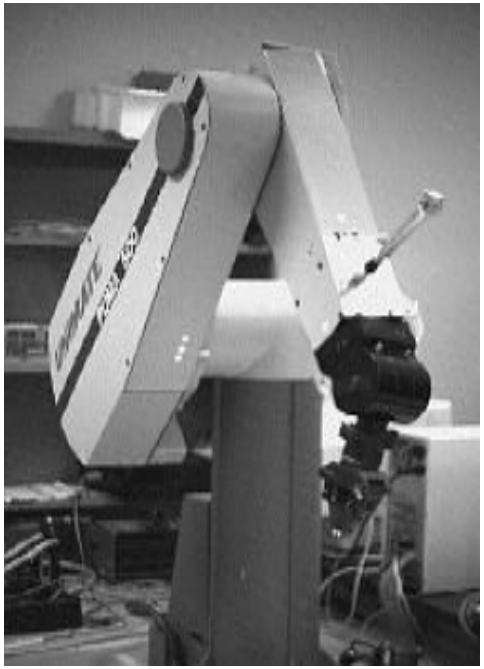
Types of Robot

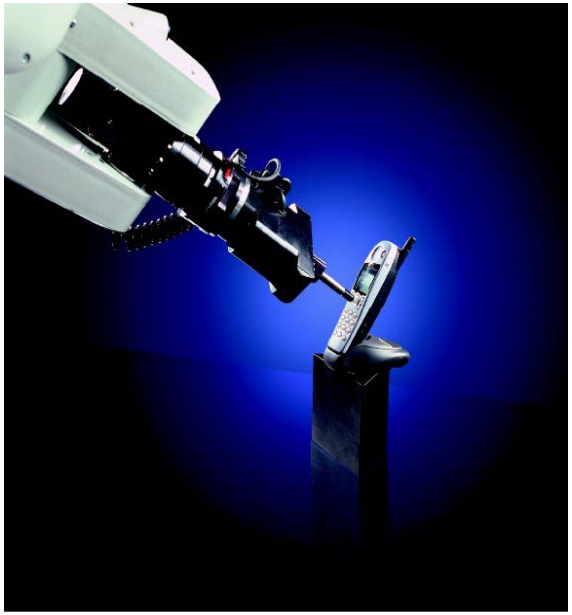
- Manipulators



Unimate Puma Robot

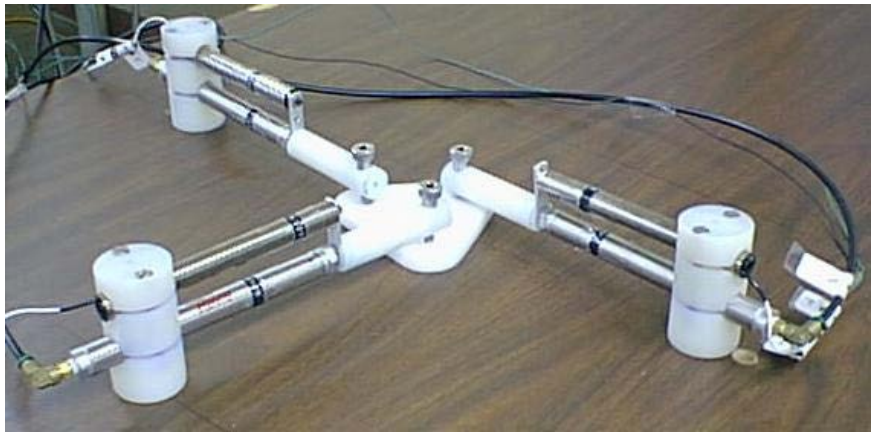
Adept's SCARA

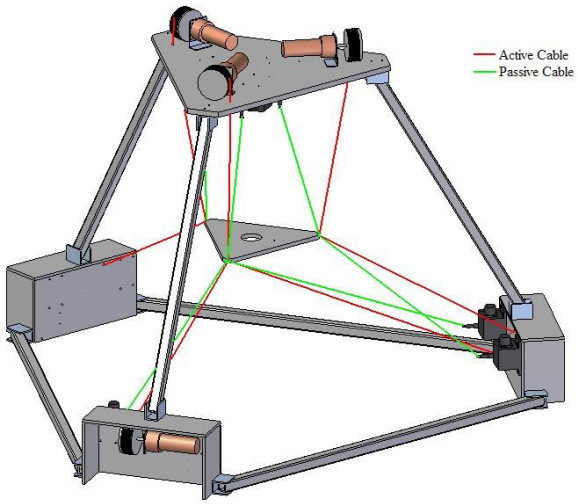
Stäubli's RX130

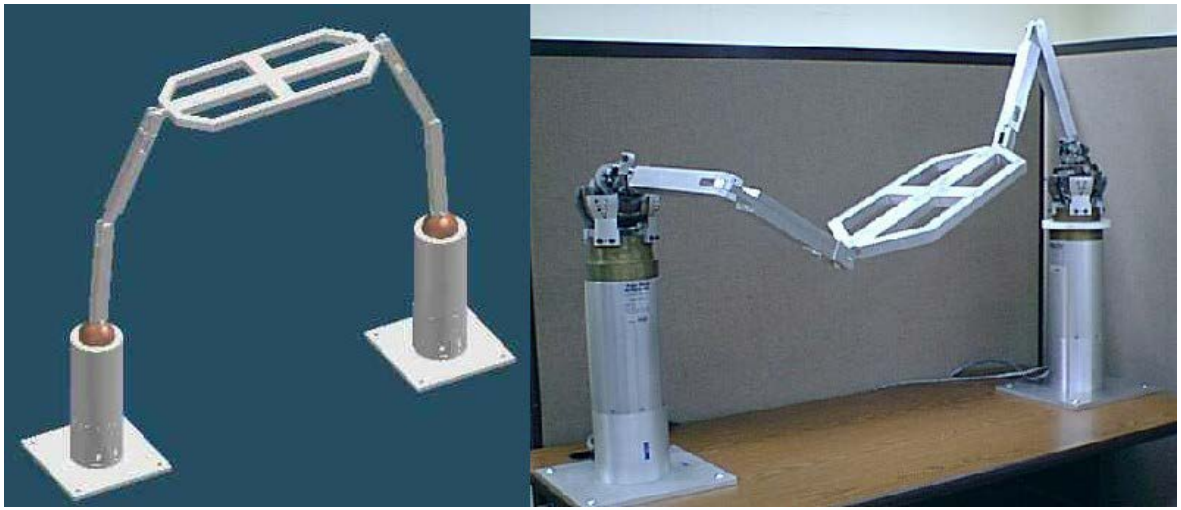


