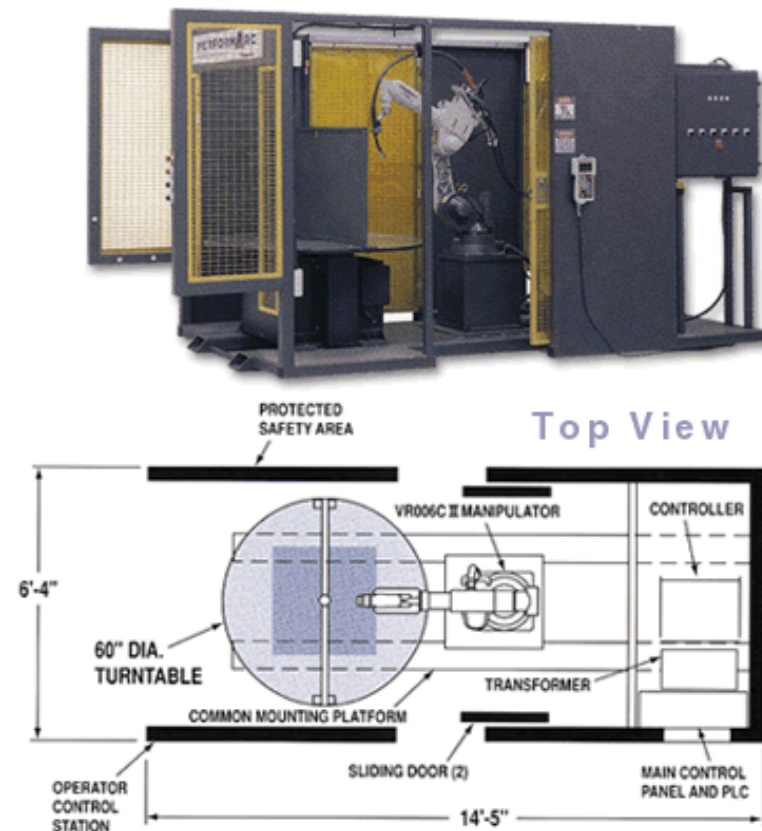


Industrial Robots

Industrial robots are mostly large-scale robot arms or manipulators

Within a production line the manipulators are formed into workcells that perform a specific stage of the production



Arranging the production line into robotic workcells automates the manufacturing process. This is called *Computer Integrated Manufacturing* (CIM)

Having workcells that can communicate with each other and can be rearranged and reprogrammed to form other production line configuration is part of a *Flexible Manufacturing Systems* (FMS)

Industrial Robot Activities

Handling- the robot's capacity to pick up objects and deposit them in specified locations:

- Palletising (placing objects on pallets in an ordered fashion)
- Warehouse loading/unloading
- Mill and machine tool tending
- Part sorting
- Packaging

Industrial Robot Activities

Manipulation – is the robot's capacity to transform raw materials into finished products:

- Arc and spot welding
- Painting
- Gluing and sealing
- Laser and water jet cutting
- Milling and drilling
- Casting and die spraying
- Grinding.
- Screwing and wiring.
- Assembling mechanical and electrical components.
- Assembling electronic boards.

