AN OBJECT-ORIENTED APPROACH TO SEMI-AUTOMATED INDIVIDUAL TREE CROWN EXTRACTION IN HIGH-RESOLUTION WINTER LOW-CONTRAST AERIAL IMAGES

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Abstract

Forestry increasingly relies on spatially-explicit individual tree information for both research and management applications. However, acquiring spatially explicit information with standard ground-based approaches is expensive and labour intensive. Remote sensed data combined with image analysis techniques can help alleviate this impediment. In the literature, there are several documented approaches for identification and extraction of individual tree crowns from aerial and satellite images. The most common techniques utilize high-contrast images acquired under sunny conditions during the summer months and localize individual crowns either by identifying tree crown centres by local brightness maxima or by outlining tree crown perimeters by following shaded valleys. However, these images and techniques have some common problems; difficulty in resolving touching and overlapping crowns, incorrect identification of understory vegetation in gaps as tree crowns, smaller trees lost in shadow of the larger trees, and lack of tree species identification component. To solve these problems we explored an object-oriented tree crown delineation approach carried out on images acquired in the winter with overcast conditions where snow obscures ground cover and the overcast conditions minimises loss of smaller trees due to shading.

We acquired three channel visible light images of five cm pixel resolution using an airborne camera. The spectral characteristics of low-contrast winter conditions precluded reliance on traditional local maxima and valley following approaches. Therefore, morphological and relational characteristics were used in combination with select spectral properties. We developed hierarchal object-based algorithms in successive iterations using the commercially available software Definiens Professional 5. For algorithm training and validation we used 12 existing manually stem-mapped plots consisting of 1117 trees in natural and managed stands ranging in age from young to mature. Six plots were used for training and six plots were used for validation. Species composition included lodgepole pine (*Pinus contorta*), hybrid spruce (*Picea engelmannii x glauca*) and subalpine fir (*Abies lasiocarpa*).