Using GPS for accurate ground and airbased fertiliser/chemical application.
Productivity gains being achieved in agriculture and application to forestry operations?

Wed 24th Nov 2010

• How GPS Works
• Various Agricultural Examples
• Potential for Forestry?
Moving With Accuracy

A simple explanation of how GPS works

(Navstar) GPS Basics

- Set up by USA Dept of Defense in early 1980’s
- 24 + satellites
- 20,000 km up
- 12 hour orbit
- Line of sight radio signal
- Selective availability turned off in 2000 (meaning no deliberate errors generated)
Other Signal Sources

• Glonass
  – Russian System, with 20+ satellites
• Galileo
  – European system getting started
  – 2014? availability
• Beidou
  – Chinese system being expanded to global
  – Availability?

How Does it Work?

• Distance from each satellite calculated from how long it takes the radio signal to arrive
• Trilateration of distances is used to fix position (as outlined on following screens)
You don’t know where you are, but derive by measuring distance from known points.

Atmospheric Error

Satellite Orbit

Ionosphere (Charged Particles)

Troposphere
Multipath Error

Constellation Availability

15 degree mask
**Constellation Position**

- **Good DOP**
- **Poor DOP**

**Satellite Position**

**Other Errors**

- Clock
- Processing of calculations
- Satellite out of position
- Signal interference and noise
Meaning the distance estimate from each satellite do not overlap exactly, meaning the GPS processor has to make a “best guess”.

But those distance estimates are also constantly moving.
So you can only rely on your position being somewhere in an accuracy circle.

Example of estimate drift over 5 minutes

4 metres
Nett Autonomous GPS Error

• Pass to pass errors
  – 1 to 5 metres
• Absolute error (repeatability)
  – 3 to 15 metres

Correction Options

• SBAS – not available in NZ
• “E-diff/G11de”
  – calculates & models the drift error
• dGPS
  – Uses a fixed point ground station to broadcast error for each satellite
• RTK (Real Time Kinematics)
  – In field fixed receiver for high precision
Benefit of dGPS

Autonomous GPS  With dGPS

How dGPS works

GPS Made Easy
RTK System

The AgGPS TrueTracker implement steering system consists of an implement mounted GPS receiver, NavController II and hydraulic platform kit that work with any implement that can be mechanically steered. This includes planter equipment, plow, strip tillage, and tractor mounted equipment. Supplemental systems such as the Orthmanni Tracker IV or Susco August Trak can be added to most implements making them controllable with the TrueTracker system.

Trimble “TrueTrack” System

The AgGPS TrueTracker II sends 12 hemis compensated corrections and precise steering instructions to the implement letting you have a “TrueTrack” of all your field operations. The AgGPS 262 GPS receiver mounts on the implement and coupled with the implement’s NavController II, provides one inch pass-to-pass and year-to-year position accuracy on the implement.
GPS Receivers for agricultural use

GPS Made Easy

Hand Helden
$350 - $750

Simple Guidance
$3000 - $7000

dGPS
>$6000

Auto Steer
$12,000 - $60,000

ForestTECH 2010
Some Examples in Agriculture

Autosteer

10% to 30% productivity improvement
20% to 70% cost savings
Yield Mapping

5% to 30% productivity improvement
5% to 35% cost savings

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Photo recognition
5% to 70% cost savings

Semi-automatic repeatability
Orchards & Vineyards

Dwarf Apples
Used for knowing what rows have been harvested

Fertiliser
Judging spacings on hill country is difficult

It is almost impossible on recently grazed paddocks
And at night

Result

• 19.8% Productivity Gain
  – Wealleans Group, Waikato

• $20/ha gain from use of GPS
  – An economic analysis of fertiliser application accuracy on New Zealand dairy farms, Lawrence & Yule 2007
Situation Awareness (Where in the paddock?)
Matching Seed to Area
Remaining

Irrigation

GPS Made Easy
Long Lateral Sprinklers

K-Line Sprinklers
Traditional solution is placing markers on fencelines

Difficult to achieve accuracy and spacings on rolling country
Relies on 1 person's memory

Results in misses
Another example (different property)

And overlap, resulting in ponding
And runoff, which is a waste of valuable water

Extra 2-4t DM/ha
15% - 30% Increase

GPS Made Easy
Pulse Sprinklers being used to vary water application

GPS Made Easy
Create and Display Farm Maps

GPS Made Easy

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Guidance for aerial spraying and fertilizing started with forestry
Can be used for accurate height for fire attack

GPS Made Easy

Aerial Toxic for Predator Control
90% reduction in toxic used (preliminary trial results)

Controlled Fuel Burning
Post Analysis Mapping

GPS Made Easy

ForestTECH 2010
Potential on Skidders?

Monitor and Map Travel?
Log to block boundary, but not over?

Questions?

GPS Made Easy