Identification of Conifer Plantation Stands Using SPOT-5 Data

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It is fundamentally necessary for forestry management that artificial forest plantation stands grow normally to be able to harvest timber from them. But if monitoring of those plantation stands were not done enough and number and area of well grown stands were not well known, it is difficult to estimate accurate amount of timber volume at harvesting time. This study aims to identify the growing condition of conifer plantation stands using satellite remote sensing data for better estimation of timber volume.

Our study site is Niihama Forest Management Unit of Sumitomo Forestry Co. Ltd. located in Shikoku Island and surrounding forest area (33°43'–56N, 133°16'–31'E), total area about 535km². Panchromatic (Pan) and multispectral (Multi) imageries of SPOT View Ortho taken on June 16, 2004 by SPOT-5 was used as RS data. Those images are atmospherically corrected by dark object subtraction, and geometrically corrected to Plane Coordinate System using nearest neighbor (NN) method (pixel size 2.5m). Ground truth was done on November, 2008.

Object based classification was employed to identify tree species by stand level. Object generation was done by eCognition 4, using Pan and Multi data, Scale=25, Shape=0.2 and Compactness=0.5, and we got about 105,600 polygons. All objects were classified by following 3 methods and their performance was compared. Other than SPOT Pan and Multi data, remote sensing data parameters (RS parameters) such as NDVI, NDWI, Ratio_NIR, Ratio_SWIR, NDI-SWR and Hue, Saturation and Intensity derived from RGB composite image using Band 4, Band 3 and Band 2, and DEM data were tested for classification. As SD of above parameters within each object was also used, 28 parameters in total were tested for classification. 11 classification categories (Sugi, Hinoki, Sugi (sparse), Hinoki (sparse), NL mixed, broad leaved, Natural pinus, grass/bare land and Sasa for vegetation classes and road and water body for non-vegetation classes) were used and 463 sample objects were selected. Of these sample objects, about 60% were randomly selected for each class (training set) and used for training objects for classification, while others (assessment set) were used for accuracy assessment.

Method 1. Classification by membership function: Mean, standard deviation, minimum and maximum value of all classification classes of all parameters, and scattergrams using combinations of 2 selected parameters were used to analyze the characteristics of each classification class. Membership functions of each class derived from above analysis were used for classification. Method 2. Classification by nearest neighbor method: NN classification by eCognition 4 was done using same 10 RS parameters used in method 1. Method 3. Classification by unsupervised methods: Mean value of 10 RS parameters of each object were classified using (a)ISOdata method, (b) Fuzzy C means method, and (c) K means method. Number of clusters are all set to 30. Assignment of each cluster to classification classes was defined by sample objects.

For methods 1 and 2, accuracy assessment was done using assessment set and accuracy calculation was done by pixel base, while all sample objects was used for method 3 and accuracy calculation by object base. Then, 10 classes were compiled to 5 broader classes. As a result, Method 1 showed the highest total accuracy for both 10- and 5-classes. Although most conifer classes showed good result, confusion between Hinoki classes and NL mixed was observed. To identify growing condition of conifer plantation stands, clear delineation of Hinoki stands from NL mixed stands, as well as identification of degraded plantation stands will be necessary.