Industrial Robot Activities

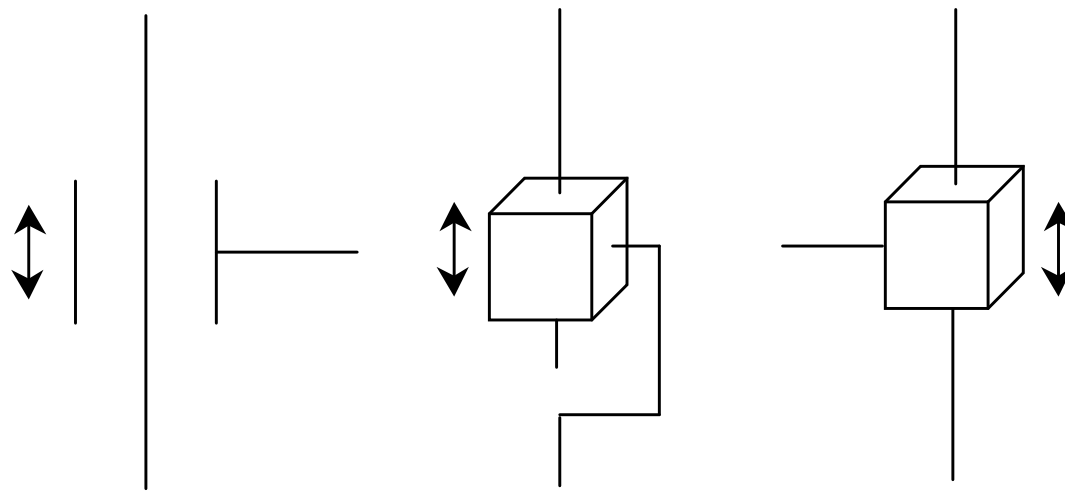
Inspection – is the robot's capacity to measure, examine and test products:

- **Object inspection.**
- **Contour finding.**
- **Detection of manufacturing imperfections .**

Robot Joints

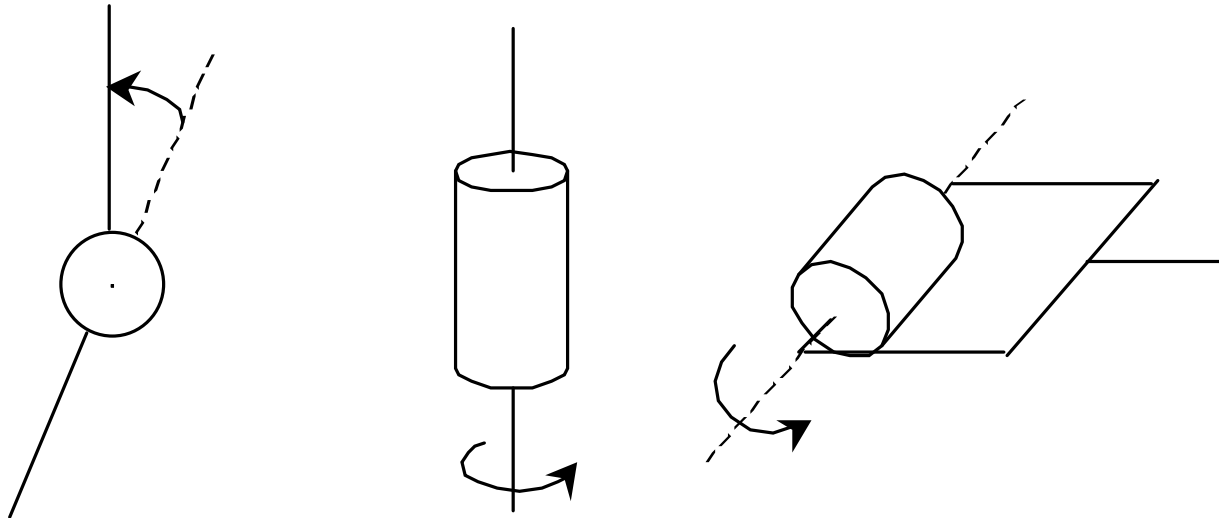
Most robots consist of a sequence of rigid links connected by joints. These joints come in two forms: *prismatic* and *revolute*

Prismatic Joints are linear joints with no rotation. They are represented by the letter **P** and the following schematic symbols:



Robot Joints

Revolute Joints are rotation joints that move about a perpendicular axis. They are represented by the letter **R** and following schematic symbols:

