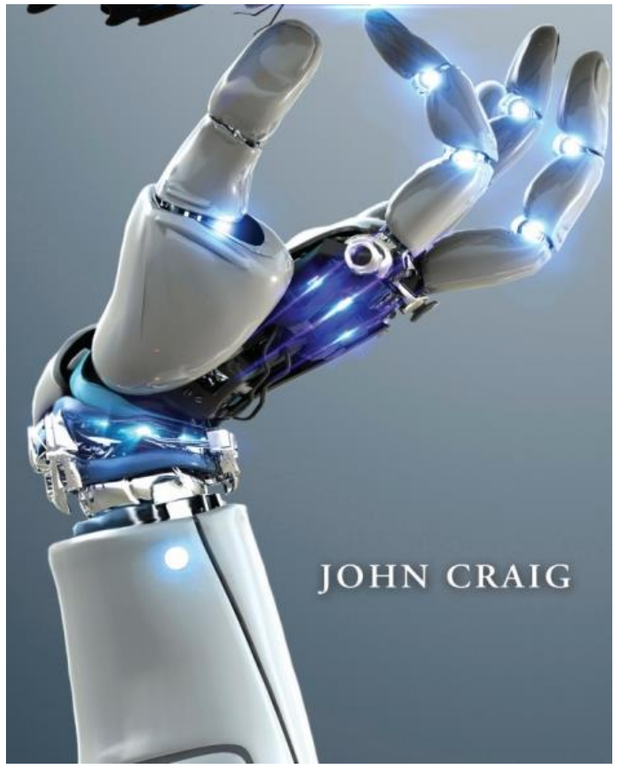
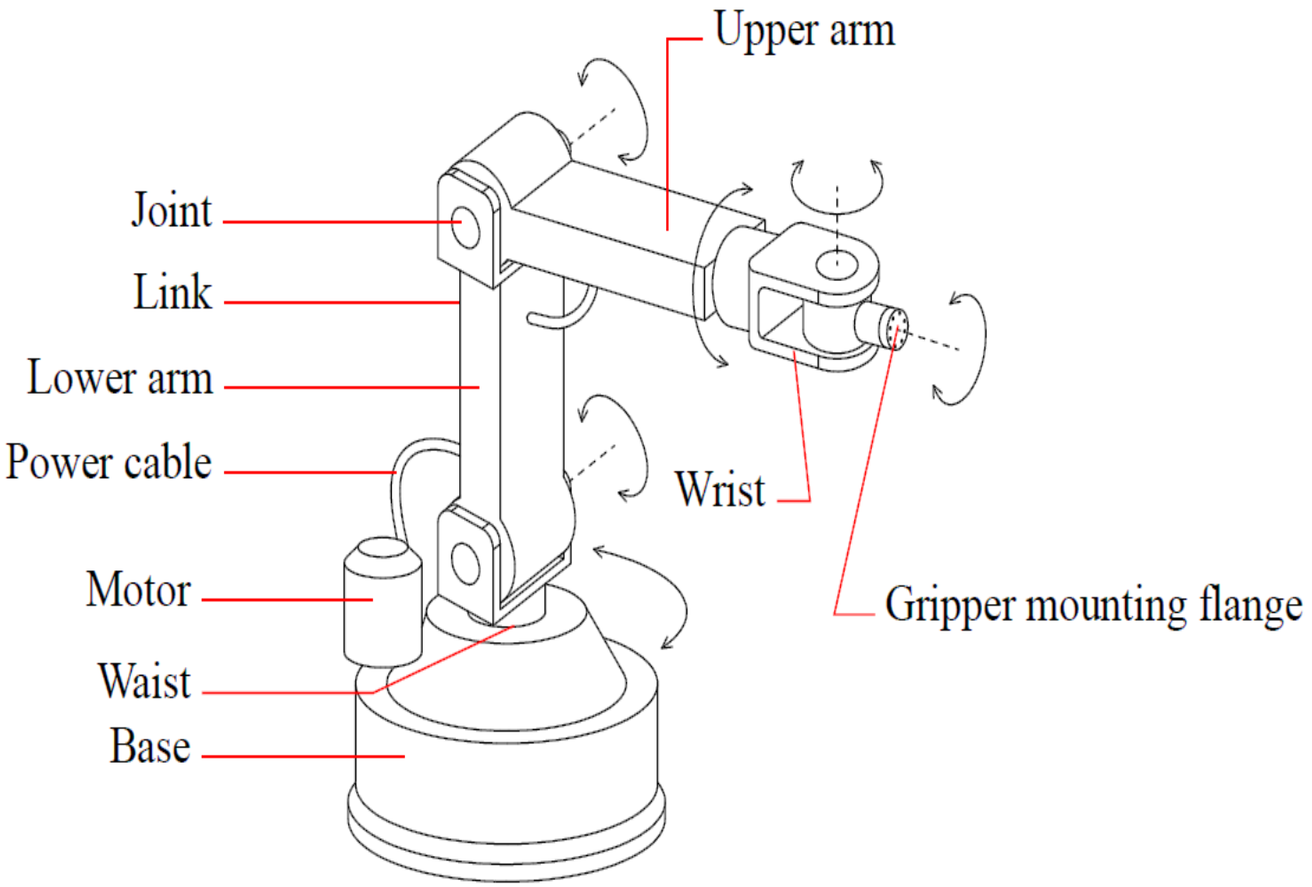
# Chapter 2




