
Unit 1: Introduction to Robotics

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based on Electrical Motor
Control Systems by Patrick
and Fardo

Unit Objectives

- ◆ Describe parts of a robotic system.
- ◆ Define “degrees of freedom”.
- ◆ Discuss robot configurations.
- ◆ Brief look at programming methods, interfacing methods, and machine vision.

Parts of a Robot

- ◆ ***Controller*** - coordinates movements of mechanical system and receives inputs through various sensors.
- ◆ ***Manipulator*** - made up of segments that can be jointed and moved
 - ➔ **End Effector** - the robot's "hand", its reach defines the work envelope
- ◆ ***Power Supply*** - provides the robot with the power to move; could be electrical pneumatic or hydraulic.

The Controller

- ◆ **Robot control is at various levels.**
 - Main Control - big picture (CEO)
 - Path Control - coordinates actual movement (Manager)
 - Actuator Control - performs movement (Worker)
- ◆ **Definition: ACTUATOR**
 - a motor or valve that converts power into robot movement
 - the part of a limit switch that causes it to change state

Type of Control System

- ◆ **Open-Loop System - Nonservo robots**
- ◆ **Closed-Loop System - Servo robots**
- ◆ ***Activity - 10 minutes, report out at end***
 - ➔ Break up in to groups of 2 to 3.
 - ➔ Come up with your own definition of open-loop and closed-loop systems.
 - ➔ Come up with an example of each type (different from book).

The Manipulator

- ◆ **The arm of the robot consisting of a series of segments and joints.**
- ◆ **The robot's actuators:**
 - ➔ **are located at the joints where segments are connected.**
 - ➔ **allow the segments to move relative to each other.**
 - » **Linear actuators provide motion along a straight line.**
 - » **Angular actuators provide rotation.**

Types of Actuator Drives

◆ Electric Drive

→ Three types of motors are commonly used - ac servo motors, dc servo motors, and stepper motors.

◆ Hydraulic Drive

→ System consists of an electric pump, liquid reservoir tank, control valves, and a hydraulic actuator.

◆ Pneumatic Drive

→ System is similar to hydraulics but uses air flow instead of liquid flow.

The Power Supply

- ◆ Provides the energy to drive the controllers and actuators.
- ◆ The three basic types are electrical, hydraulic, and pneumatic.
- ◆ In an industrial site
 - ➔ The most common form of power available?
 - ➔ Second most common?
 - ➔ What kind of power is needed by the electronics?

Degrees of Freedom

- ◆ **Describes the number of directions that there is independent freedom of motion.**
- ◆ ***Activity - 10 minutes, report out at end***
 - ➔ **Break up in to same groups as before.**
 - ➔ **Describe each degree of freedom that:**
 - » **Your wrist has without moving the elbow or shoulder joint.**
 - » **Your elbow has without moving the wrist or shoulder joint.**
 - » **Your shoulder joint has without moving the elbow or wrist.**

Robot Configurations

- ◆ **Cartesian Configuration - Fig. 22-36**
 - Arm movement is described by three intersecting perpendicular straight lines, referred to as X, Y, and Z axes.
- ◆ **Cylindrical Configuration - Fig. 22-38**
 - The arm moves along two perpendicular axes mounted on a rotary axis.
- ◆ **Spherical Configuration - Fig. 22-39**
 - Similar to cylindrical except the arm can move up and down, not only rotate.

Robot Interfacing

- ◆ **Definition: INTERFACE**

- ➔ **The common point at which systems communicate with each other.**

- ◆ **For a robot to communicate, it must be provided with input and output ports.**

- ➔ **Basic Digital Port Types**

- » **Dedicated - Figs. 22-45 and 22-46**

- » **Serial - Fig. 22-48**

- » **Parallel - Fig. 22-49**

Machine Vision

- ◆ Provides “eyes” for the robot using video cameras.
- ◆ Uses Image Processing Technology.
- ◆ Steps to Image Processing:
 - ➔ Image Acquisition
 - ➔ Image Preprocessing - may not be necessary with a digital camera
 - ➔ Image Analysis
 - ➔ Image Interpretation

FILL OUT ASSESSMENT FORMS

- ◆ **Each class participant is to fill out the activity assessment forms.**
- ◆ **Please write Unit 1 on the top of the form.**
- ◆ **Respond honestly and hand the form in.**

The End

- ◆ **Activity**

- ➔ Tour an industrial site with robots.

- ◆ **Homework**

- ➔ Read Chapter 22

- ➔ Chapter 22: All review questions, p. 474

- ➔ Be prepared to answer questions concerning advantages/disadvantages of various robot configurations.