

## Module 2 : Robots mechanisms

### Lecture 4 : Industrial Manipulator Kinematics

#### Objectives

In this course you will learn the following

- Kinematics of Industrial Manipulators
- Accuracy and Repeatability

#### Introduction

- Manipulators are built as serial chains or parallel chains or occasionally a combination of both..
- Link and joints (revolute and prismatic), that are mostly used in manipulators, are shown in Figure 4.1.1
- 3R planar manipulator is shown in Figure 4.1.2
- 2RPR planer manipulator is shown in Figure 4.1.2

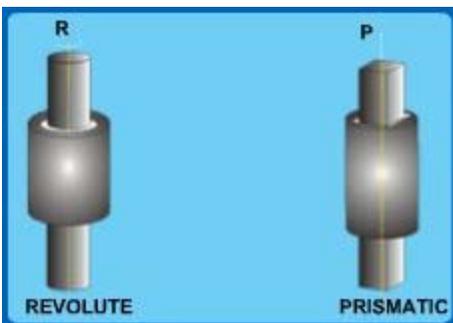


Figure 4.1.1

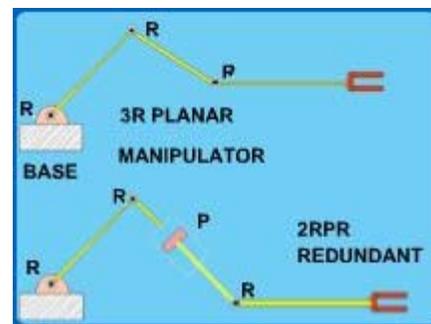


Figure 4.1.2

In spatial manipulators (open chains) adjacent axes are parallel or perpendicular to each other.

#### Forward or direct kinematics & inverse kinematics

- Direct kinematics: Here link parameters (link lengths) and joint variables (typically angles) are given and one has to find out the position and orientation of the end-effector (EE).
- Inverse kinematics: Given link parameters and position and orientation of the end effector, one has to find joint variables.

Example of 2R & 3R manipulator are given in next sessions, for the forward & inverse kinematics problem.

## Accuracy & Repeatability

Resolution (least-count), accuracy and repeatability are often sought by the user. The resolution may be called as the least distance the robot end effector could move through. This depends on the resolution of the actuator system, sensors used to control joint motions, and varies with position of EE in the workspace. Accuracy is the difference between the position attained and the desired target position. When a robot is programmed to reach a point repeatedly it may be reaching a cluster of points close to each other. Such a robot has good repeatability. If this cluster is close to the targeted point the robot has not only good repeatability but also good accuracy. A robot could provide good repeatability but poor accuracy if this cluster is far from the targeted point.

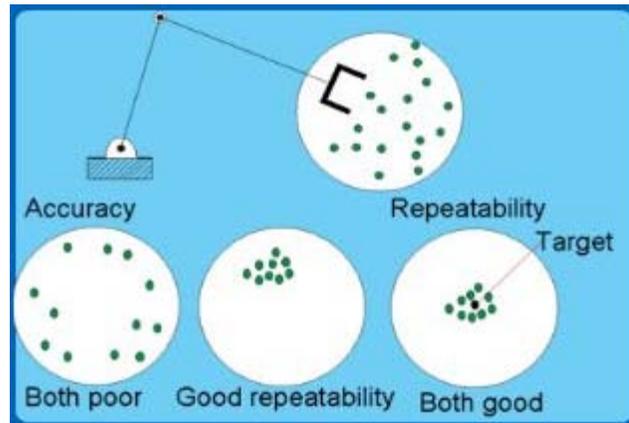


Figure 4.1.3

In figure 4.1.3 the robot EE is required to reach the centre of the circle – the target point. The circle on extreme left shows the situation when the robot has poor accuracy and poor repeatability. The circle in the middle shows the EE has been repeatedly reaching positions which are close together though away from the target point. The third picture shows the robot has repeatedly reached points close to the target and this is a case of good repeatability and accuracy.

## Recap

In this lecture we have examined:

- Kinematics of Industrial Manipulators
- Accuracy and Repeatability

Congratulations, you have finished Lecture 4. To view the next lecture select it from the left hand side menu of the page

