Site-Specific Forestry in the Southeast US

John Fulton¹, Matthew Darr², Timothy McDonald¹, Steven Taylor¹, Joey Shaw³, Christian Brodbeck¹, Mathew Smidt⁴, and Frank Corley⁵

¹Biosystems Engineering, Auburn University
²Food, Agricultural, & Biological Engineering, The Ohio State University
³Agronomy and Soils, Auburn University
⁴Forestry, Auburn University
⁵Corley Land Services, Chapman, AL

Agenda
- Precision Forestry goal
- Past research
- Current research
- Where we are headed...

PRECISION FORESTRY

GOAL: Using of geospatial-based tools and technologies for planning, conducting, and acquiring site-specific and condition-specific forest management activities and operations.
- to improve wood product quality and utilization, reduce waste, increase profits, and maintain environmental quality
- for quality assurance and compliance of timber management practices

SITE-SPECIFIC DATA

- End Users
  - Landowner
  - Consultants
  - Contractor
- Information
  - Verification of services provided
  - Input to management decisions
  - Audits for SFI compliance
  - Certification

Quantifying Machine Productivity and Performance

Harvesting Machines
- GPS receivers placed on feller bunchers and skidders
- Position data recorded during harvest operations

Harvest Traffic Intensity

Adapted from Carter et al., 2000
Feller Buncher Tracking

Adapted from McDonald et al., 2000

Precision Ground-Based Spraying

Banded spraying and VRT

As-Applied Map

Mapping Mechanical Site Preparation Operations

<table>
<thead>
<tr>
<th>D6</th>
<th>AVG Speed (MPH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug 6 (AM)</td>
<td>1.6</td>
</tr>
<tr>
<td>Aug 6 (PM)</td>
<td>2.7</td>
</tr>
<tr>
<td>Aug 7</td>
<td>3.3</td>
</tr>
<tr>
<td>Aug 9 (AM)</td>
<td>3.9</td>
</tr>
<tr>
<td>Aug 9 (PM)</td>
<td>3.7</td>
</tr>
</tbody>
</table>

TIMBER MAPPING

TREE DBH MAP

9 ac. site at the CAT Forest Pro Training Facility
SOIL AND TERRAIN ANALYSIS

PRODUCTIVITY ZONES

VALUE MAP

SUMMARY PER ZONE

SMARTPACK DEVELOPMENT

BACKPACK CONCERNS

- Worker Safety & Compliance
  - Walking Through the Contaminated Vegetation All Day (Reentry Issues)
  - Improper Personal Protective Equipment
  - Compliance with worker regulations

- Quality Issues
  - Proper Ground Speed
  - Skips and Double Sprayed Rows
  - Tank Mix Not Correct
  - Dumping Product
  - Wand Height Not Correct
SPATIAL DATALOGGERS
- Microcontroller based system
- 4 analog inputs
- Garmin 18 DGPS receivers
- Data recorded to compact flash card
- Data downloaded into GIS to generate as-applied maps and analyses

SMARTPACK SYSTEM
- Speed Display
- Toggle Switch

AS-APPLIED MAP
12-ft row spacing

SmartPack Activity Report
Contractor

<table>
<thead>
<tr>
<th>SmartPack</th>
<th>AVG Speed</th>
<th>Target +/-15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.6</td>
<td>68.0%</td>
</tr>
<tr>
<td>2</td>
<td>2.6</td>
<td>68.0%</td>
</tr>
<tr>
<td>3</td>
<td>2.5</td>
<td>69.0%</td>
</tr>
<tr>
<td>4</td>
<td>2.6</td>
<td>69.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SmartPack</th>
<th>Feet of Row Sprayed</th>
<th>Acres per Hour</th>
<th>Gross Acres</th>
<th>Treated Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>70,118</td>
<td>1.9</td>
<td>19.3</td>
<td>6.4</td>
</tr>
<tr>
<td>2</td>
<td>85,750</td>
<td>1.8</td>
<td>18.1</td>
<td>6.0</td>
</tr>
<tr>
<td>3</td>
<td>68,233</td>
<td>1.9</td>
<td>18.8</td>
<td>6.3</td>
</tr>
<tr>
<td>4</td>
<td>64,462</td>
<td>1.8</td>
<td>18.3</td>
<td>6.1</td>
</tr>
<tr>
<td>Totals</td>
<td>270,566</td>
<td>7.5</td>
<td>74.6</td>
<td>24.8</td>
</tr>
</tbody>
</table>

SMARTDIBBLE
- Integrated wireless system
- GPS and Datalogger

Quality Assurance Data for Landowner
- Target
  - 545 trees/ac
  - Tree spacing = 6 ft
  - Row spacing = 12 ft
- Actual
  - 551.7 trees/ac (CV = 12%)
  - Tree spacing = 6.2 ft (CV = 18%)
  - Row spacing = 11.3 ft (CV = 24%)
As-Planted and SmartPack Application Map

FUTURE
- Remote sensed imagery
  - LiDAR
- Wireless communication - data transfer
- Site-specific vegetation management
- Timber quality
  - Assess mechanical properties of trees at harvest
  - Quality map
    - Stiffness
    - Defects
  - Segregation of trees to different markets

GPS / GIS - based systems can schedule and transport wood directly to optimal processing location.

SUMMARY
Precision Forestry accomplishments at Auburn:
- Techniques have been refined for site-specific herbicide and fertilizer application (with industry collaborators)
  - Mechanical and manual spraying systems
- New technology has been developed for quality assurance for manual operations
  - SmartDibble
  - SmartPack

QUESTIONS