Remote sensing curriculum for advanced technology education at the community college level - Mississippi State University and USDA cooperating

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Abstract
A junior college curriculum was developed to meet the short- and long-term industry needs for an Advanced Agricultural Specialist. The curriculum consists of eight courses developed by both federal and state scientists at the Delta Research and Extension Center in Stoneville, MS. Courses developed for the program will be taught by state scientists beginning Fall Semester, 2002. In addition to their primary course, each course developer also assisted in developing the other

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courses. This served to identify areas of overlap between courses and to identify where re-enforcement of a topic might be needed. Because of the curriculum's applied nature, laboratory and field experiences were emphasized in course development, and labs will be conducted at the Stoneville experimental fields. By having the students on site at the Stoneville campus, these 2-year students will be exposed to substantially more research and actual crop production than is available in most programs of undergraduate study.

**Keywords.** Curriculum, teaching, education, hands-on learning, precision agriculture, remote sensing.
Introduction

In the lower Mississippi Delta region, agriculture remains a strong economic force. This region has traditionally been one of America’s most prolific producers of cotton, rice, soybeans, and other major agricultural products. Profit margins have been under great pressure in recent years, making efficient production systems a necessity. Research in Precision Agriculture has progressed steadily and is beginning to be used in the region’s agricultural production system. Training a competent workforce is essential for the proper implementation of site-specific management.

Mississippi Delta Community College in collaboration with industry leaders, the USDA, and the Mississippi State Extension have developed and are at the implementation stage of a curriculum in Precision Agriculture. Curriculum development and instruction were funded in large part by a grant from the National Science Foundation.

The curriculum offers an Associate of Applied Science Degree in the Agricultural Business and Management Technology Program. Through input from existing ag. technology programs, and established training partners, the curriculum was developed around both short and long term industry needs for an Advanced Agricultural Specialist. This program will develop the students’ basic competencies, workplace values, and technological awareness through: faculty/instructor enhancement internships, practical classroom experiences, student internships, and articulation of curricula from two to four year levels. The curriculum will be transferable to other community colleges with similar needs.

Curriculum development was a unique effort, primarily because of organization of the development effort, the cooperation between participants in developing the individual courses, and the extent of participation from outside personnel. The curriculum will provide extensive training and hands-on learning for undergraduate students in all aspects of precision agriculture, site-specific management, and remote sensing of field variables. Individual courses were developed with one person serving as primary coordinator, and several colleagues participating in various aspects of the course development. Each individual course was then integrated into the curriculum. Frequent interaction and collaboration among the coordinators provided cross-cutting and integration of the individual courses, insuring complementary coverage of the coursework within several different individual courses.

By examining various aspects of precision agriculture in several different courses, the students will gain a thorough and comprehensive understanding of the factors integral to production agriculture, and the development and implementation of a site-specific management plan. For example, a developed course in Crop Management Zones explores the basics of soil variability and crop growth and production. The course will introduce various remote-imaging techniques that examine soil properties, and provide information on crop growth status. Specifics of remote imaging systems will be explored in more detail in the Remote Sensing class. In addition to remote sensing for crop monitoring, the Crop Management Zones course introduces variable rate technologies, geographic information systems, and global positioning systems, all of which are presented in greater detail in other courses in the curriculum. By presenting the crop production information in conjunction with this additional information, the background information is reinforced for the students. The students will receive hands-on experience through lab and field exercises.

Another unique aspect of the program is the presentation of the curriculum at the Delta Research and Extension Center. This center, located in Stoneville, Mississippi, is the primary agricultural research center for the Delta. The center has approximately 90 federal and state
scientists and engineers. By having the students on site at the Stoneville campus, these 2-year students will be exposed to substantially more research and actual crop production than is available in most programs of undergraduate study. Scientists at the station have been recruited for course development and will serve as primary instructors. In addition, much of the laboratory work and exercises have been developed around experiments already in place at the research station. This will greatly expand the experience of the students, and provide them with a close examination of actual production experience, and innovative technologies under development. Technically proficient workers capable of utilizing the technology to make decisions are essential for the rapidly expanding field of Precision Agriculture.

This paper summarizes procedures in development and issues regarding implementation of a remote sensing course, which is part of the overall precision agriculture curriculum.