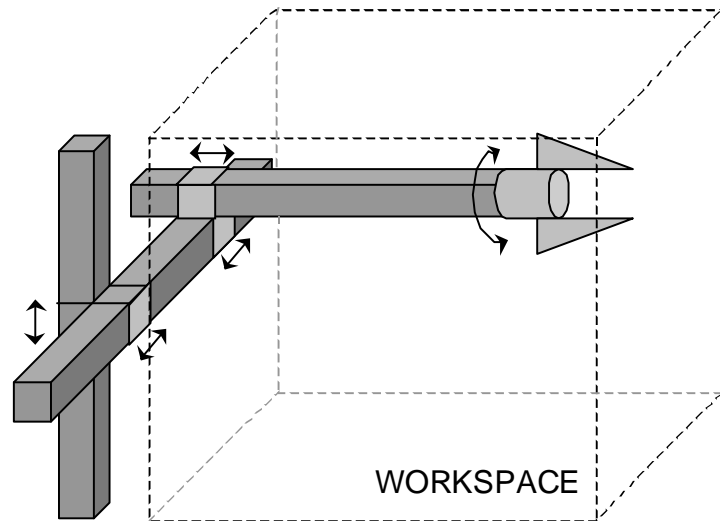


Workspace or Work Envelope

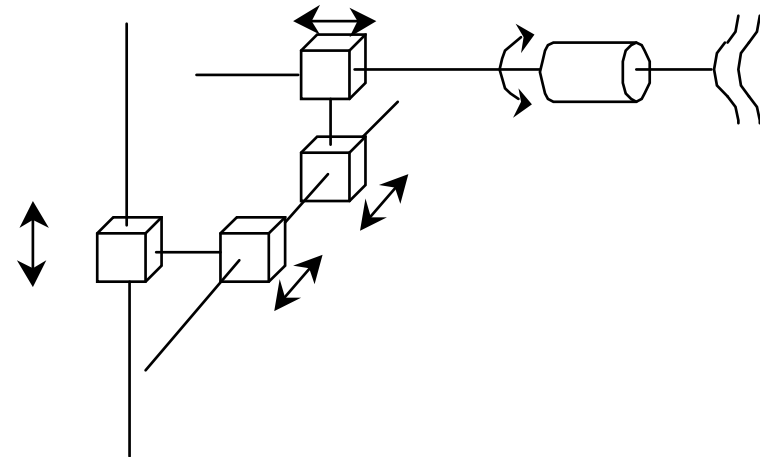
The workspace of a robot manipulator is the area within which the end of the manipulator (called *the end effector*) can access. This is the operational limits of the robot and is defined by the articulation of the joints.

