

## Strategies of spectrometric measurements for tree species classification

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The tree species classification is crucial for forest mapping, monitoring, and sustainable forest management. Recent studies used combinations of various remote sensing methods to improve the overall accuracy of the classification. However, hyperspectral imaging (HSI) contains extra information and can distinguish tree species better than SAR or LiDAR systems, especially when there are higher numbers of species. Besides hyperspectral images are a large amount of data and it requires a lot of processes to download from satellites.

We installed the inexpensive spectrometer developed at Hokkaido University (HU) on the drone and then generated a spectral mapping in the Tomakomai research forest of HU, in Oct 2022. The Tomakomai forest has the lowest timber volume compared to the other research forests of the university and is a mixed forest of conifers and deciduous. As a result of the measurement, the spectral mapping was made on a 16-hectare area and NDVI mapping was done. Due to a lack of reference data, we only performed unsupervised classification (clustering) for the target area because a tree species mapping of the forest does not yet cover all areas in the census data.

Based on this previous measurement, we will prepare the reference data or measure the area included in census data to improve tree species classification. The reference data can be prepared in the field measurement. After that, we will perform the spectral measurement of the target area with our small spectrometer installed on the drone. We will find a suitable combination of wavelengths to be able to distinguish tree species using the normalized difference spectral index (NDSI).

In addition to classifying forest species, our further goal is to estimate the growth rate by estimating the annual changes of the forest and estimating the carbon fixation using spectral images. Forest biomass, tree-species classification, and growth rate are essential for further forest management. Through this study, we will generate valuable data with an inexpensive spectrometer placed on the drone and use it to develop a tree species map of the research forest.

Keywords: Spectrometer, Tree-species classification , Wavelengths , NDSI , Growth rate