CRS' F3 Robot testing a mobile phone

Parallel manipulators







Robot Hands and Cooperative Manipulations

BH8-260 Hand from Barrett Technology

Manipulation Robots

Cooperation

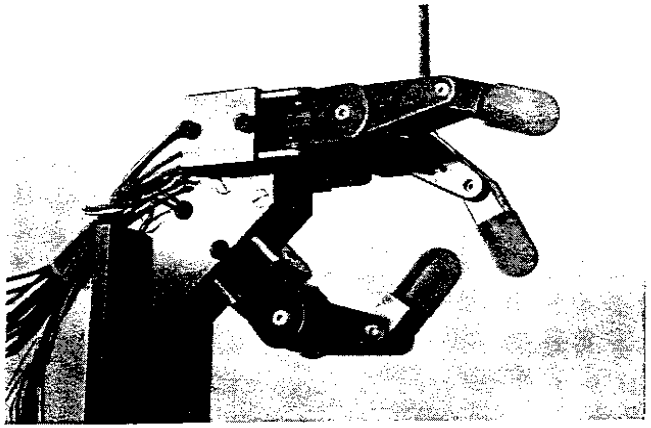
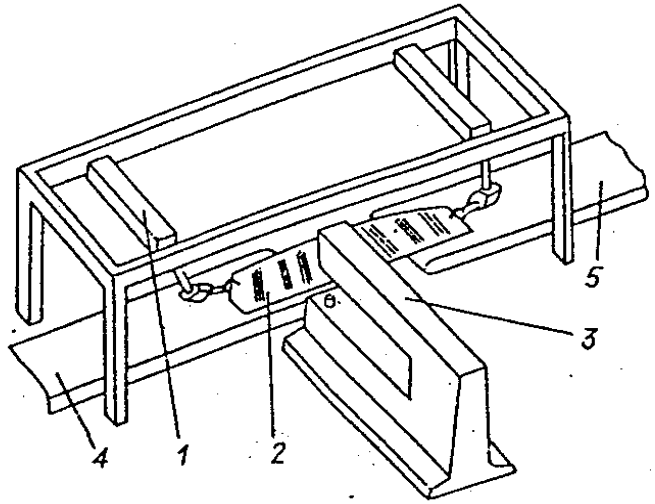


