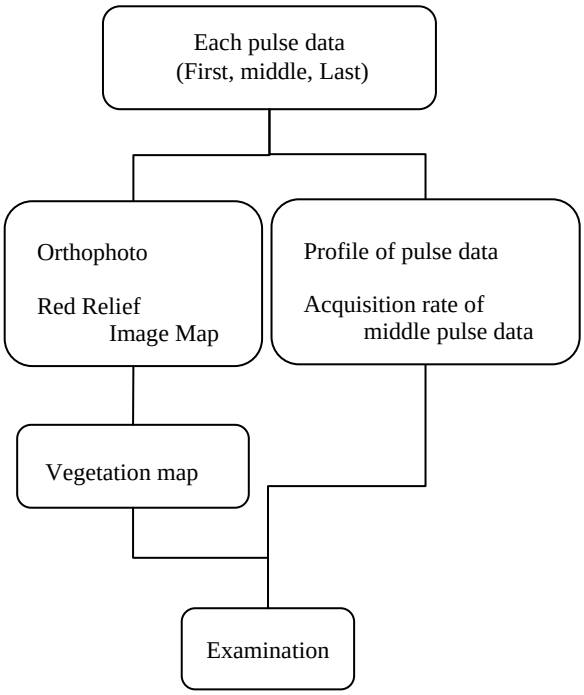


Figure 3. workflow

4. VEGETATION MAP

We can make a vegetation map without specific technique by photograph, ortho photo and Red Relief Image Map[1)]. There is a case to hesitate about judgment depending on image condition only with the photograph, by using the Red Relief Image Map, it is easy and precise to extract boundary lines of plant communities.

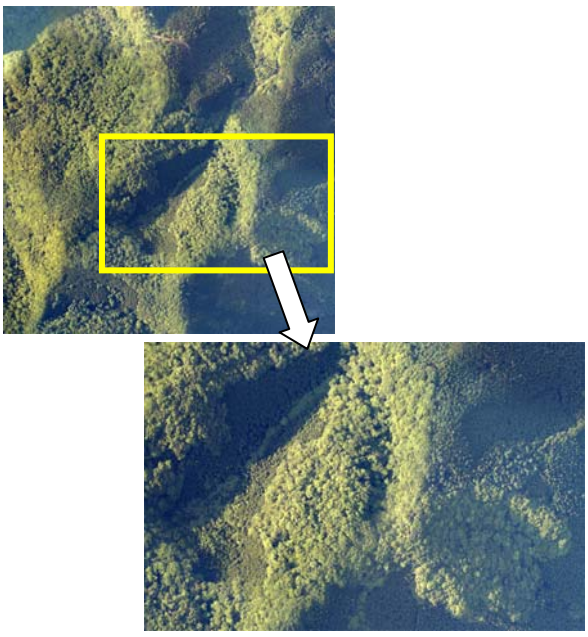


Figure 4. Example of Ortho Photo

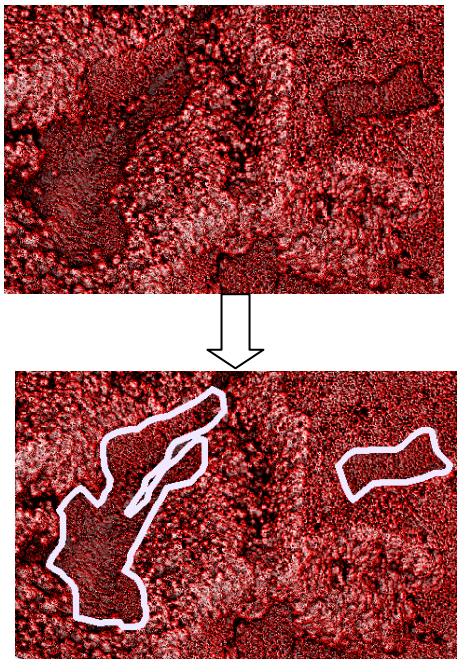


Figure 5. Example of vegetation map

5. ANALYSIS OF THE DISTRIBUTION OF MIDDLE PULSE DATA

5.1 Image of pulse mode

Figure 6 shows the image of laser pulse.

