APPLICATIONS OF GLOBAL POSITIONING SYSTEMS IN AGRICULTURE

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FOR ASSINIBOINE COMMUNITY COLLEGE

BRANDON, MANITOBA

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OVERVIEW

Have you ever stopped for a moment to consider the practical effects of technology in your life? Perhaps you have, and you may have marvelled at what a unique time in history we live. The last generation has probably experienced more technological change than any other in history. Breakthroughs that once might have rocked our perceptions of the world have become almost mundane, a regular occurrence. Sometimes it becomes difficult to evaluate their real significance. However, your enrolment in this course indicates that you have caught at least a glimpse of that significance in one area, that of the application of GPS technology in agriculture. Site-specific agriculture, or precision farming, as some have called it, is an emerging approach to agriculture, which makes use of several of the latest technologies. The Global Positioning System (GPS), the subject of this course, is one of the key technologies that enable the practice of site-specific agriculture.

You may already be aware of the impact of GPS on agriculture, but perhaps it would be useful to review some of those applications before we get started. GPS technology gives us the opportunity to accurately determine our geographical position, and to use that position measurement in various agricultural operations. Yield mapping, for example, is an important application of GPS. If we can measure our yield while harvesting, and link that data with position data, then display it in the form of a map, we can learn valuable lessons about the production of our land. If we can link soil sample data, topography, weed and insect pressures, salinity and other soil conditions to position data, we can learn much about our farming practices. And if we can use position measurements to apply seed, fertilizer and chemicals strategically to optimize their effectiveness while minimizing costs, we can improve our bottom line.

There are, potentially, many ways that GPS can be used to strengthen our farm management practices. Some of these are still only ideas, others have already proven their potential. One thing is sure: GPS is a powerful tool, and one that promises much if we can effectively harness its power. But it is only one of several technologies, scientific disciplines and--that old difficult-to-define quality--'common sense', that must work together to deliver the necessary results. Ongoing efforts to apply these technologies continue on several fronts. Technology must be blended with agronomic knowledge and proven management practices in ways that have never been done before. As we continue to apply the new technology to the age-old field of agriculture, the challenge, as always, is to acquire the knowledge and skills, which will take us where we want to go. This course is a part of that process.

The Purpose of this Course

The purpose of this learning module is to provide you with a basic understanding of how GPS technology works and how it can be implemented in agriculture. This will help you make good decisions about your own involvement in this new field. You will gain a basic understanding of GPS technology and terminology, but this module has not been designed to delve into the electronics of GPS receivers, or the mathematics of geomatics.

This learning module will be most effectively used in a workshop environment under the guidance of a qualified instructor. No pre-requisites are required, although some experience in agriculture will help you to better understand some of the applications. The module is written as simply as possible considering the technical nature of the subject. Various learning aids have been included to enhance the learning experience. Tables and diagrams are provided throughout the module to support the associated text. Sections 2 through 6 include Self-tests. Section 8 provides answers to these Self-tests. A Summary in Section 7 highlights the most important points associated with the body of the document. Appendix A includes a series of practical exercises that can be carried out, most of them using inexpensive handheld GPS receivers. The Summary, Self-tests and Exercises are designed to provide the student with an opportunity to reinforce the material learned in each section. To further support the learning experience, a Glossary of GPS Terminology has been included in Appendix B to help the student become familiar with some of the terminology associated with global positioning. Appendix C contains references used in researching the content of this document, including a listing of Internet websites where additional information can be found. Appendix D contains samples of information relating to various GPS products currently in use in agriculture.

We sincerely hope that this manual will provide you with the practical assistance you may need in your quest to learn more about applications of GPS in agriculture.

Ron C. Johnson, A.Sc.T.

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LEARNING OBJECTIVES

GENERAL OBJECTIVES:

For each of the following objectives, upon completion of the course the student should be able to:

1. Demonstrate an understanding of the basic principles of satellite positioning and navigation.
2. Explain the difference between GPS and DGPS.
3. Identify sources of error in GPS systems.
4. Analyze and explain the accuracy of GPS measurements.
5. Demonstrate an understanding of the considerations in configuring and integrating GPS with data logging equipment.
6. Use typical GPS equipment to map and collect geo-referenced data.
7. Use typical GPS equipment to set, edit and navigate to specified waypoints.

SPECIFIC OBJECTIVES:

1. Demonstrate an understanding of the functionality of Global Positioning Systems.
   a. Explain the principles and techniques used in satellite-based positioning systems.
   b. Identify the various systems available that provide positioning data.
   c. Recognize differences between NAVSTAR, LORAN and GLONASS systems.
   d. Describe satellite orbiting patterns.
2. Describe and explain the operation of GPS receiver systems.
   a. Describe functionality, features and operation of typical GPS receivers.
   b. Explain how the receivers determine position.
   c. Demonstrate the use of a receiver to determine position and to navigate to a predetermined position or determine satellite status.
3. Describe typical GPS data logging techniques.
4. Demonstrate an understanding of GPS accuracy and typical correction techniques.
   a. Describe accuracy issues as they relate to GPS
   b. Explain the difference between accuracy and precision.
   c. Describe common accuracy and precision concepts and specifications of various GPS systems.
   d. List common sources of error and methods of correcting for them.
   e. Predict Dilution of Precision based on satellite location.
5. Describe common techniques and standards used to correct for GPS errors.
   a. Explain how differential correction data is produced and used.

b. Determine the most effective source of differential correction data for a particular site and application.
c. Configure a typical mobile GPS to accept and use differential correction data.

6. Demonstrate an understanding of precision agriculture applications of GPS.
   a. Describe the use of GPS and related equipment in agricultural applications.
   b. Configure a system to collect data and navigate to referenced points.
7. Describe the use of GPS and other data in mapping.
   a. Using typical mapping software, create an organized map of a farm.
8. Describe the use of GPS for navigation.
   a. Create waypoints for soil sample points and navigate to those points.

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