Figure 1-8 : Nine degree-of-freedom robot hand. This articulated hand is being used to study control, sensing, and language issues at the M.I.T. Artificial Intelligence Laboratory. *Photograph courtesy of D. R. Lampe, The MIT Report.*



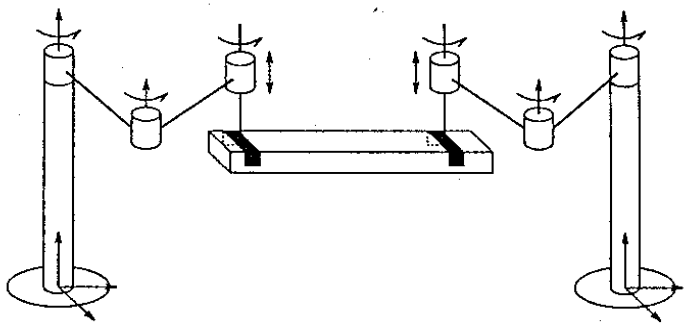
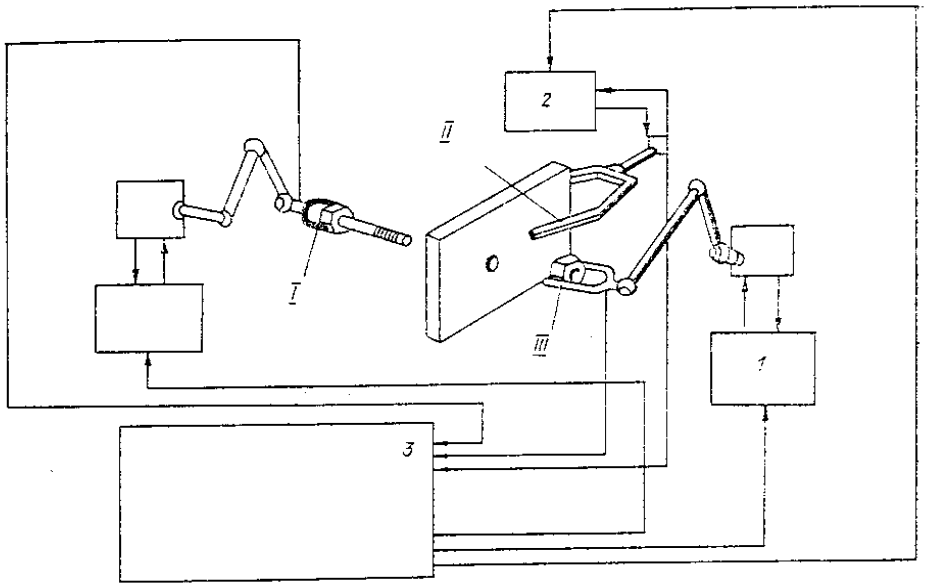


Figure 6.3: Coordinated lifting.

Applications Fields...