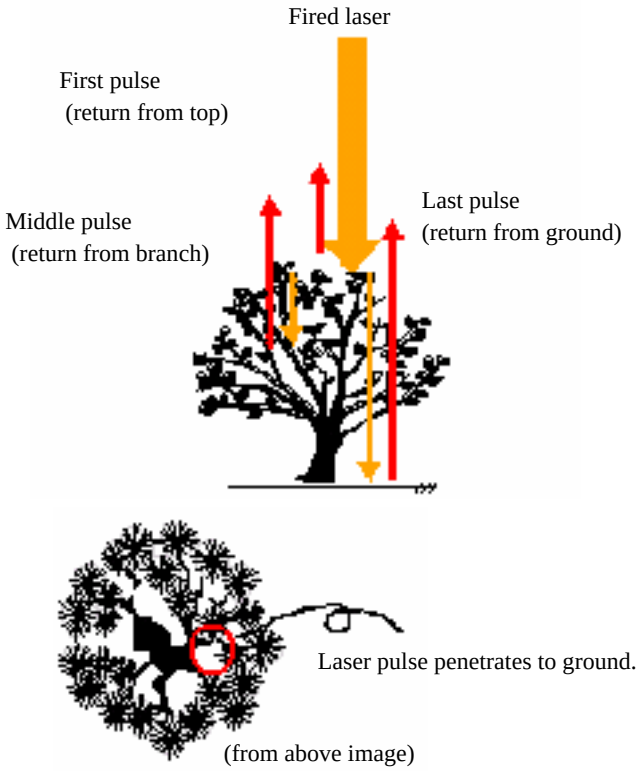


Figure 6. image of reflect laser pulse

5.2 Study area

This theme is to show the possibility that we can easily distinguish forest type and the management situation from the distribution of middle pulse data. By profiling the distribution of middle pulse data, study area is divided into three types(1～3).

(1) planting coniferous forest which are managed
(2) planting coniferous forest which are not managed
(3) deciduous forest that is not managed

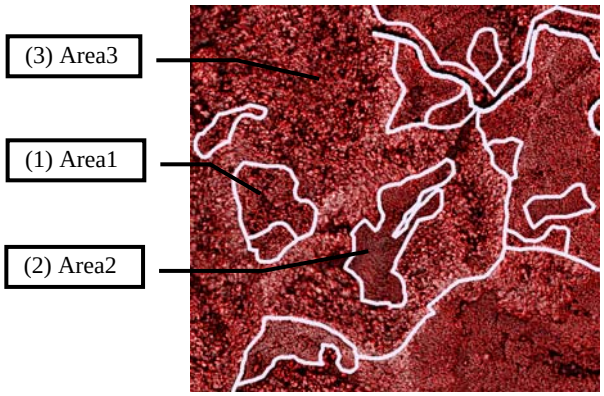


Figure 7. Study area

Figure 8. managed area of planting coniferous forest(1)

Figure 9. not managed area of planting coniferous forest(2)

5.3 The distribution grasp of middle pulse data by the profile

In case of (1), by profiling the distribution of middle pulse data, the hierarchy of each pulse(First, middle and Last) is shown in Figure 10. It is clear to understand the distribution of each pulse. In case of (2), because trees grow thick and there is little forest floor vegetation, it is difficult to acquire the middle and Last pulse data (Figure 11). In case of (3), the middle pulse data are in a condition to have varied in a wide range because leaves in deciduous forests structure the multi-layer that scrambled for light (Figure 12).

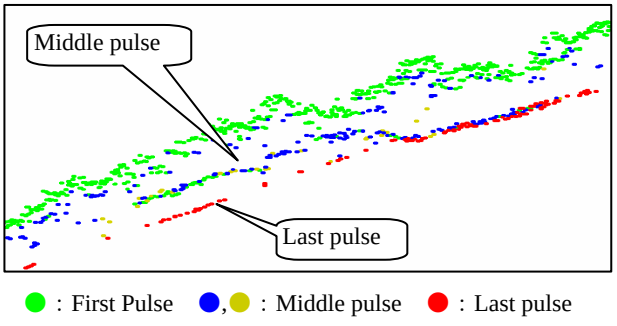
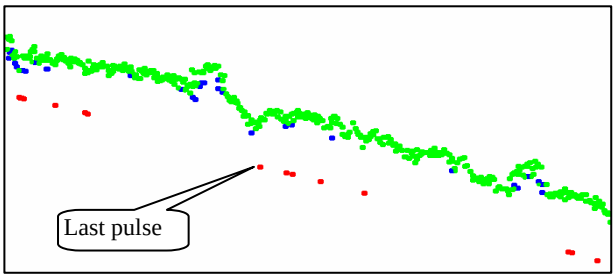
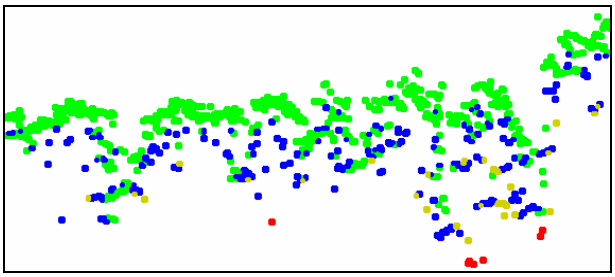


