

Unit C: Agricultural Power Systems

Lesson 9: Using Robotics Systems

Student Learning Objectives:

Instruction in this lesson should result in students achieving the following objectives:

1. Discuss robotics terms and explain how robotics differ from other machines.
2. Describe some functions of robots.
3. Explain robotic movements.

Recommended Teaching Time: 2 hours

Recommended Resources: The following resources may be useful in teaching this lesson:

- Exploring Manufacturing Technology.* Columbia, Missouri: University of Missouri Instructional Materials Laboratory, 1997. (Curriculum Unit)
- Herren, Ray V., and Elmer L. Cooper. *Agricultural Mechanics Fundamentals and Applications.* Albany, New York: Delmar Publishers, Inc., 2002. (Textbook, Chapter 37)
- Burton, L. DeVere. *Agriscience & Technology.* Albany, New York: Delmar Publishers, 1998.

List of Equipment, Tools, Supplies, and Facilities:

- Writing surface
- PowerPoint Projector
- PowerPoint Slides
- Transparency Masters
- Copies of student worksheets

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slide 2):

- Axis
- Cartesian work area
- Cylindrical work area
- Hollow sphere working area
- Robot
- Robotics
- Rotation
- Solid sphere working area
- Translation

Interest Approach:

Ask the students if they can think of some practical uses of a robot. As they suggest ideas, steer them towards the use of robots in agriculture. Use the discussion to move to move into the lesson's first objective.

SUMMARY OF CONTENT AND TEACHING STRATEGIES

Objective 1: Discuss robotics terms and explain how robots differ from other machines.

Anticipated Problem: What terms are commonly used when discussing robotics? How do robots differ from other machines?

- I. In order to understand the use of robots in agriculture, it is helpful to know specific terms and how robots differ from other machines.

(PowerPoint Slides 3, 4, 5, 6, and 7)

- A. A **robot** is a mechanical device that is capable of performing human tasks. They are widely used in industry and are becoming more common in agriculture. Robots are commonly powered by hydraulics, pneumatics, and electricity. **Robotics** is the term used to describe the application of robot technology.

(PowerPoint Slides 8 and 9)

- B. Robots differ from other machines in the following areas:
 - i. Robots are freely computer programmable.
 - ii. Robots are able to do a variety of tasks.
 - iii. Robots have a three dimensional freedom of motion.
 - iv. Robots are equipped with grippers and/or tools.

Display TM: 9-1 to help reinforce an understanding of terms associated with robots. Define the two terms in this objective and have students respond aloud with the word you are defining.

Objective 2: Describe some functions of robots.

Anticipated Problem: What are some common functions of robots?

(PowerPoint Slides 10 and 11)

- II. Robots can be built for a variety of tasks. Often they can do these tasks faster and more accurately than humans. Robots have precise movements and are able to repeat the exact same movements for extended periods of time. Robots are especially useful when carrying out the following functions:
 - A. Arranging parts
 - B. Handling parts
 - C. Distributing items
 - D. Positioning tools and work pieces
 - E. Moving tools in predetermined patterns
 - F. Gripping, directing, and assembling
 - G. Fastening, attaching, and detaching

Use classroom discussion to reinforce the function that robots do well. Ask students to come up with specific examples of the use of robotics by referring back to the list that was created during the Interest Approach.

Objective 3: Explain robotic movements.

Anticipated Problem: What types of motion are robots capable of?

(PowerPoint Slides 12 and 13)

III. Robots are built to be capable of different types of motion. Circular robotic motion is called **rotation**. Linear robotic motion is called **translation**. Robots have at least one or more rotational and translational axes. An **axis** is the straight line around which a body rotates. Axes is the plural of axis. The more axes that a robot has, the more motions it can perform. Each axis provides the robot with one degree of freedom. A robot's degree of freedom is dependent on its number of axes. Robots can be categorized by the space of their motion.

(PowerPoint Slide 14)

- A. A **cartesian work area** refers to a box-like work space. A robot with three translational axes can perform motions in a Cartesian work area.
- B. A **cylindrical working area** describes a robot that has a working area in the shape of a cylinder. In this case, at least one of the axes is a rotational axis.
- C. A **hollow sphere working area** is one that is ball-shaped. It can be achieved with two rotary axes and one translational axis. A robot with this motion can work around the outside of a round area, but not in the middle of the sphere.
- D. A **solid sphere working area** refers to robot motion similar to a solid ball. It can be achieved by robots with three rotational axes. Using this motion a robot can work in any part of a round area.

Use TM: 9-2 to reinforce the type of work areas that are capable through combination of axes. Show students pictures of different categories of robots and have them identify which category the picture falls under.

Review/Summary: The review and summary of the lesson may be accomplished by viewing the transparency masters with the students. (**PowerPoint Slide 15**) A discussion should be performed with students before proceeding with the laboratory activities and testing.