Industry



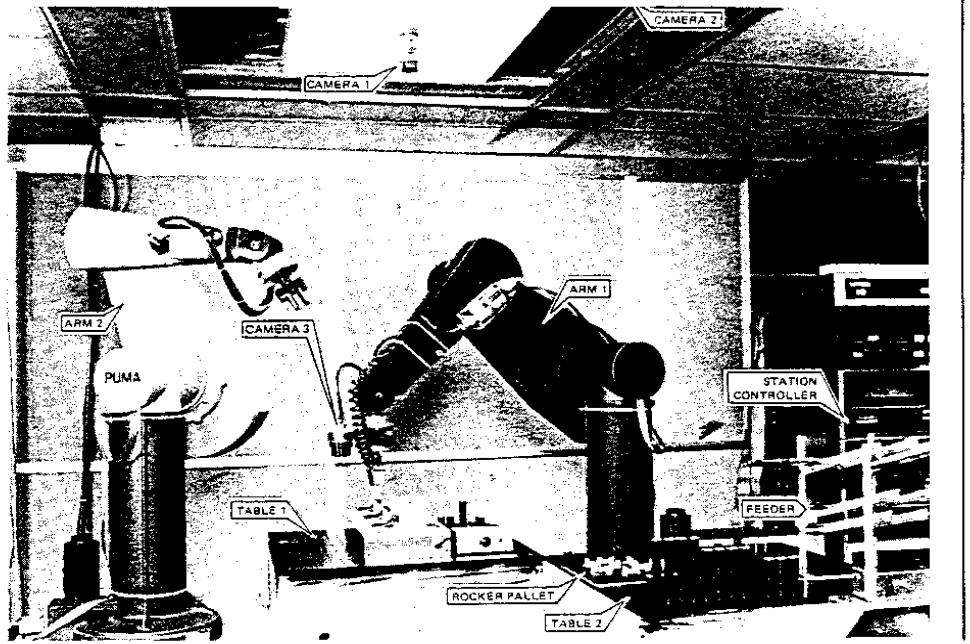
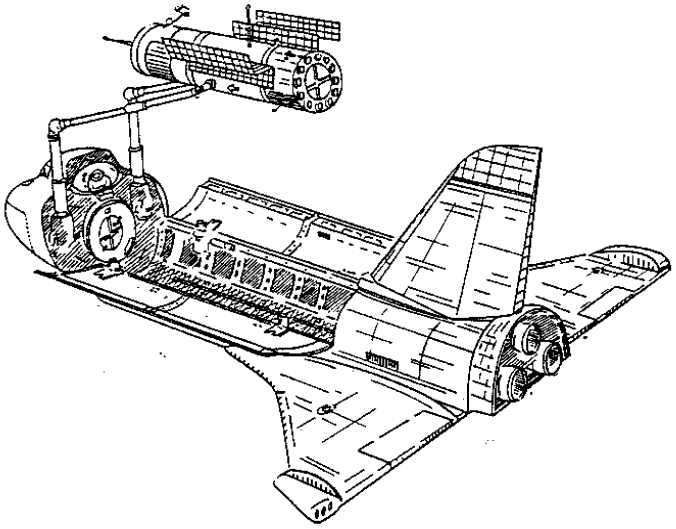
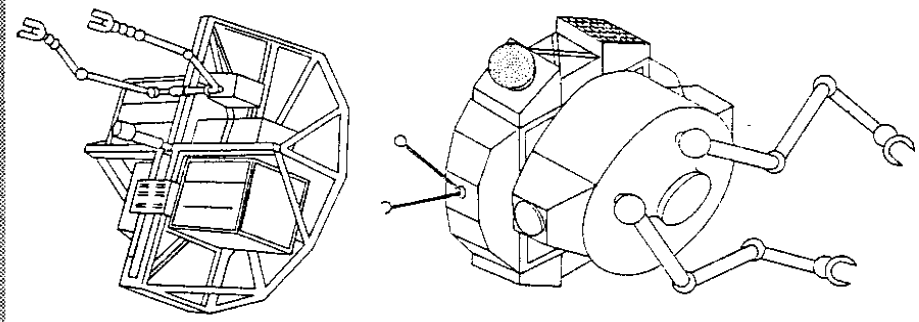