Figure 10. Distribution of data in case of (1)



● : First Pulse ●,● : Middle pulse ● : Last pulse

Figure 11. Distribution of data in case of (2)



● : First Pulse ●,● : Middle pulse ● : Last pulse

Figure 12. Distribution of data in case of (3)

5.4 The distribution grasp of middle pulse data by the acquisition rate

Next to distribution grasp by the profile, we partition the study area into small mesh(25m × 25m) and calculated the acquisition rate of middle pulse data on all mesh. In case of (1), the rate is more than about 20%, In case of (2), it is less than about 10%, In case of (3), it is more than10%. As a result, the distribution grasp by the acquisition rate accord with the forest types and management situation.

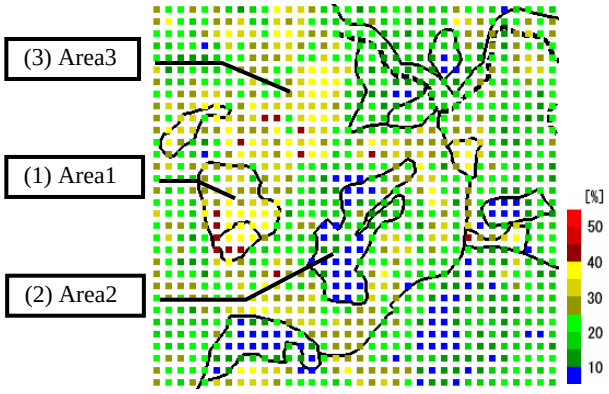


Figure 13. Acquisition rate of middle pulse data

5.5 The distribution grasp of milled pulse data by the height

It is difficult to know the position of laser reflected (near the top of tree or the ground) by acquisition rate of middle pulse.

The tree height data are subtracted the ground data from surface data. This data processing has been supplied the distribution map of tree height (Figure 14). In the same way, Figure 15 shows height of middle pulse.
As a result, the distribution grasp by the height of middle pulse data accord with the forest types and management situation.

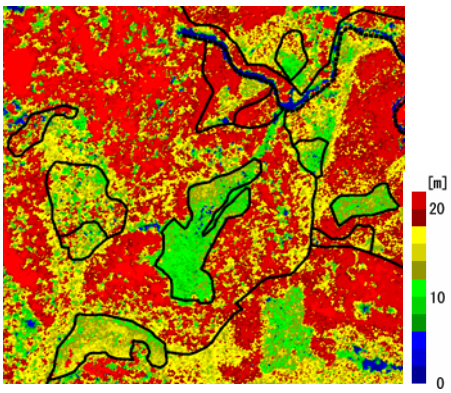


Figure 14. Distribution map of tree height

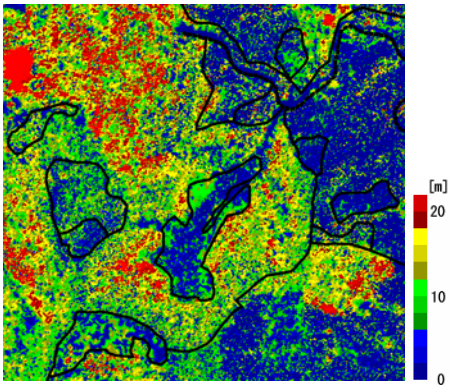


Figure 15. Distribution map of middle pulse height

6. SUMMARY AND PROBLEM

By analyzing the acquisition rate of middle pulse data of the LIDAR, we can grasp that the management situation of the forest roughly.

Generally it is difficult to get position information, and there are various difficulties in the field work, so this method is useful to know the forest which is necessary to maintenance with precedence.

We will try to perform similar examination in other seasons or other fields, and establish the method.

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1) Red Relief Image Map(RRIM : acquired an international patent by Asia Air Survey)
It is constituted of 3 parameters. Slope, Down openness, Upper openness except the elevation.
Characteristic points is

- It is difficult for people to understand the ordinary contour map. It is easy to read the topographic features on RRIM.
- If we compare RRIM with shared map expressed by light direction, it is able to distinguish from ridges and valleys on RRIM. Ridges are drawn by white, and valleys are drawn by black. The slope is the steeper, RRIM is expressed redder.