Types of Industrial Robots

Cartesian or Rectangular Robot



Diagram



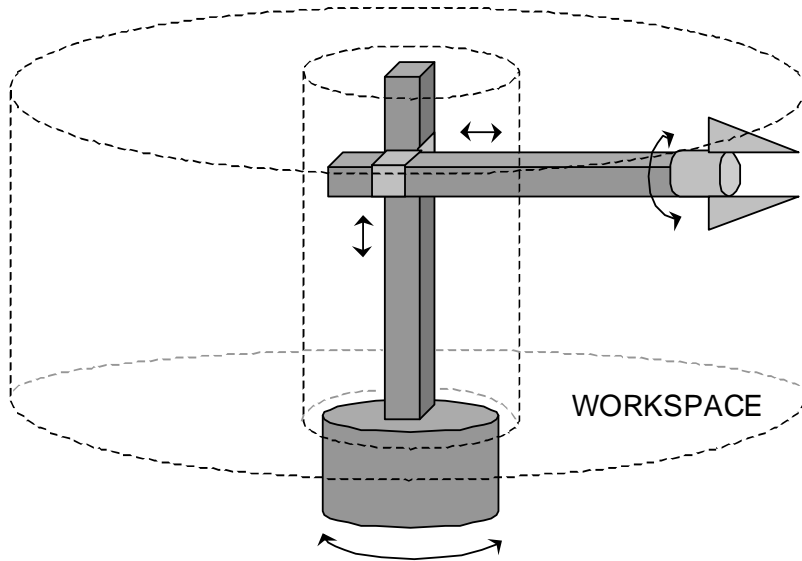
Schematic



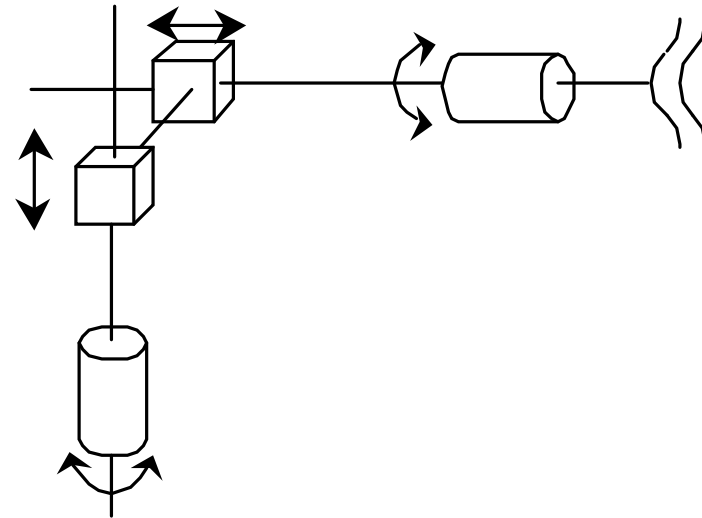
Samsung Electronics: FARAMAN RCM4-M

Types of Industrial Robots

Cylindrical Robot



Diagram



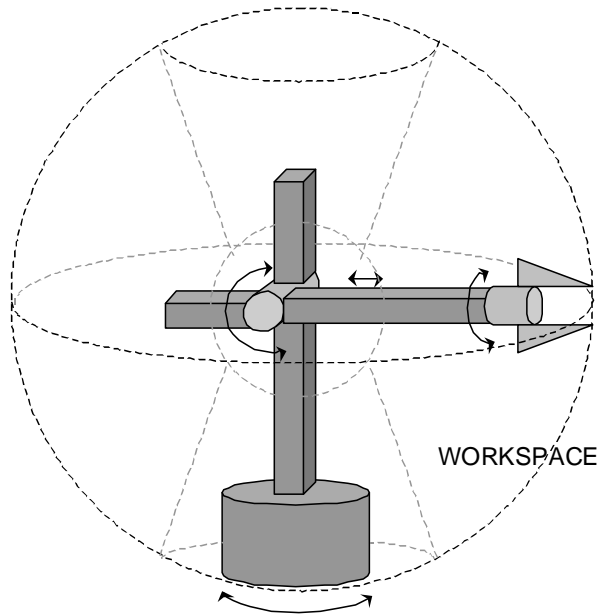
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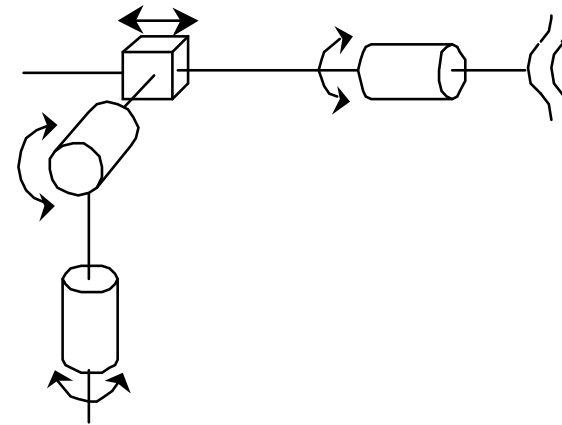
Samsung Electronics: LTR A1000