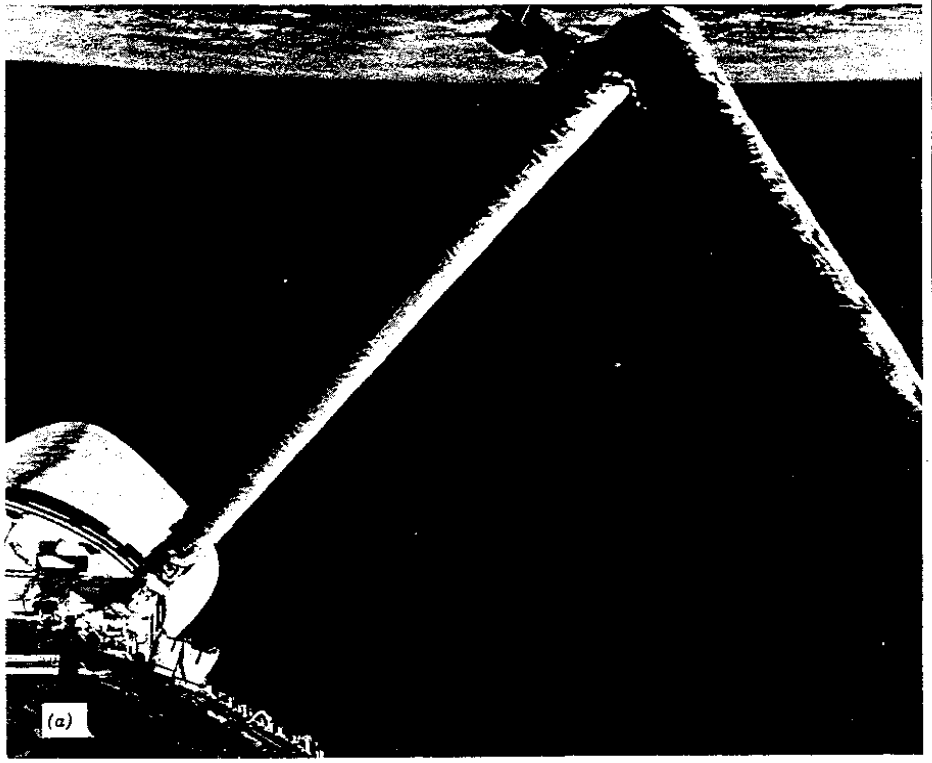
Figure 1-5 : Vision-guided assembly robots. Two video cameras are installed on the ceiling, while a third camera is carried by Arm 1 (S.R.I.).

Applications Fields…

Hazardous and Agressive Environments







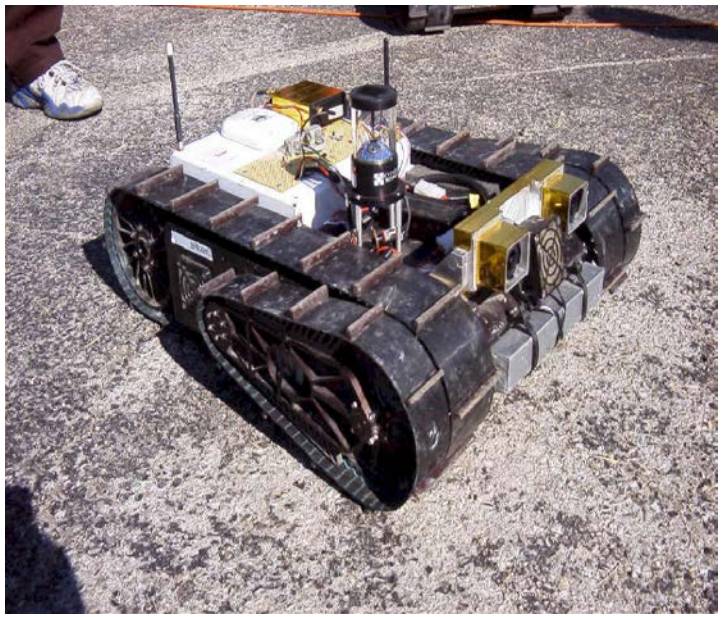
The Space Station Remote Manipulator System (SSRMS)