## Robotics Anatomy: Degrees of Freedom (DoF)

# Robotics Manipulator



# Degrees of Freedom (DoF)

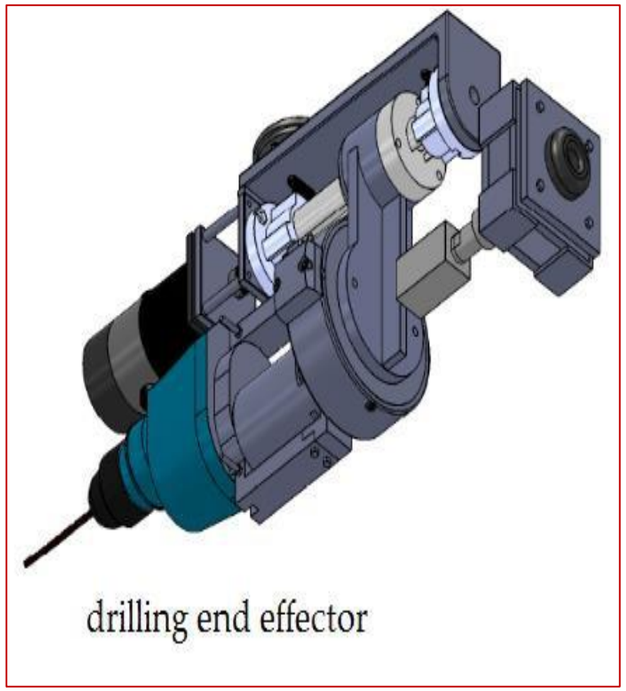
The ability of a joint to produce linear or rotary movement when actuated.

- Polar, cylindrical and jointed arm configuration consist 3 DOF with the arm and body motions are:
  1. Rotational navigation: Rotation of the arm about vertical axis such as left-and-right twist of the robot arm about a base
  2. Radial traverse: Involve the extension and retraction (in or out movement) of the arm relative to the base
  3. Vertical navigation: Provide up-and-down motion of the arm
- Cartesian coordinate robot has 3 DOF are:
  - Vertical movement (z-axis motion),
  - in-and-out movement (y-axis motion), and
  - right-and-left movement (x-axis motion)

# End Effectors

- Attached to the robot's wrist to allow the robot to accomplish a specific task.
- Two categories of end effectors: grippers and tools.
- Grippers: capable of  only two actions: opening and closing
- The robot is used to position the end effector
- The robot's wrist is used to orient the end effector.


Additional Laser Beam Delivery Components


drilling end effector

vaccum end effector


spray end effector

# Wrist Movements

- Wrist movement enable the robot to orient the end effector properly to perform a task
- Provided with up to 3 DOF which are:
  1. Wrist Yaw: Involve right-and-left rotation of the wrist
  2. Wrist Pitch: Provide up-and-down rotation to the wrist
  3. Wrist Roll: Is the rotation of the wrist about the arm axis

# Wrist Motion

1. Yaw – Rotary motion executed about $z$-axis. Causes movement in left and right directions.
2. Pitch – Rotary motion executed about $y$-axis. Causes movement in up and down directions.
3. Roll – Rotary motion executed about $x$-axis.