Successful Implementation of Real-Time Networks and Advanced GPS/GNSS
Providing Positioning Data for Precision Ag Technology

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Today, we are not purchasing GPS receivers, we are buying technology with integrated GPS/GNSS.

Question:
What positioning technology provides the
– accuracy level for my operation and what is its reliability?
– ability to expand on its capabilities

Understanding GPS Classes

Levels of Correction
– Sub-meter
– Decimeter
– Centimeter (RTK)

Number Required
– GPS: 4 satellites
– RTK: 5 satellites

Approximate positioning accuracies between various GPS correction services
Selection of GPS Accuracy
Pass-to-Pass vs. Long-Term

<table>
<thead>
<tr>
<th>Correction Service</th>
<th>Pass-to-Pass Accuracy</th>
<th>Potential Range of Drift</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAAS</td>
<td>± 6 to 13 inches</td>
<td>± 4.7 ft</td>
</tr>
<tr>
<td>Sub-meter</td>
<td>± 2 to 4 inches</td>
<td>± 1.7 ft</td>
</tr>
<tr>
<td>Sub-meter</td>
<td>± 6 to 13 inches</td>
<td>± 2.3 ft</td>
</tr>
<tr>
<td>RTK</td>
<td>± 1 inch</td>
<td>± 0.3 ft</td>
</tr>
</tbody>
</table>

5 Operating GPS Satellites, 2 Blocked by Trees

ISSUE
- Too few GPS satellites
- Lose correction
RESULT = DOWN TIME
Can't complete last couple of passes using guidance system!

GNSS = GPS + GLONASS
Corrects of low satellite count (>8)
RESULT = Improved Reliability
Can complete last couple of passes and operate near obstructions!

9 Operating Satellites, 2 Blocked by Trees

Varying Terrain Compensation

Companies:
- AutoFarm / Agleader
- John Deere
- Rainbird
- Topcat
- Topcon
- Trimble

Array vs. Real-Time Network
RTK Options
A. Correction provided by a single base station
   - Radio
   - Cellular modem (internet)
B. Multiple base station data being used for correction.
   - Cellular modem
Cellular Delivered RTK

(Internet = cellular data plan)

MyWay RTK
- Private
- Subscription

CORS
- State DOT managed
- Free or small fee
- Network or single-base

Trimble VRS
- Private
- Subscription
- Network solution

Satellite Delivered RTK

Trimble Centerpoint RTX
- 1.5" accuracy
- GPS or GNSS correction
- Eliminates need for cellular plan
- Limited coverage in US currently

Accuracy vs. Reliability

• Accuracy (relative): measured in distance and has long been the standard metric for analyzing the performance of GPS systems.

• Reliability measures the up-time of a GPS system. Combination of:
  - Satellite availability
  - Correction service availability.
  - Want to operate 24/7/365 for agriculture applications

Trimble CFX-750

Ability to Expand Capabilities

Standard Capabilities
- Guidance System (lightbar)
- GPS receiver - WAAS correction
- Cables + Brackets
- Turn-key system for installation on most equipment.

Upgradeable Capabilities ($)
- Assisted steering
- GNSS
- Dual frequency or RTK
- Rate control including (VRA)
- Automatic section control

“Guidance Ready”

Products and names are used solely for information purposes and does not imply endorsement or recommendation by Auburn University.

Integrated System

John Deere Greenstar AutoTrac System
- 2630 Display with AutoTrac unlock
- SF3000 Receiver with iTC (GNSS + terrain compensation)
- Non-RTK (JD only correction)

Upgradeable Capabilities ($)
- Dual frequency or RTK
- Rate control including (VRA)
- Automatic section control

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Trimble CFX AutoPilot

**Standard Capabilities**
- RTK Autoguidance
- GNSS Receiver
- Subscription fee + cellular data plan

**Upgradeable Capabilities ($)**
- Rate control including (VRA)
- Automatic section control

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**Value of Precision Ag**

**Joint Project between Auburn and University of Tennessee**

**Corn**
- 20% to 52% yield loss
- Harvest loss: >2 times (>2 bu/ac)
- Higher incidence of Aflatoxin

**Cotton**
- 12% to 27% yield loss (2 vs 1.6 ba/ac)
- Increase in plugged tubes (headache)

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**Farming by the Inch?**

Does it make a difference?

- Cotton strip-till research at USDA-NSDL, Auburn, AL
  - **Yield decreased**
    - 16% when row 2-inches off center
    - >30% when row 9-inches off center

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**Purchase Considerations**

- Select the *proper* system for your operation
  - Determine your required accuracy
  - Brand which allows you to grow with the technology
- **Source of correction service**
  - Free vs. purchase
  - Reliability
  - Match between your system and correction service (GPS vs. GNSS)
- **Local service** and support (upgradable)

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**Precision Ag technologies simultaneously enhance production efficiency and environmental stewardship.**

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