First large area forestry LIDAR test in Sweden

The first large area airborne laser scanning project for the purpose of forest inventory was performed by the Dalarna-Gävleborg regional forestry board (www.svo.se) in central Sweden. The objective was to compare airborne laser scanning with traditional operational methods for forest variable estimation over a 5000 ha large area.

Introduction

The objective field methods that exist today are too expensive to use for all forest land at the stand level and therefore several subjective methods are used to support forestry. The traditional methods used operationally are also expensive and one should try to improve the accuracies for estimations of forest parameters by using new methods. Airborne laser scanning, also referred to as LIDAR, is now operated by a large number of firms. The scanners take several thousand laser distance measurements to objects on the ground per second. By combing laser range data with data from a positioning system, the position of objects that reflect a laser pulse can be calculated with 0.1-0.3 m accuracy. Recent technical developments have increased pulse frequency, thus reducing the operation costs for covering an area with a specific resolution. Several studies have indicated that mean tree height, basal area, and stem volume can be empirically related to the height (distance from ground) distribution of laser reflections in the canopy. Thus, forest parameters can be estimated using medium resolution data, without the necessity of detecting and measuring individual trees.

Material and Methods

The laser scanning system was operated from an altitude of 800 m above ground and with a flight speed of 75 m s^{-1}. There were 1.2 laser measurements per square meter on average. The laser data describe the three dimensional structure of the forest (Figure 1).

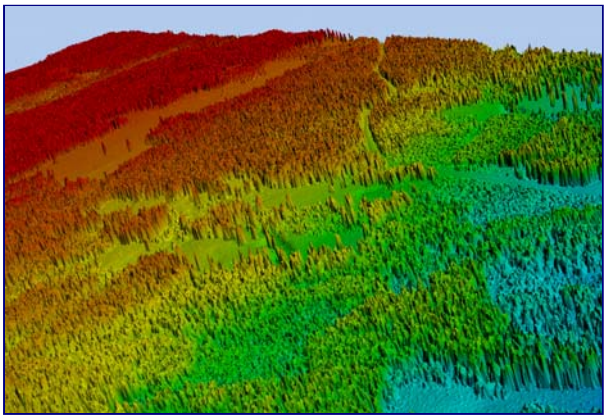

Figure 1. Visualization of LIDAR data for a forest on a hillside. Blue and red represent low and high elevation, respectively.

Forest stands were delineated and classified using aerial photo interpretation. A sample of forest stands was selected based on the classification in order to achieve a training dataset representing all forest types in the area. One field plot was placed within each forest stand. Linear regression models were used to predict forest parameters based on variables derived from laser data.

Results and conclusion

For validation, 29 forest stands were randomly selected, but two-layered forest stands and forest stands partly harvested between laser acquisition and field inventory were excluded. Approximately 10 field plots were placed within each forest stand and the mean values from these plots were used for validation. The relative RMSE at stand level was 5% (0.8 m) for mean tree height, 9% (1.9 cm) for mean stem diameter, 12% (3.0 m^2ha^{-1}) for basal area, and 14% (28.7 m^3ha^{-1}) for stem volume estimation. The results are superior to results that usually are achieved by using traditional subjective methods.

CONTACT INFORMATION

Title PhD
Name Johan Holmgren
Address SE-90183 Umeå, Sweden
Phone +46-(0)90-7868602
Mail Johan.Holmgren@resgeom.slu.se