EVALUATION FOR DAMAGED DEGREE OF VEGETATION BY FOREST FIRE USING LIDAR AND DIGITAL AERIAL PHOTOGRAPH

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Abstract

The amount of vegetation physically damaged by forest fire can be evaluated using LiDAR (Light Detection And Ranging) data because the loss of canopy height and width by forest fire can be relevant to the number of points transmitted to the ground through the canopy of the damaged forest. On the other hand, biological damage of vegetation caused by forest fire can be obtained from the Normalized Difference Vegetation Index (NDVI), which determines the vegetation vitality. In this study, the degree of physical damage from the LiDAR data was classified into two classes, Serious Physical Damage (SPD) and Light Physical Damage (LPD). The degree of biological damage using NDVI was likewise classified into two classes, Serious Biological Damage (SBD) and Light Biological Damage (LBD). Overall, the area damaged by forest fire was graded into the following four categories: 1) SPD and SBD, 2) LPD and SBD, 3) SPD and LBD, and 4) LPD and LBD.

Objective of Study

- ✓ With characteristic of the LiDAR, we could evaluate the damaged area by forest fire as grading the damage.
- ✓ we also used a Near Infra-Red (NIR) aerial photograph for evaluating biological damage because LiDAR had the only physical information of burned area.
- ✓ Through the integration of the both data, the damaged area was classified into four grades as evaluated with serious or light biological and physical damage.

Study Area

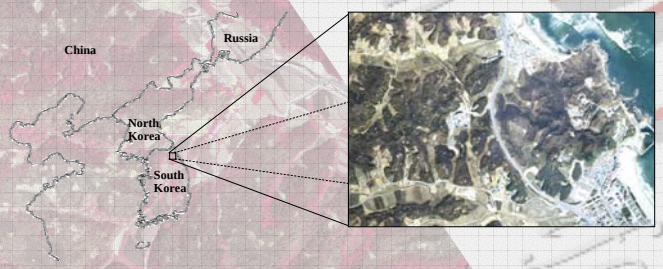


Figure 1. Location of study area

- ✓ The study area is located in the Yangyang-Gun, where forest fires occurred on 5th April 2005 (Figure 1).
- ✓ The forest area is composed of *Pinus koraiensis* (Korean Pine) mainly. Approximately 315 ha of whole area were selected for this study.

Materials

- ✓ **LiDAR system**
  - Optech ALTM 3070
  - ▪ Acquisition of LiDAR data
    - 6th April 2005
    - Point density : 1.27m^2

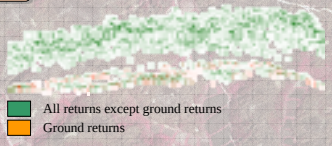


Figure 2. Structure of LiDAR data

- ✓ **Digital aerial photograph**
  - Taken by DC 4K02
  - ▪ Acquisition of photograph
    - 6th April 2005
    - Spatial resolution : 0.7m

(a) RGB Band (b) NIR Band

Figure 3. Acquired digital aerial photograph by DC 4K02

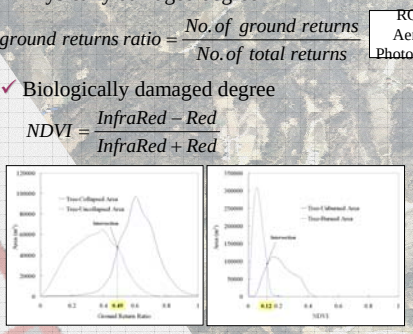
Processing

- ✓ Physically damaged degree

$$ground\ returns\ ratio = \frac{No.of\ ground\ returns}{No.of\ total\ returns}$$

- ✓ Biologically damaged degree

$$NDVI = \frac{InfraRed - Red}{InfraRed + Red}$$



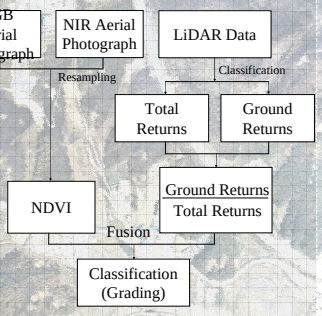


Figure 4. Method dividing each two class and processing grades

- ✓ When we determined the dividing criterions for both ground return ratio and NDVI, the intersections between each data set were used. (GRR: 0.49, NDVI: 0.12)

Result and Discussion

- ✓ Classification of Ground Returns Ratio and NDVI

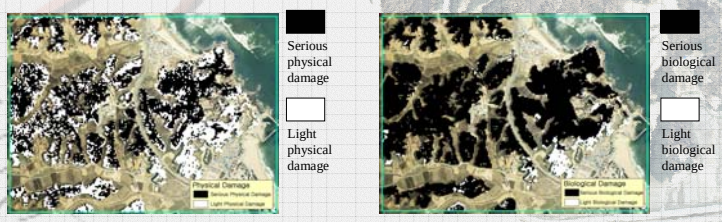


Figure 5. Classification of ground return ratio and NDVI into 2 grades

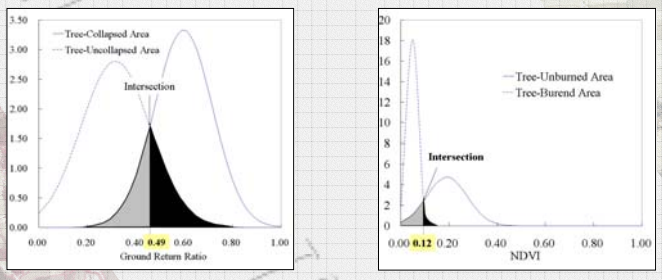


Figure 6. The probability density functions of GRR and NDVI of damaged area when following normal distribution. The gray and black color are the probabilities of misclassification.

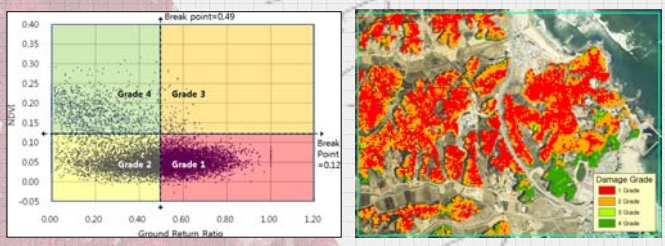


Figure 7. Evaluation of damaged severity integrating GRR and NDVI data sets

- ▪ SPD and SBD (1st Grade) ▪ LPD and SBD (2nd Grade)
- ▪ SPD and LBD (3rd Grade) ▪ LPD and LBD (4th Grade)