**Precision Agriculture Curriculum**

The precision agriculture option is part of the Agricultural Business and Management Technology Center of Mississippi Delta Community College. Most courses are to be taught in the fall and spring semesters of the student's sophomore year, beginning fall, 2002. Eight courses with heavy emphasis on practical field experience were developed for the program. These courses include Spatial Information Systems, Remote Sensing, GPS-Data Collection, Variable-Rate Technology, GIS I, Agricultural GIS, Crop Management Zones, and Integrated Pest and Weed Management. Spatial Information Systems is the only course to be taught spring semester of the students' freshman year, and is designed to present an overview of spatial information concepts that touch on all areas of precision agriculture. These concepts are treated by the other courses in-depth in the sophomore year.

The following is a summary of participation, instructor background, teaching structure, and general observations:

1. Five scientists from Mississippi State University and three scientists from the USDA-ARS developed courses for the curriculum.

2. Of the group of scientists, three scientists had very little teaching experience, three had moderate teaching experience, and two had significant teaching experience.

3. The Federal participants developed their courses after work hours, while the State participants were more flexible in that regard.

4 The State participants developed courses that they will teach themselves consistent with their assigned duties, and the Federal participants developed courses that will be taught by the Mississippi State scientists. The latter presented some unique challenges for course development although Federal participants will do guest lectures, consult, and participate periodically.

**Development of the Remote Sensing Course**

The remote sensing course was developed by Thomson (the senior author) for Sudbrink (the second author) to teach. With this in mind, it was decided that a significant amount of information would be required up-front, all the way to PowerPoint slides for the lectures themselves. The developed framework was designed to include more information than could probably be taught in one semester, with the understanding that the instructor will modify the course as teaching proceeds.
For some uniformity, it was decided that a framework patterned after course outlines already created by the Precision Agriculture Education network (PrAEN, 1999) would be used for development of course modules.

**Structure of the Remote Sensing Course**

Before development of the course, an outline was supplied to the curriculum coordinator, Donald Sudbrink. Most of the laboratory exercises were created from actual practice and collaborative work at Stoneville. Lecture modules for the Remote Sensing course were a combination of the senior author's experience, the experience of associate developers, and topics gleaned from Web pages published by lecturers around the nation. In all cases, Web pages published on the Internet were geared towards four-year academic programs, so an attempt was made to modify material to be suitable for the junior college level. It was clear that quality lab exercises would be most crucial for this course, and all field exercises were from the senior author's and co-developers' experiences. Lab exercises (subject to change) are as follows:

**General lab modules**

1. Georeferencing an image
2. Using digital numbers from a field image for weed discrimination
3. Qualitative differences in algae populations of catfish ponds – evaluation by digital number (DN) comparisons
4. A ‘cheap’ white reference panel
5. Creating a vegetative index (VI) image
6. Creating ratio and other vegetative index images from multiple bands
7. Acquiring commercially available imagery
8. Use of the spectroradiometer
9. Digital video characteristics and mode settings
10. Mosaicing images with PanaVue image stitching software

An essential lab component was development of skills in image analysis. However, there was some discussion on how much depth to treat image analysis at the junior college level. Laboratory exercises were developed from our applications and with the help of lecture notes on ERDAS Imagine published on the Web (Eickhorst, 2002). It was felt that procedures indicated for ERDAS Imagine could be translated easily to other packages such as ENVI or, to a limited degree, the Image Analysis extension of Arcview. Lab exercises on image analysis cover major topics listed below:

**Image Analysis Lab Modules**

1. Introduction to Image Analysis Software
2. Characteristics of Landsat, SPOT images
3. Image Pre-Processing, Rectification
4. Image Enhancement:
Further Observations

All courses developed for this program followed a similar approach, but in the end, detail of presentation varied widely between developers. For example, the Remote Sensing course outlined lab experiments in good detail including objectives, procedures, support files needed from the lecture set, apparatus and software required, and questions to be answered. The same held true for the course on Crop Management Zones. Although the Federal participants will be doing guest lectures from time to time, courses they developed will be taught by others. For this reason, it was felt that those courses should contain substantial detail for the instructor, subject to later modification.

Instruction and evaluation has yet to be accomplished, but all course developers felt that the number of hours spent developing their course was worth the effort. Development of a Precision Agriculture curriculum for the junior college level was an exercise in cooperation, which will train a technically proficient workforce in all aspects of the field.

References


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