Autosteer Systems for Strip Tillage

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Outline

• Autosteer Hardware
• GPS
  • Accuracy
  • Differential Correction
• Implement issues
Autosteer Classes
Components

- GPS
- Valve or motor (actuator)
- Display/Task Controller
- Inertial sensors
- Wheel angle sensor
Auto-Guide Components

Vehicle Interface Unit

Wheel Angle Sensor

Hydraulic Steering Control
Terminals
Future Electronics

To take you from this…

To this…
Lessons Learned

• The autosteer hardware does make a difference
• Use “bolt-on” systems only with caution
# GPS Classifications

<table>
<thead>
<tr>
<th>Low-Cost</th>
<th>Sub-Meter</th>
<th>Decimeter</th>
<th>RTK</th>
</tr>
</thead>
<tbody>
<tr>
<td>$70-300</td>
<td>$1k – 4k</td>
<td>$5k-10k</td>
<td>&gt;$25k</td>
</tr>
<tr>
<td>3-15 ft.</td>
<td>&lt;3 ft.</td>
<td>&lt;10 in.</td>
<td>&lt; 1 in.</td>
</tr>
<tr>
<td>WAAS</td>
<td>Many Options</td>
<td>Omnistar HP, XP, Deere SFII</td>
<td>Build Your Own</td>
</tr>
</tbody>
</table>
Differential Corrections

• Sub-meter (3 ft.)
  • WAAS, USCG Beacon, Omnistar VBS, Starfire I, Racal

• Decimeter (2-6 in.)
  • Starfire II, Omnistar XP
  • Omnistar HP

• RTK (1 in.)
  • Build your own
  • Utilize a network
RTK Base Stations
GPS Accuracy

- Absolute vs. Relative
- Pass-to-Pass vs. Long Term (Year-to-Year)
- Time of day
Absolute vs. Relative
(Accuracy) vs. (Precision)
Implications

• Multiple operations
• Multiple receivers
  • Particularly with different DGPS correction sources
• RTK base stations and networks
• Utilize external reference or “nudge” for calibration
GPS Accuracy

- Absolute vs. Relative
- Pass-to-Pass vs. Long Term (Year-to-Year)
- Time of day
Pass-to-Pass

- GPS will drift with time
- How close can I get after 15 minutes?
- Farmers only “hear” pass-to-pass accuracy
# Differential Correction Sources

## Comparison Chart

<table>
<thead>
<tr>
<th>Differential Correction Sources</th>
<th>SBAS (WAAS &amp; EGNOS)</th>
<th>Beacon</th>
<th>L-Band</th>
<th>XP</th>
<th>HP</th>
<th>RTK</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Differential Correction Price (US Dollars)</strong></td>
<td>Free</td>
<td>Free</td>
<td>$800 / Year</td>
<td>$800 / Year</td>
<td>$1,000 / 100 days</td>
<td>Base Station Setup</td>
</tr>
<tr>
<td><strong>Pass-to-Pass Accuracy (inch &amp; centimeter)</strong></td>
<td>39.4 in (100 cm)</td>
<td>Based on Location</td>
<td>12 in (30 cm)</td>
<td>3-5 in (7-13 cm)</td>
<td>2-4 in (5-10 cm)</td>
<td>1 in (2.54 cm)</td>
</tr>
<tr>
<td><strong>Horizontal Static Accuracy (inch &amp; centimeter)</strong></td>
<td>41.3 in (105 cm)</td>
<td>Based on Location</td>
<td>33 in (84 cm)</td>
<td>8 in (20 cm)</td>
<td>4.1 in (10.5 cm)</td>
<td>1 in (2.54 cm)</td>
</tr>
<tr>
<td><strong>Vertical Static Accuracy (inch &amp; centimeter)</strong></td>
<td>53 in (134.6 cm)</td>
<td>Based on Location</td>
<td>42.5 in (108 cm)</td>
<td>5.8 in (14.7 cm)</td>
<td>1.5 in (3.7 cm)</td>
<td></td>
</tr>
</tbody>
</table>

Source: Red Hen Farming Systems
# Accuracy Comparison

<table>
<thead>
<tr>
<th>Sub-Meter (WAAS, L-band, Beacon)</th>
<th>XP/SF2</th>
<th>HP</th>
<th>RTK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass-to-Pass</td>
<td>~12</td>
<td>3-6</td>
<td>2-4</td>
</tr>
<tr>
<td>Horizontal</td>
<td>~36</td>
<td>8-12</td>
<td>4</td>
</tr>
</tbody>
</table>
Implications

- Extended breaks during field operations
- Multiple operations
- Drift compensation in guidance systems
- Guidance path generation from:
  - Previous path
  - Original path
GPS Accuracy

- Absolute vs. Relative
- Pass-to-Pass vs. Long Term (Year-to-Year)
- Time of day
Implement Tracking
To do it right:

- Get good autosteer hardware
- Probably need RTK
- Be aware of accuracy issues
- Remember the implement especially on hills and countours
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