

# USE OF GPS AND GIS IN HARDWOOD FOREST INVENTORY

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**Abstract**—Recent advances in GPS satellite survey, geographic information systems, and a portable electronic distance measurement device are useful new tools which, when combined with classical tree measurement, timber volume calculation, statistical inventory procedures, provide a pathway for generating highly accurate digital timber stand information for effective forest management decision makings. This presentation describes the methods and procedures used in the design of an intensive timber inventory conducted in a mountainous forest watershed.

In this prototype study, GPS, laser ranging, and GIS techniques are used to replace traditional forest inventory tools such as chains, compasses, altimeters, and optical forks. GPS land navigation technique is employed to locate inventory plot centers and a differential GPS point positioning technique is used to permanently determine surveying plot locations. A laser ranging instrument, called Criterion, is used to measurement upper-stem diameters and subsequently to determine merchantable lengths of commercial trees. Georeferenced timber survey data and computer generated environment data such as slope and aspect maps are stored in a geographic information system for subsequent analyses.

The inventory uses a traditional systematic line-plot design to tally timbers in an eastern hardwood forest situated on

the western slope of the Appalachian mountain. Using Criterion's laser ranging capability, plot trees are identified by measuring the distance between plot and tree centers. For a plot tree, its dbhob is measured by a caliper and its merchantable length is measured by the criterion. The Criterion's diameter and height measurement functions allow foresters to accurately determine the position of a prescribed upper-stem diameter and the measure the vertical distance between two points on tree stems. The digital display feature provided by this instrument eliminates the need to interpret analogous scales on conventional tree measurement and portable surveying equipment. Tree measurement data are subsequently inputted into a personal computer for the computations of both board-foot and cubic-foot saw-timber volumes. All these measurements exceed functional accuracies specified for intended forest inventory work.

Using statistic estimation methods, plot data are expanded to provide interval estimates of timber stocking on a per acre basis or for the entire forest stand. In addition, all inventory data are entered into a GIS framework which contains environmental data such as aspect and slope maps. The GIS is used to store, display, and query of timber stands information for effective forest management decision makings.

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