Canadarm - Robot arm on every Space Shuttle


Canada

Types of Robot

- Mobile robots



Urban Robot Platform
NASA JPL

iRobot-LE

Honda's P3 Robot

Types of Robot

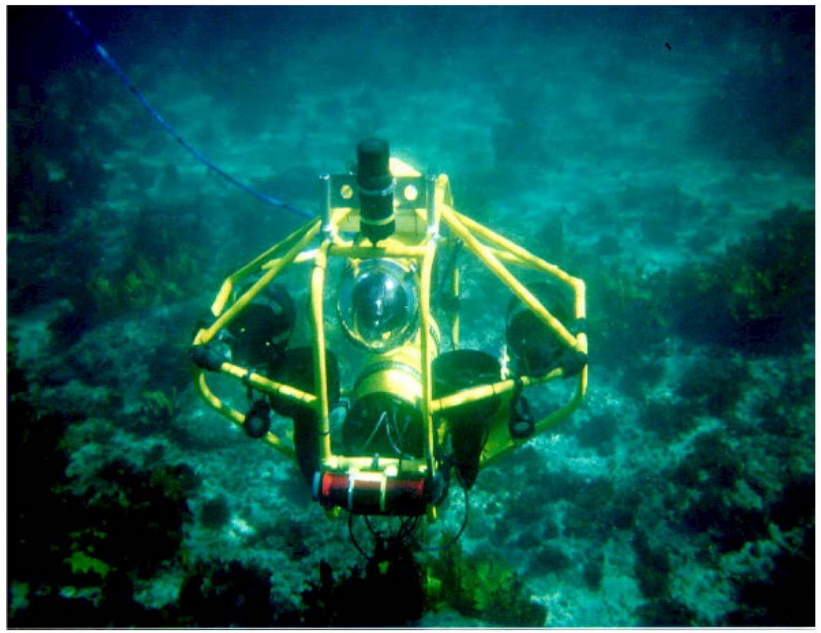
- Mobile robots

Mars Sojourner, NASA

Rescue robot

Types of Robot

- mobile robots



Oberon - underwater robot developed
by the Australian Centre for Field Robotics

Grass cutter

Types of Robot

- Entertainment

Sony's Aibo

Kosuge’s dancing teacher (in pink)