Application: Include the following student activity using the attached lab sheet.
Internet Web Search LS: 9-1

Evaluation: Objectives should be reviewed by the students. Laboratory activities should be performed before the written test is given to students.

Answers to Sample Test:

Matching

1. B
2. D
3. A
4. E
5. C
6. F

Fill-in-the-blank

1. Mechanical
2. Cartesian work area
3. Cylindrical working area
4. Hollow sphere working area
5. Solid sphere working area

Short Answer

1. Robot functions are:
 - a. Arranging parts
 - b. Handling parts
 - c. Distributing items
 - d. Positioning tools and work pieces
 - e. Moving tools in predetermined patterns
 - f. Gripping, directing, and assembling
 - g. Fastening, attaching, and detaching
2. Robots differ from other machines in the following areas:
 - a. Robots are freely computer programmable.
 - b. Robots are able to do a variety of tasks.
 - c. Robots have a three dimensional freedom of motion.
 - d. Robots are equipped with grippers and/or tools.

Using Robotics Systems

Name: _____

Matching: Match each word with the correct definition.

- | | |
|------------------------------|----------------|
| a. robotics | d. translation |
| b. solid sphere working area | e. axes |
| c. rotation | f. axis |

- _____ 1. Robot motion similar to a solid ball.
- _____ 2. Linear robotic motion.
- _____ 3. The study of the design and use of robot technology.
- _____ 4. More than one axis.
- _____ 5. Circular robotic motion.
- _____ 6. The straight line around which a body rotates.

Fill-in-the-blank: Complete the following statements.

1. The robot is a _____ device that is capable of performing human tasks.
2. _____ refers to a box-like work space.
3. _____ describes a robot that has a working area in the shape of a cylinder.
4. _____ refers to a ball-shapes work space.
5. _____ refers to a box-like work space.

Short Answer: Answer the following questions.

1. Name some functions that robots carry out.
2. How do robots differ from other machines?

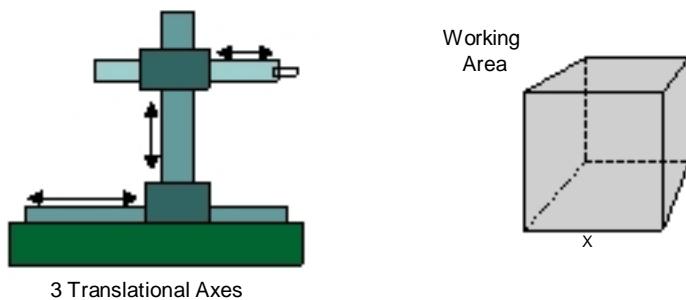
COMMON TERMS

Robot—a mechanical device that is capable of performing human tasks

Robotics—the term used to describe the application of robot technology

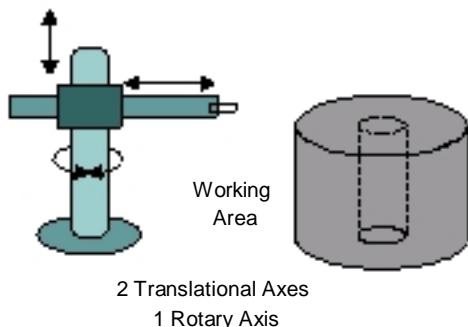


AGRICULTURAL ROBOTIC ARM



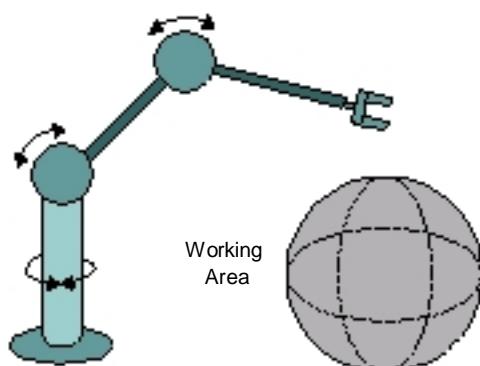
3 Translational Axes

The cartesian work area of a three-translational robot.

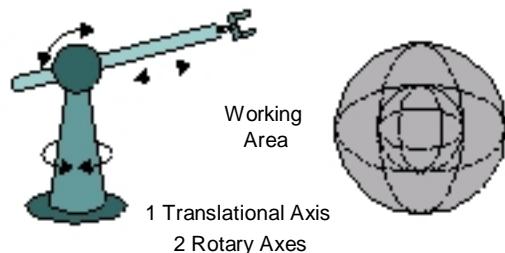


2 Translational Axes
1 Rotary Axis

A cylindrical work area is possible with
two translational axes and one rotational axis.



3 Rotational Axes



1 Translational Axis
2 Rotary Axes

A hollow sphere work area is possible using
two rotary axes and one translational axis.

A solid sphere work area is possible
using three rotational axes.

(Courtesy, Interstate Publishers, Inc.)

LS: 9-1

INTERNET WEB SEARCH

Use the key words “robotic systems” in agriculture to find and record as many web sites as possible.