Equip Tips

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A Satellite-Based Positioning System for Land Managers

The Global Positioning System (GPS) is a satellite-based navigation system with outstanding potential for land managers. GPS is the Defense Department's all-weather navigation and position-fixing system that uses radio signals transmitted from satellites. Receivers on earth translate these signals into highly accurate position and velocity readings for latitude, longitude, and elevation. The system also continuously provides the precise time and time interval on a global basis to properly equipped users. It is purported to be unaffected by weather and provides a single worldwide common grid reference system.

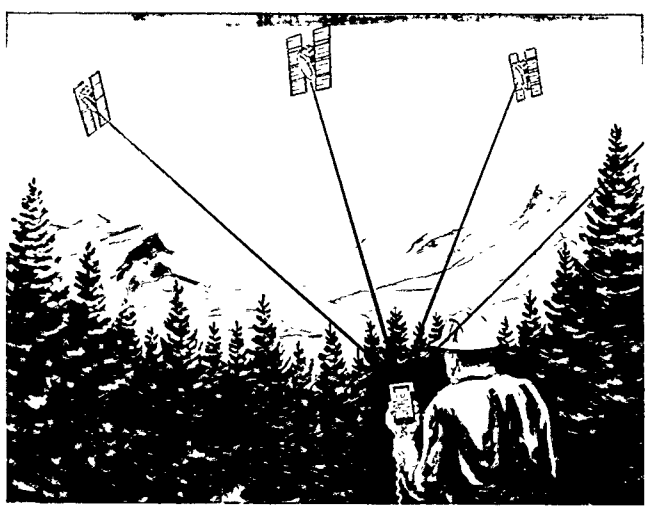
In FY 1984 the WO Engineering and Timber Management Staffs directed the Missoula Technology and Development Center (MTDC) to determine Forest Service requirements for a position-locating system and to identify equipment to meet those needs. MTDC surveyed engineering and timber management personnel in every Forest Service Region. The respondents told us that they need an accurate, portable, easily operated position-fixing system to accomplish land management tasks. They identified 46 separate tasks that require a more effective system than present equipment and techniques provide. These tasks included establishing timber cruise plot locations; locating sale boundaries; locating roads and trails; aircraft guidance; land surveying; topographic and geotechnical mapping; and locating or monitoring crew and vehicle locations.

For example, timber sale preparation requires cruising the area to establish volume, timber types, and cutting prescriptions, as well as designating roads and landings. These activities require determinations accurate enough to allow a contract logger to cut the timber as prescribed. Locating a single point like a den or nest of an endangered animal or bird is often crucial. For example, activity on the National Forest system is limited within a prescribed distance of a bald eagle nest. Relative elevation of ground points is critical when laying out a cable corridor for logging. Soil sampling, measuring fire perimeters, marking disease or insect infestations, or marking archeological areas could all benefit from an accurate, portable position-fixing system.

The ideal system should be portable, accurate and have a minimum weight and bulk because of distances and difficult terrain that must be traversed (often on foot). Field experts also asked that a system be affordable and that it have the ability to establish a fix quickly.

MTDC conducted a market and literature search that revealed a number of potentially acceptable systems. MTDC engineers decided the Global Positioning System holds the most promise for land management resource work.

Hand-held GPS equipment is being evaluated in difficult terrain to perform typical land management tasks.



Receivers translate signals from satellites into highly accurate latitude, longitude, and elevation readings.

GPS has a test block of seven temporary satellites, with 18 or more fully operational satellites planned for continuous worldwide coverage. The satellites circle the earth in six orbital planes inclined at 55 degrees. Each plane contains three or four satellites equally spaced in 12-hour orbits. Position fixes are based on the transit time of radio signals from four satellites within the constellation. Ranges to the satellites are determined by scaling the transit time by the speed of light. The transmitted messages enable the user's receiver to automatically calculate the position of each satellite at the time it transmits a signal. The user's position is then automatically calculated from the range intersection of spheres centered at the satellites.

Currently, hand-held GPS equipment provides approximately 100-foot accuracy. Differential operation (two units—one at a known stationary location and one with the observer) is purported to provide 10-foot accuracy or better and stationary geodetic GPS receivers can deliver pin-point accuracy. The National Oceanic and Atmospheric Administration (NOAA) is certifying geodetic survey GPS equipment at their test site in the Washington, D.C., area. MTDC is evaluating hand-held GPS equipment to determine its performance on steep mountains and in varying degrees of vegetative cover that may affect signal attenuation, path, and coverage. MTDC will lay out test courses at the University of Montana's Lubrecht Experimental Forest test site near Missoula that will simulate plot locations, open and closed traverses, and ground and aerial surveys. The tests will:

1. Evaluate the operating characteristics of various kinds of receivers, as well as their weight, bulk, accuracy, response time, and ease of operation.

2. Compare GPS performance with currently used location-determination equipment and techniques on typical forest tasks.

3. Provide industry with specific requirements for developing new equipment and refining existing equipment for Forest Service applications.

Lubrecht Forest has an extensive grid of established geodetic control points that can be reached on foot or by vehicle. Some of these are on steep slopes of varying aspect to allow evaluation of possible multipath errors in signal. Both deciduous and coniferous timber stands are available to predict signal attenuation. Canopy cover has been classified by accepted forestry practices. Direction and distance between points, stems per acre, and volume per acre are known, and will serve as the basis for testing.

Preliminary results from the Lubrecht tests will be reported in FY 1988. Subsequent tests will evaluate GPS equipment on selected National Forests. If you are interested in participating in the evaluations at Lubrecht or on your own Forest, contact Tony Jasumback, Project Leader, Missoula Technology & Development Center, Ft. Missoula, Bldg. 1, Missoula, MT 59801.