Teaching Precision Agriculture Concepts (UNL Program)
Viacheslav I. Adamchuk
Biological Systems Engineering
University of Nebraska - Lincoln

Course Description
• Title: Site-Specific Crop Management
• Offering: Fall semester – 3 credit hours (2 hrs lecture and 3 hrs lab) - elective
• Prerequisites: Senior standing with previous introduction to soils and/or general agriculture
• Cross listing: Agronomy, Mechanized Systems Management and Agricultural Engineering majors
• Instruction: Co-taught between Biological Systems Engineering and Agronomy and Horticulture (Dr. Richard Waldren) Departments with several guest speakers
• Description: Principles and concepts of site-specific management. Evaluation of geographic information systems for crop production practices. Practical experience with hardware and software necessary for successful application of information affecting crop management.

Course Objectives
1. Use global positioning system (GPS) receivers and understand the meaning of the geo-referenced data
2. Use geographic information systems (GIS) software to accomplish primary data management tasks
3. Work with yield monitoring and other relevant data acquisition equipment
4. Identify major sources of errors and develop proper data handling strategies
5. Determine potential usages for remote sensing and automated on-the-go measurement systems
6. Understand the principles of variable rate application of seeds, water, fertilizers, lime, and pesticides
7. Integrate yield and soil nutrient maps with other geo-referenced data to develop an effective site-specific crop management program
8. Apply a system approach and common sense to deduct the causes of spatial variation and develop corresponding recommendations
9. Identify potential advantages (both economic and environmental) and current limitations of site-specific crop management

Enrollment

General Topics
• History and present level of Precision Agriculture
• Principles of yield mapping
• Principles of Global Positioning System (GPS)
• GPS vehicle guidance
• Principles of Geographic Information Systems (GIS)
• Web-based data layers
• Methods for soil sampling and analysis
• On-the-go soil & plant sensors
• Site-specific nutrients and water management
• Introduction to remote sensing
• Interpolation and processing of georeferenced data
• Statistical/geostatistical tools
• System approach to improved management strategies
• Variable rate technology

Relevant Background

Every student has had farming experience (95% - family operations)
**Textbooks**

- *Precision Farming Guide for Agriculturists*
- *Precision Agriculture: Soil Sampling for Precision Agriculture*
- *Precision Agriculture: Understanding the GPS Data Stream*
- *Precision Agriculture:Obtaining Vehicle-Based Soil Sensors*
- *Applications of Remote Sensing in Site-Specific Management*
- *Precision Agriculture: Listening to the Story Told by Yield Maps*

**Hand-on Experience**

- **Field trips**
  - GPS field practice
  - Yield mapping practice
  - Soil pH/EC mapping and sampling practice
  - Husker Harvest Day visit
- **Laboratory**
  - Yield monitor and lightbar guidance displays
  - GPS data interpretation (MapSource)
  - From basic data to prescription maps (AgLeader SMS Advanced)
  - Profitability of precision agriculture (EXCEL)

**GPS Practice**

- Tracking (boundary)
- Measurements (distance)
- Navigation (hide and find)

**Field Mapping Practice**

- Yield monitor installation, calibration, and operation
- On-the-go mapping of soil pH and electrical conductivity
- Soil sampling

**Functional Displays**

- Yield Monitor
- Lightbar Guidance

**Knowledge Assessment**

- **Assignments**
  - Spreadsheet assignments (GPS and yield data, profitability)
  - Spatial data importing and display
  - Yield history analysis
  - Development of prescription maps
- **Two term projects**
  - Technology – recommended line of equipment
  - Applications – case studies
- **Two written tests**
Case Studies

- Three locations
  - Clay Center, NE (160 acres)
  - Cairo, NE (160 acres)
  - Bellwood, NE (200 acres)
- Principle data
  - Field boundary (.shp)
  - Six-seven years of crop yield (.txt)
  - Field topography (.txt)
  - DOQ image (.jpg)
  - Soil map (.shp)
  - Electrical conductivity measurements (.txt)
  - Soil laboratory analysis – 1 acre sampling (.txt)
  - Soil texture analysis – 3 acre sampling (.txt)

- Center pivot irrigation
- Ridge tillage
- Continuous corn (soybean enclosures)

Course Website

Site-Specific Crop Management

http://bse.unl.edu/adamchuk/class_ssm

Graduate Level Course

- Title: Mechanized Agricultural Systems / Precision Agriculture Advances
- Offering: 3 credits – fall semester (odd-numbered calendar years)
- Description: Advanced concepts of equipment used in agriculture with emphasis on site-specific management (precision agriculture). Focuses on hardware development and information technologies applied to generic agricultural production

Teaching Precision Agriculture Concepts

(Survey Results)

Viacheslav I. Adamchuk

Biological Systems Engineering
University of Nebraska - Lincoln
Questions

• Who are the instructors?
• Whom do we teach?
• What do we teach?
• How do we teach?
• What can be improved?

Scope of the Survey

• 18 completed course survey forms have been submitted
• These forms reported on 19 different courses (17 different major instructors)
• Universities from the following 14 states are represented:
  - Alabama
  - Colorado
  - Florida
  - Georgia
  - Indiana
  - Kansas
  - Michigan
  - Minnesota
  - North Carolina
  - Nebraska
  - South Dakota
  - Tennessee
  - Texas
  - Washington

Course Titles

• Principles of Precision Agriculture
• Introduction to Precision Agriculture
• Precision Agriculture Technologies
• Crop Production with Precision Farming
• Agricultural Precision Systems
• Site Specific Management
• Site-Specific Crop Management
• Using GIS in Production Agriculture
• GIS in Agriculture
• GIS/GPS Applications to Biosystems
• Spatial Technology for Precision Agriculture
• Advanced Precision Agriculture

General Course Info

Every reported course represents 3 credit hours (lectures and labs)

Teaching Effort

Engineering/Technology: 57%
Agronomy: 33%
Economics: 6%
Other: 4%

General Student Info

Total number of students reported:
• 2001-02 – 199
• 2002-03 – 259
• 2003-04 – 281

Class size:
• Average – 16
• CV – 44%
• Min – 3 (G)
• Max – 27 (37)
Student Majors

- Engineering: 13%
- Technology: 39%
- Agronomy: 24%
- Business: 6%
- Other: 18%

Prerequisites

- Soil: 2
- Agriculture: 4
- Mathematics: 6
- Statistics: 8
- Other: 10

Major Topics

- GPS Guidance
- GIS
- VRT
- Sampling
- Sensors
- RS Applications
- Profitability

Laboratory Sessions

- Lectures: 12
- Labs: 14
- In Class: 10
- In Field: 6

GIS Software Used

<table>
<thead>
<tr>
<th>Software</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESRI (ArcView 3.x, ArcGIS 8.x)</td>
<td>7</td>
</tr>
<tr>
<td>SSToolbox</td>
<td>3</td>
</tr>
<tr>
<td>AgLeader (SMS Advanced)</td>
<td>3</td>
</tr>
<tr>
<td>FarmWorks</td>
<td>3</td>
</tr>
<tr>
<td>Surfer</td>
<td>2</td>
</tr>
<tr>
<td>Other (MapInfo, MapCalc, SGIS, JDOffice)</td>
<td>6</td>
</tr>
</tbody>
</table>

Discussion Issues

- Optimum course structure
- Majors involved
  - GIS applications vs. precision agriculture
- Sharing of training data
- Software diversity
- Textbook needs
- Open courseware
- What can/should be improved?