

Module 1 : Introduction to robotics

Lecture 2 : Anatomy of Robots

Objectives

In this lecture you will learn about

- Anatomy and SubSystem of robots
- Manipulators
- Robot control

Anatomy of industrial robots

There are several classes of robots: robotic aircraft, robotic ships, mobile robots and others. An important application of robots is in industry – for machine tending, welding, painting, assembly and etc. These “industrial robots” can be viewed as consisting of a mechanical portion “the manipulator” controlled by a microprocessor.

- Subsystems of industrial robots include:
 - Actuators
 - Transmission systems
 - Power supplies & power storage system
 - Sensors
 - Microprocessors & controllers
 - Algorithms & softwares (higher level & lower level)

- **Actuators:**

Actuators are basically prime movers providing both force and motion. Pneumatic cylinders, hydraulics, permanent magnet motors, stepper motors, linear motors are some conventional actuators. More advanced ones are based on hi-tech polymers, shape memory alloys, piezo patches, and pneumatic muscles. Brushless servo motors also exist for low noise levels, and printed armature motors are used for quick response.

- **Transmission systems:**

The transmission system used in robot to transmit power and motion consists of chains, timing belts,

metal belts, cables and pulleys and linkages. Gear boxes and harmonic drives serve to provide speed reduction. Ball screws are used with suitable mechanisms to convert rotary motion to linear motion and if needed back to oscillatory motion. Drive stiffness is an important consideration in robotics and so also is backlash.

- **Power supplies:**

Hydraulic and Pneumatic power packs: These consist of a motor driving a positive displacement pump or compressor to generate the high pressure fluid flow. In using hydraulic systems the necessity of having an oil tank increases the weight of the system, additionally the issue of ensuring that the oil is free of contaminants is to be handled. In pneumatics power pack dry air is desired.

Electric motors use what are known as PWM (pulse width modulation) amplifiers. These are electronic devices, consisting of transistors used as switches to rapidly switch on and off the supply in a controlled manner to control motor speeds. Such drives have higher efficiency.

- **Sensors and other electronics:**

The sensors for feedback in robots consists of tachometers and encoders and potentiometers to sense motor motions, simple switches, force sensors, acceleration sensors, optical systems, special cameras and vision systems.

- **Electronics:**

There are a host of electronic circuits, motor controllers, analog to digital converters and digital to analogue converters, frame grabbers and so on utilized to handle sensors and vision systems and convert the inputs from them into a form usable by the processor for control of the entire system in conjunction with the algorithms and software developed specifically for the purpose.

- **Software:**

The software used consists of several levels. Motor control software consists of algorithms which help the servo to move smoothly utilizing the data from feed-back units. At the next level there is software to plan the trajectory of the end effector and translate the same into commands to individual motor controllers. The output of sensors is also to be interpreted and decisions made. At the highest level there is software which accepts commands from the user of the robot and translates it into appropriate actions at the lower level.

Control of individual motors and actuators.

Planning trajectory & individual actuators in motion.

Planning trajectories of end effector.

Acting upon sensors input

Planning tasks

Recap

In this lecture one has learnt about

- Anatomy and Subsystems of robots
- Manipulators
- Robot control

Congratulations, you have finished Lecture 2. To view the next lecture select it from the left hand side menu of the page