Advantage
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GPS tracking of feller-bunchers in selection harvesting

Abstract

This report presents the results of a study to examine the potential use of onboard GPS-based tracking systems to map harvest blocks. The results indicated that current GPS tracking systems can be used to monitor the progress of feller-bunchers, but because they do not track boom movements, they may not provide sufficiently accurate area calculations and boundary locations to meet regulatory needs.

Introduction

GPS tracking systems are being used successfully to monitor site-preparation operations, but their suitability for harvesting operations has not been proven. GPS tracking systems mounted on harvesting equipment encounter difficult conditions because satellite signals may be blocked or deflected by trees and the boom, producing erroneous positions as a result of multipath effects. These problems become even more significant in partial cuts.

Multipath effects generally pose fewer concerns in the center of a cut block. However, accurate positioning along the block edge is important in determining harvested areas and boundary trespasses. FERIC studied the potential of GPS tracking systems for accurately determining harvest areas and boundaries. The results from the tracking system were compared with the results from walking the perimeter of the block with a GPS unit.

Study method

FERIC mounted a LoKtor Path Tracker™ system (Viasat Geo-Technologies) on a feller-buncher performing mixedwood selection harvesting. The perimeter of the area harvested each day was surveyed both with a Trimble GeoExplorer II® (post-corrected) and a Trimble Pathfinder® Pro XRS (corrected in real-time using Coast Guard DGPS corrections). These receivers represented (respectively) lower- and higher-end units commonly used in forestry.

The data from the LoKtor tracking system was differentially corrected and exported as shapefiles into ESRI's ArcView® GIS. Using a free ArcView extension (Xtools), we generated polygons by applying buffers to the machine's travel path to represent the assumed average boom reach. We then overlaid these polygons on the polygons created using the Trimble GPS receivers, and calculated the area of each.

Results

Table 1 shows the cutblock area harvested per day estimated using the Path Tracker system for various assumed boom reaches, and the percent difference from the values determined by walking the perimeter with the GeoExplorer II and the Pathfinder Pro XRS.

Discussion and conclusions

The areas determined using onboard GPS tracking varied by +54% to –28% from the baseline areas obtained by walking the cutblock perimeter. It was obvious that the choice of buffer size (boom reach) was the principal cause of this variation. The correct buffer distance to use depends on operator practice (the average proportion of the

Table 1. Comparison of areas determined using the Path Tracker results (at various assumed boom lengths) with the results of walking the perimeter using two different GPS receivers

	Daily area recorded (ha)				
	Day 1	Day 2	Day 3	Day 4	Overall area
Path Tracker					
7-m reach	3.03 (54, 43) [a]	2.62 (24, 20)	2.33 (15, 16)	2.71 (34, n.a.) [b]	9.80 (20, n.a.)
5-m reach	2.68 (36, 26)	2.42 (15, 11)	2.14 (5, 7)	2.34 (15, n.a.)	9.00 (11, n.a.)
3-m reach	2.22 (13, 5)	2.05 (–3, –6)	1.82 (–10, –9)	1.83 (–10, n.a.)	7.65 (–6, n.a.)
2-m reach	1.87 (–5, –12)	1.71 (–19, –22)	1.52 (–25, –24)	1.47 (–28, n.a.)	6.42 (–21, n.a.)
GeoExplorer II	1.97	2.11	2.03	2.03	8.14
Pro XRS	2.12	2.18	2.00	n.a.	n.a.

[a] Numbers in parentheses = % difference between the Path Tracker estimate and the GeoExplorer II and Pathfinder Pro XRS values, respectively.
[b] n.a. = not available

boom's full reach that is used, among other factors), tree size, stand density, topography, and machine type. Consequently, it's not practical to use a standard buffer size. In our trial, a 3.4-m buffer produced the best correlations with the areas calculated by walking the perimeter, but this distance would change for another operator working in a different stand with a different machine.

Delineating the correct boundary was also problematic (Figure 1), since operators rarely maintained a constant working distance from the boundary. Consequently, if a fixed buffer is applied when the machine is working at the cutblock boundary (even in the absence of multipath effects), a trespass may be shown when none occurred.

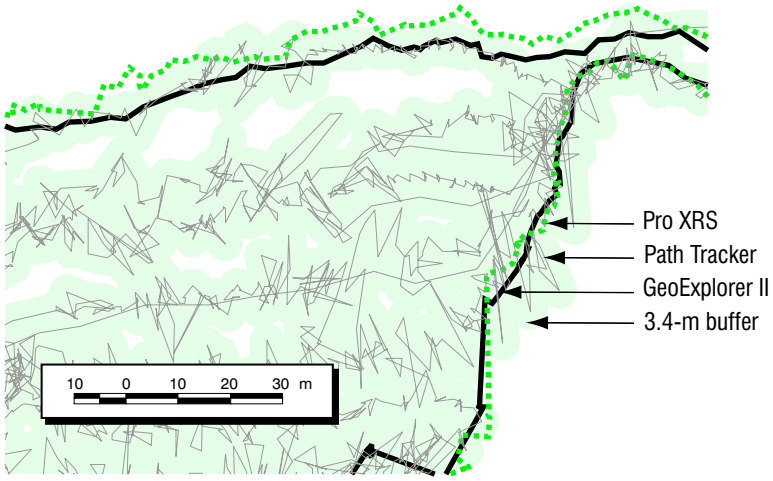

Figure 1. The feller-buncher's track assuming a 3.4-m boom reach (buffer), and the boundary lines determined by walking the perimeter with GPS receivers. Note the effect of buffering and multipath effects along the cut boundary.

Implementation

Although current GPS tracking systems have proven reliable for monitoring silvicultural equipment, the results of this trial suggest that, when used on felling equipment during selection harvesting, they provide insufficiently accurate cutblock areas and boundary locations for regulatory reporting purposes; this is because they do not monitor the location of the felling head itself. The magnitude of this problem decreases with increasing block size, but in general, such systems are best used only to monitor the progress of harvesting and to provide an indication of the shape and size of the cutblock.

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