Clearcut Detection between Aerial and Satellite Imagery Supporting Species-wise Forest Variable Estimates

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This study is part of the on-going NewForest project, whose objective is to develop remote sensing data analysis methods for producing species-wise forest variable estimates with accuracy that is adequate for operational forest inventory. Species-wise forest estimates relies on individual treetop locations detection from the remote sensing imagery. As ground data used for validation has been acquired at a different date as the satellite and aerial imagery, one of the first step was to identify clearcuts and thinning areas that occurred within the temporal span of all gathered data. This was done using image-based change detection.

The study area is located in Kuortane, central Finland (62°46'54"N, 23°27'49"E). Coniferous forest on mineral soil is the dominating forest type, second type being mixed forests on mineral soil. The image dataset include two sets of QuickBird images (Panchromatic at 0.6m resolution + Multispectral at 2.4m), and an aerial image at 0.5m resolution. The QuickBird images were obtained from database and dated of 07th September 2003, whereas the aerial image was acquired on 2006 by the University of Joensuu. In addition, records of clearcuts done in year 2007 in the study area was obtained from Metsäliitto and field inventory data from 2006 by the University of Joensuu. A field inventory trip was done in Kuortane in June 2009 to collect ground data. This field trip was customised for tree species classification from remote sensing images.

As preprocessing, the satellite and aerial images were co-registered one to another, using 25 ground control points and in-house rectification software InRec. The co-registration was carried out twice, by taking alternatively the satellite image or the aerial image as a reference, resulting in average RMS errors of 0.386 pixel and 1.076 pixel, respectively. These residual registration errors are compatible with high resolution change detection [2]. The size of co-registered and clipped images were 9429×11754 pixels when the aerial image was the reference, and 7858×9795 pixels when using the satellite image as a reference.

Standard change detection methods were used on the two sets of registered imagery. Baseline methods included pixel-to-pixel image difference and the use of AutoChange, a software developed at VTT for the detection of changes in forested areas [1]. A clearcut-specific change detection method was designed based on Support Vector Machines and post-classification change detection. Single-class SVM (1-SVM) was run separately on the aerial and satellite images to characterise forested areas, using a training/testing approach. The combination of classification maps obtained by changing the data source used in SVM training (satellite and aerial image, respectively) and the data source used in testing (aerial and satellite image, respectively) provided altogether a map of forested areas and of clearcuts. Thinnings detection was refined by comparison of treetop detection in aerial and satellite images.

References

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