Types of Industrial Robots

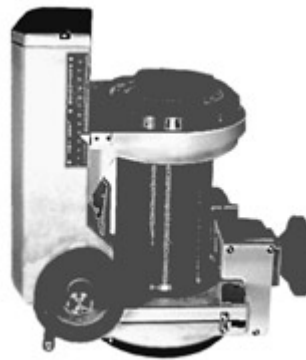
Spherical or Polar Robot



Diagram



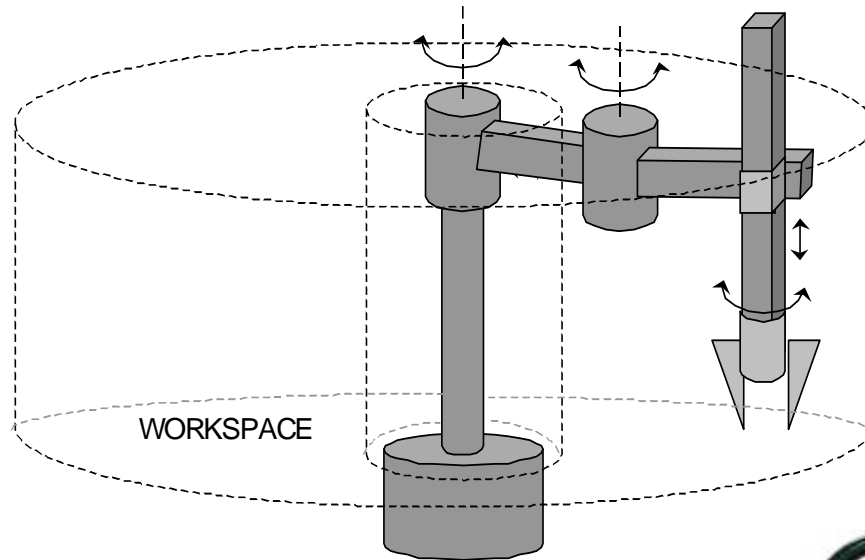
Schematic



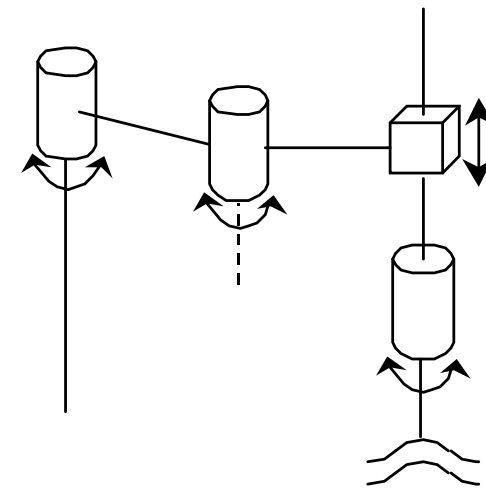
Huntington PCM 640

Types of Industrial Robots

SCARA Robot



Diagram



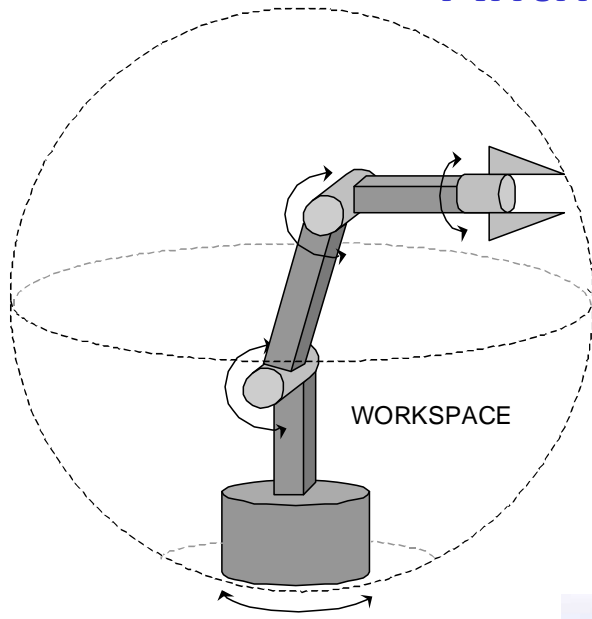
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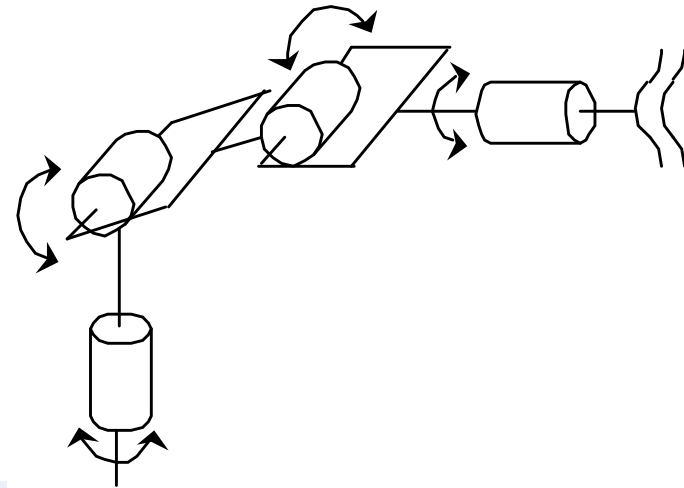
Toshiba SR-554HSP

