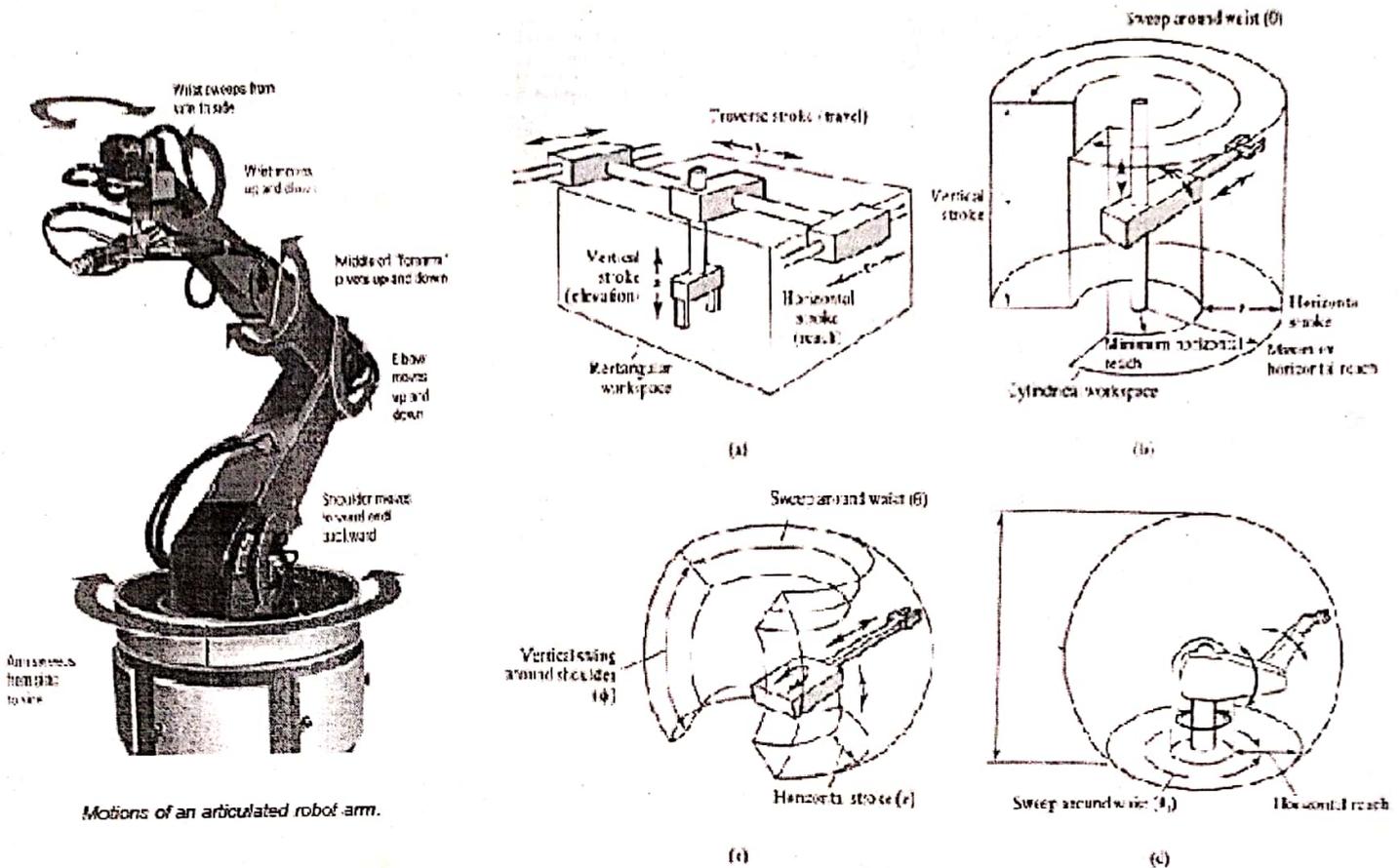


Efficient Design of An Articulated Arm Industrial Robot

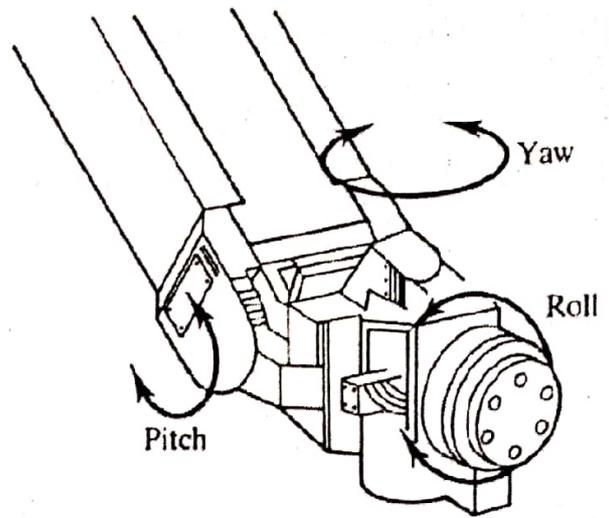


Workspaces for different robot geometries: (a) Cartesian geometry; (b) cylindrical geometry; (c) polar/spherical geometry; (d) revolute geometry/articulated arm, (from [McKerrow]).

- Manipulators are grouped into classes according to the combination of joints used in their construction.
- A **Cartesian geometry arm** (sometimes called a gantry crane) uses only prismatic joints, and can reach any position in its rectangular workspace by Cartesian motions of the links.
- By replacing the waist joint of a Cartesian arm with a revolute joint, a **cylindrical geometry arm** is formed.
- If the shoulder joint is also replaced by a revolute joint, an **arm with a polar geometry** is formed.
- Finally, replacing the elbow joint with a revolute joint results in a **revolute geometry, Articulated arm**.
- The workspace of an articulated arm is a rather complex thick walled spherical shell. The outside of the shell is a single sphere, but the inside is a set of intersecting spheres.

Comparison of Robot configuration:

Robot	Joints	Coordina.
Cartesian	prismatic waist prismatic shoulder prismatic elbow	<p><i>Advantage</i></p> <ul style="list-style-type: none"> linear motion in th simple kinematic rigid structure easy to visualize can use inexpensi drives for pick ar operation. <p><i>Disadvantag</i></p> <ul style="list-style-type: none"> requires a large v work space is sm unable to reach ar guiding surfaces must be covered
Cylindrical	revolute waist prismatic shoulder primatic elbow	<p><i>Advantage</i></p> <ul style="list-style-type: none"> simple kinematic easy to visualize good access into very powerful wl <p><i>Disadvam</i></p> <ul style="list-style-type: none"> restricted work sj prismatic guides and liquids back of robot can
Spherical	revolute waist revolute shoulder prismatic elbow	<p><i>Advantage</i></p> <ul style="list-style-type: none"> covers a large vo can bend down to <p><i>Disadvanti</i></p> <ul style="list-style-type: none"> complex kinematic difficult to visuali
Articulated	revolute waist revolute shoulder revolute elbow	<p><i>Advantage</i></p> <ul style="list-style-type: none"> maximum flexibi covers a large we revolute joints ar suits electric motc can reach over an <p><i>Disadvam</i></p> <ul style="list-style-type: none"> complex kinemat difficult to visual control of linear i structure not very



Robot wrist

- A wrist where the three axes of rotation intersect is called a *spherical wrist*.
- The kinematic structure of the robot arm allows to position its end point at any (x,y,z) location in the 3D space (... within the robot's working space)