Precision Agriculture

Precision Guidance:
How do I choose?

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No guidance at work here …
Presentation Overview

• Benefits of guidance
• Overview of guidance systems
• *Differential correction services
• Purchase considerations
• Final comments
Benefits of Guidance

- Extends operational hours
- Minimizes driver fatigue
- Improves field efficiency:
  - Reduce overlap and skips
  - Cover more acres with fewer operating hours
  - Minimize driver errors (guessing)
  - Operate at faster field speeds
  - Reduce per acre fuel consumption
- More accurate placement of agronomic inputs
- Adoption of new and innovative field practices
Ability to work accurately at night
Guidance Usage

- Spraying
- Spreader/applicators
- Tillage
- Bed preparation
- Cultivation
- Planting
- Harvesting
- Forage
Guidance Systems

Lightbar or Parallel Tracking

Lightbar mounted on hood for easy visualization.

AutoGuidance
Aftermarket Products

Check compatibility of older model equipment with manufacturer.

Images courtesy of Trimble and John Deere
Terrain Compensation

Image courtesy of Trimble
# GPS Receiver Performance

<table>
<thead>
<tr>
<th></th>
<th>Low-Cost</th>
<th>Sub-Meter</th>
<th>Sub-Foot</th>
<th>RTK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price Range</td>
<td>$80-300</td>
<td>$1k – 4k</td>
<td>$5k-10k</td>
<td>&gt;$35k</td>
</tr>
<tr>
<td>Accuracy</td>
<td>3-15 ft.</td>
<td>&lt; 3 ft.</td>
<td>&lt; 6 in.</td>
<td>&lt; 1 in.</td>
</tr>
<tr>
<td>WAAS</td>
<td>WAAS</td>
<td>Various</td>
<td>Omnistar HP Starfire2</td>
<td>Need Base Station</td>
</tr>
</tbody>
</table>
Autosteering Guidance System Classes

- RTK-based Autosteering Systems
- DGPS-based Autosteering Systems
Sources of Real-Time Correction

• Satellite-based differential correction (wide-area)
  – WAAS - free
  – Commercial services (OmniStar)
  – John Deere Starfire

• Local Area differential correction
  – US Coast Guard beacon - free
  – RTK
  – CORS - free
  – Networks
Wide Area Augmentation System (WAAS)

- Developed by FAA
- Coverage
  - Entire US
  - Parts of Canada and Mexico
- 3 to 5 meter (free)
- Broadcast at 1575.42 MHz or same frequency as the L1 GPS signal.
  - Only 1 antenna required for GPS and WAAS signals
OmniStar and John Deere

- Subscription services
- Receiver must be compatible

- OmniStar
  - VBS: sub-meter ($800 / year)
  - XP: 20 cm ($800 / year)
  - HP: 10 cm ($1500 / year)

- John Deere Starfire System
  - SF1: 1 meter (free)
  - SF2: 10 cm ($800 / year)
Local Area Services
USGS Coast Guard Beacon

- **Free** real-time correction service
- **Sub-AM band radio signal**
- Around 2 meter accuracy

**Disadvantages**
- US not fully covered
- Towers positioned around navigable waterways
- Terrain and thunderstorms can interfere.

Courtesy of USCG
RTK-Based Autoguidance

Advantages

• Inch level accuracy
  – Planting, cultivating, harvest
• No drift over time
• Operate multiple rovers

Disadvantages

• 2 to 6 mile coverage limitation (line of sight) – repeaters
• Need to move base station
• Tree lines, buildings and structures
• Costs ($35K to >$40k)
CORS Coverage

- Eliminates need for a personal base station
- Hundreds of sites nationwide – increasing
- Cellular modem communication
- 2 – 4 inch accuracy up to 25 miles (Auburn Research)
RTK Networks

- Allow for expanded operating range of RTK enabled equipment.
- Reduced investment cost for RTK applications.
- Prevent producers from dealing with maintenance and upkeep of base station equipment.
- Subscription fee required
RTK Applications

- Controlled Traffic
- Planting
- Precision strip tillage and fertilization
- Automatic sprayer boom section / nozzle control
- Precise seeding and fertilization
Purchase Considerations

• Application - planting, spraying, etc.
• Type of differential correction 
  (desired accuracy for operation)
• Guidance paths
  – Straight
  – Contour and Straight
• Shift track capabilities (GPS Drift adjustments)
• Terrain compensation (necessary for rolling terrain)
• Upgradeable
Final Note

• “Farming by the Inch” --- does it make a difference to the crop?

• Cotton strip-tillage research at USDA-NSDL, Auburn, AL
  – Yield decreased
    • 6% when row 2-inches off center
    • >30% when row 9-inches off center
Minimize Guess Work?

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