Title: Robotics Introduction

Robot Applications

- Reduce labor costs
- Eliminate dangerous jobs
- Increase output rate
- Improve product quality
- Reduce waste

Robotics

Robotics is the science and technology of robots, their design, manufacture, and application.

The word was first used in print by Issac Asimov

The word "robot" was coined by Karel Čapek in his 1920 play R.U.R. (Rossum's Universal Robots)

The word means "drudgery" or "hard work" in Czech and Slovak

Robot Parts

Parts of a typical robot

- Manipulator
- Power Supply
- Controller

Manipulator

- Joints
- Grippers
- Process tooling
- General purpose effectors

Robot Power Supply

- Can be electric, hydraulic, or pneumatic
- Electric is most common
- Motors may be servo or stepper

Robot Subsystems

An industrial robot is a complex, technical system consisting of several subsystems operating together.

Main subsystems:

- Kinematics
- Control systems
- Drive

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Kinematics

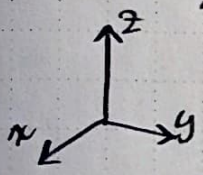
Kinematics is the spatial arrangement of the axes of movement in relation to one another.

Basic types of movement of an industrial robot

- Cartesian cordinate robot
- Cylindrical cordinate robot
- Polar cordinate robot
- Jointed Arm robot
- SCARA robot

Cartesian Cordinate Robot

Consists of a column and an arm and is sometimes called an x-y-z robot (L-L-L)



X-Axis: Lateral motion
Y-Axis: Longitudinal motion
Z-axis: Vertical motion

Cartesian or Gantry robots have a rectangular work envelope

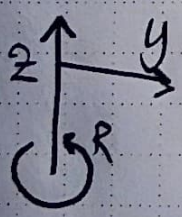
Work envelope is the volume of space defined by the maximum reach of a robot around 3 dimensions

Typical Applications

- Arc welding
- Handling machine tools
- Most Assembly operations
- Application of sealant
- Pick and place

Cylindrical Cordinate Robot

Similar to the cartesian robot a column and a base, but the column is able to rotate (L-R-L)



Y-Axis: Longitudinal motion
R-Axis: Rotation around Z-axis
Z-Axis: Vertical motion

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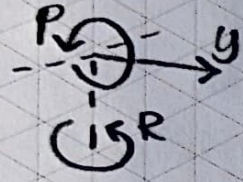
Polar Cordinate Robot

This type of robot consists of a rotary base, an elevation pivot, a telescoping extension, and a retraction boom.



Y-Axis: Longitudinal Motion

P-Axis: Rotation around the X-axis - elevation

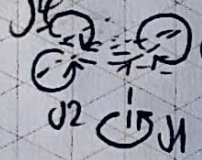
R-Axis: Rotation around the Z-axis - Base rotate

Typical Applications

- Handling machine tools
- Spot welding
- Handling diecast machines
- Fetling Machines
- Gas Welding
- Arc Welding

Jointed Arm Robot

This type of robot resembles a human arm. Usually stands on a rotating base and has an articulating shoulder and elbow joints (R-R-R)



J1: Base/Shoulder

J2: Shoulder

J3: Elbow

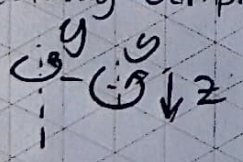
J4: Wrist

Typical Applications

- Most assembly operations
- Handling diecast machines
- fetling machine
- Gas Welding
- Arc welding
- Spray Painting

SCARCA Robot

Selectively compliant articulated robot arm



y-Axis: Rotation creates longitudinal motion

z-axis: Vertical Motion

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Movment of a wrist joints is commonly referred to as roll, pitch, and yaw

The arm and the wrist, give the robot the required six degress of freedom to position a tool at many orientations.

Typical Applications

- Pick and Place
- Application of Sealant
- Most assembly operations
- Handling of machine tools

Robotic Control Systems

A control system provides a logical sequence for a robot to follow

It provides positional values required for each step of the process

The robot then continuously checks the values to keep the system on course

Two Basic types of Control Systems

- Point-to-point
  - Records beginning and ending positions
  - Determines the best path between these two points
  - Used when greater repeatability required or when the specific path does not matter
- Continuous Path
  - The robot path is programmed to follow an irregular path exactly as recorded
  - The path is represented by many stored points close together
  - During the work cycle, the robot follows the points to reproduce a desired path

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Robotics Drive Systems

typically:

- Electromechanical
- Pneumatic
- Hydraulic

Drive systems determine

- Speed of arm
- Strength of the robot
- Dynamic performance
- Application type

Electromechanical Drive Systems

Driven by

- Servo Motors
- Stepper motors
- Pulse Motors
- Direct Drive Electronic Motors

Advantages — Precise motion control, greater strength

Disadvantage — Expensive, inefficient, high maintenance, noisy

Pneumatic Drive Systems

Advantages — Inexpensive, good for clamping

Disadvantage — Speed and position not easily controlled

Hydraulic Drive Systems

Advantages — Compact, highly controllable, usually being replaced by screw-driven ball screw type systems

Disadvantages — Messy, fluid leaks, environmentally dangerous, expensive

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