

## **Unit IV Navigation, Path Planning and Control Architecture**

### **4.9 Robot Programming Methods**

There are three basic methods for programming industrial robots but currently over 90% are programmed using the teach method.

#### **Teach Method**

The logic for the program can be generated either using a menu based system or simply using a text editor but the main characteristic of this method is the means by which the robot is taught the positional data. A teach pendant with controls to drive the robot in a number of different coordinate systems is used to manually drive the robot to the desired locations.

These locations are then stored with names that can be used within the robot program. The coordinate systems available on a standard jointed arm robot are:

#### ***Joint Co-ordinates***

The robot joints are driven independently in either direction.

#### ***Global Co-ordinates***

The tool centre point of the robot can be driven along the X, Y or Z axes of the robots global axis system. Rotations of the tool around these axes can also be performed

#### ***Tool Co-ordinates***

Similar to the global co-ordinate system but the axes of this one are attached to the tool centre point of the robot and therefore move with it. This system is especially useful when the tool is near to the work piece.

### ***Work piece Co-ordinates***

With many robots it is possible to set up a co-ordinate system at any point within the working area. These can be especially useful where small adjustments to the program are required as it is easier to make them along a major axis of the co-ordinate system than along a general line. The effect of this is similar to moving the position and orientation of the global co-ordinate system.

This method of programming is very simple to use where simple movements are required. It does have the disadvantage that the robot can be out of production for a long time during reprogramming. While this is not a problem where robots do the same task for their entire life, this is becoming less common and some robotic welding systems are performing tasks only a few times before being reprogrammed.

### **Lead Through**

This system of programming was initially popular but has now almost disappeared. It is still however used by many paint spraying robots. The robot is programmed by being physically moved through the task by an operator. This is exceedingly difficult where large robots are being used and sometimes a smaller version of the robot is used for this purpose. Any hesitations or inaccuracies that are introduced into the program cannot be edited out easily without reprogramming the whole task. The robot controller simply records the joint positions at a fixed time interval and then plays this back.

### **Off-line Programming**

Similar to the way in which CAD systems are being used to generate NC programs for milling machines it is also possible to program robots from CAD data. The CAD models of the components are used along with models of the robots being

used and the fixturing required. The program structure is built up in much the same way as for teach programming but intelligent tools are available which allow the CAD data to be used to generate sequences of location and process information. At present there are only a few companies using this technology as it is still in its infancy but its use is increasing each year. The benefits of this form of programming are:-

- Reduced down time for programming.
- Programming tools make programming easier.
- Enables concurrent engineering and reduces product lead time.