Types of Industrial Robots

Anthropomorphic Robot



Diagram

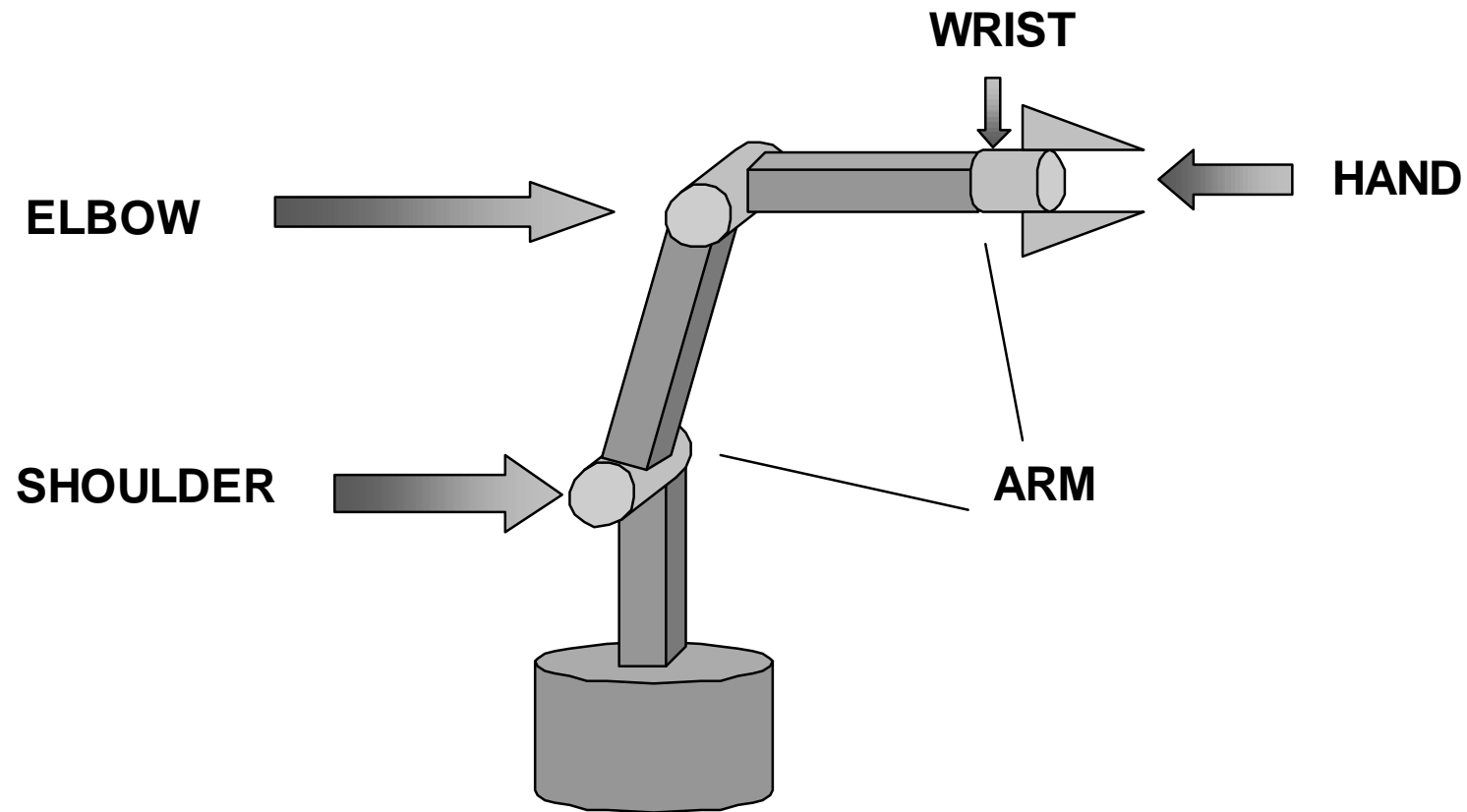


Schematic

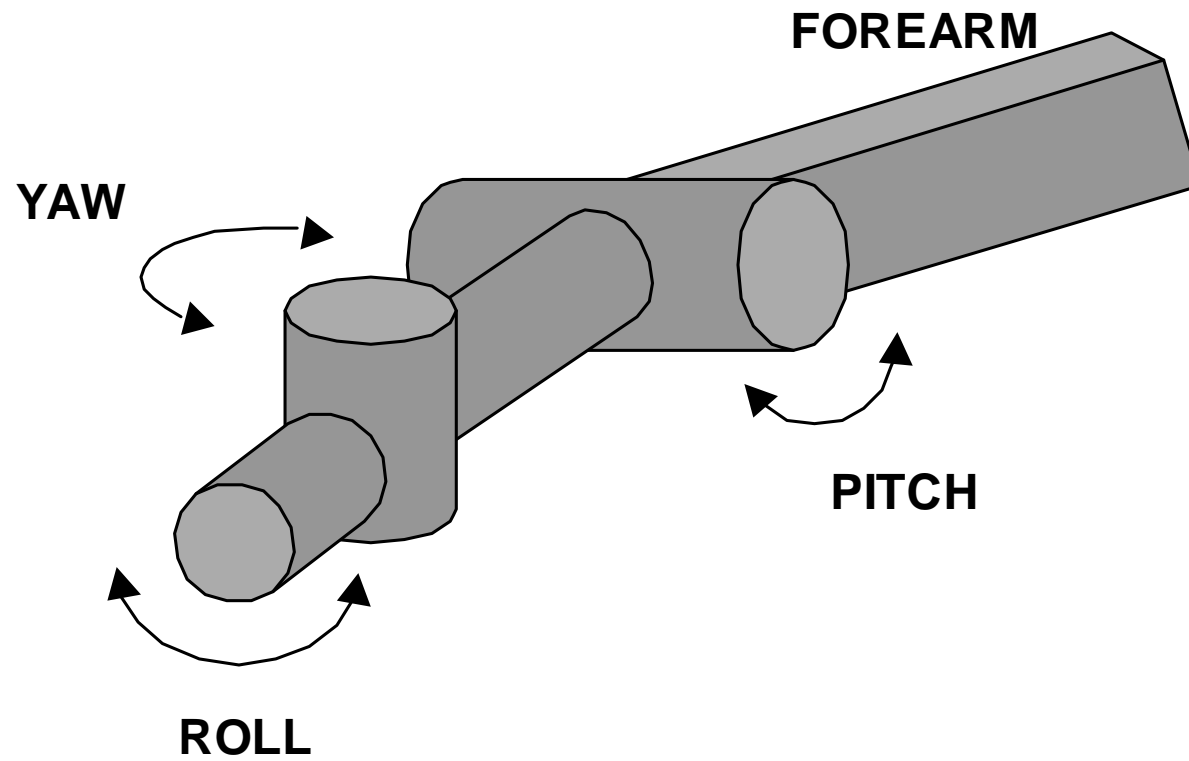


Kuka Kr500

Anatomy of a Robot Manipulator



Wrist Motion



Advantages and disadvantages of using these types of robots

SEE Fuller

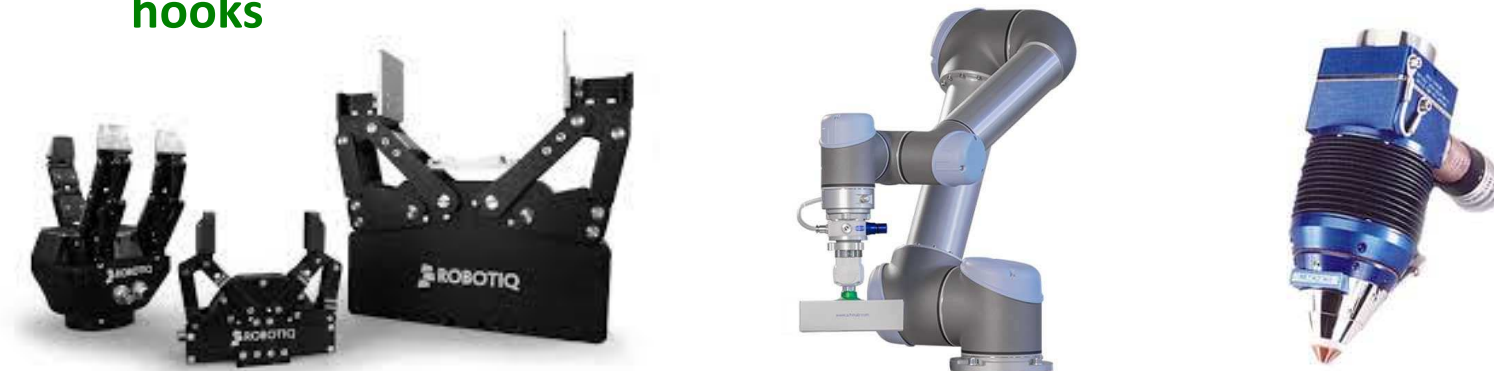
End Effectors

The End Effector is regarded as the *hand* or *tool* at the “business end” of the manipulator or robot arm. Sometimes called *End of Arm Tooling* (EOAT), there are different types of End Effectors that can be deployed depending on the task being performed. Generally there are three basic types:

- **Robotic Process Tools:** specific tools that can be used in the manufacturing process
 - **Material Applying Tools:** used for applying material e.g. welding and 3D printing processes
 - **Material Removal Tools:** used to remove material e.g. drills, cutting tools, sanders
 - **Painting Tools:** used to apply paint and glue
 - **Assembly Tools:** used to screw or rivet components together

End Effectors

- **Robotic Sensors:** specific tools for sensing, scanning, testing, inspecting and monitoring functions
- **Robotic Grippers:** the most common End Effector generally representing a human hand with 2-5 fingers
 - **Electric Grippers:** use motor-driven fingers
 - **Pneumatic Grippers:** use air-driven pistons to operate fingers
 - **Suction Cups:** use vacuums to pick up objects
 - **Magnetic Grippers:** use magnets to pick up objects
 - **Mechanical Grippers:** non-power mechanical grippers e.g. forks and hooks



Characteristics of a Robot Manipulator

Manipulators (and other robots) can be characterised using the following terms:

- **Payload** – amount of weight it can safely carry
- **Reach** – maximum distance robot can reach
- **Precision** – accuracy with which the robot can reach a specified point
- **Repeatability** – accuracy with which the robot can acquire the same point if the motion is repeated many times