Types of Robot

- Education

PalmPilot Robot Kit, CMU

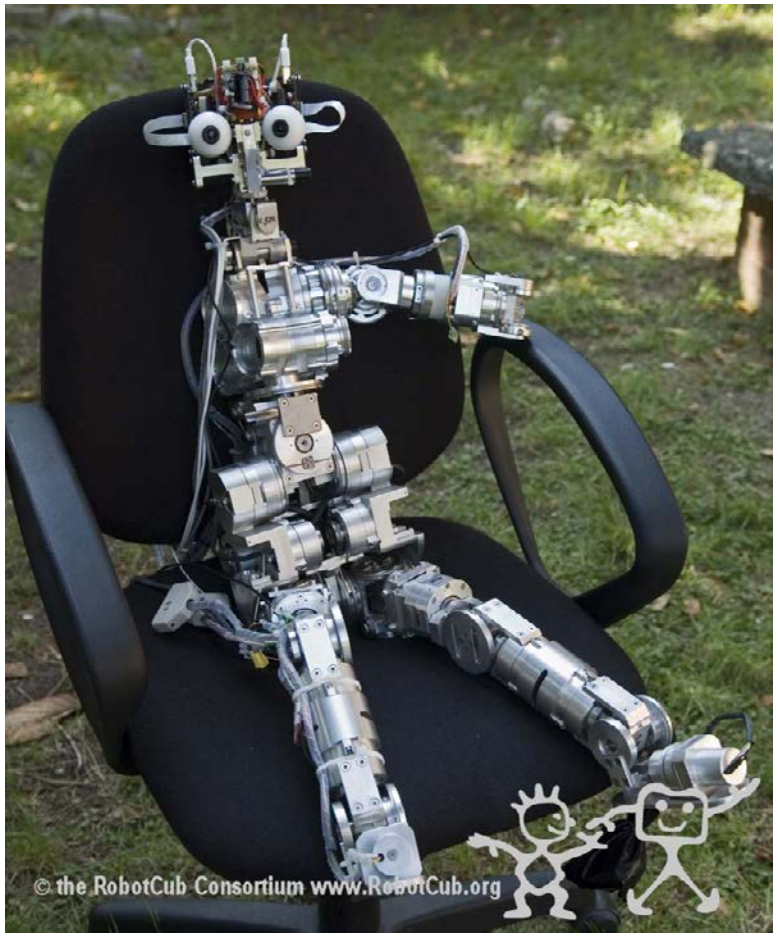
Lego Mindstorms

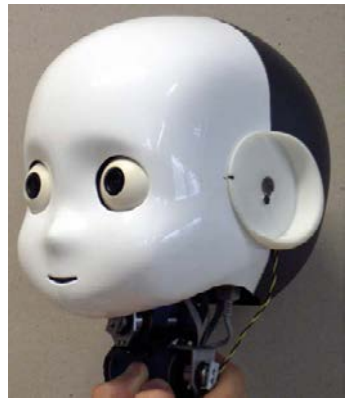
Pioneer from activmedia.com

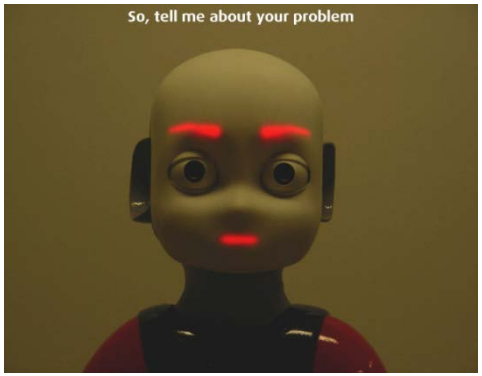
Types of Robot

- Robots for studying artificial intelligence

MIT AI Lab COG







iCub

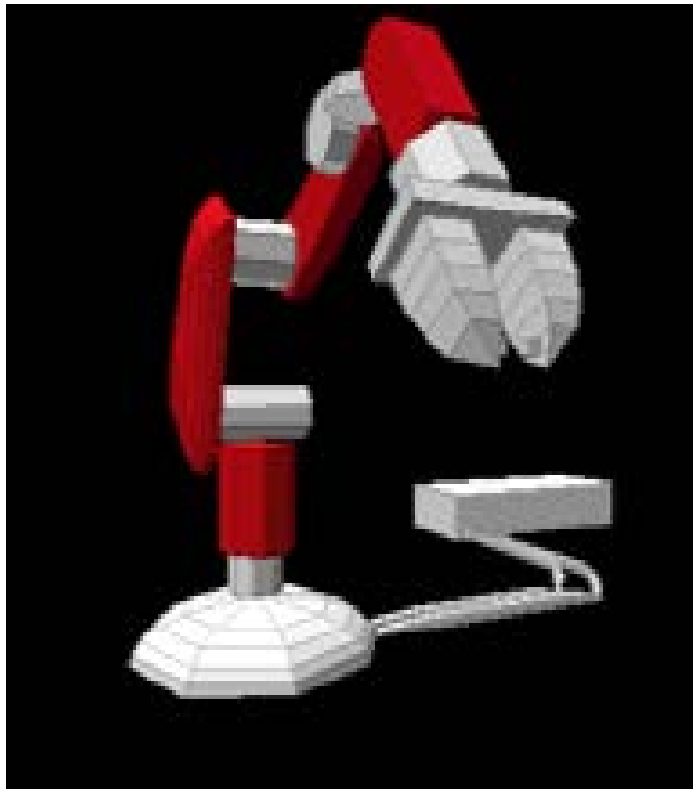
Robotic Applications

- Industrial
  - Parts handling
  - Assembly
  - Painting
  - Welding
- Surveillance
- Security
- Home help (grass cutters, vacuum cleaners)
- Medical care (nursing) & rehabilitation
- More

Robotic care takers

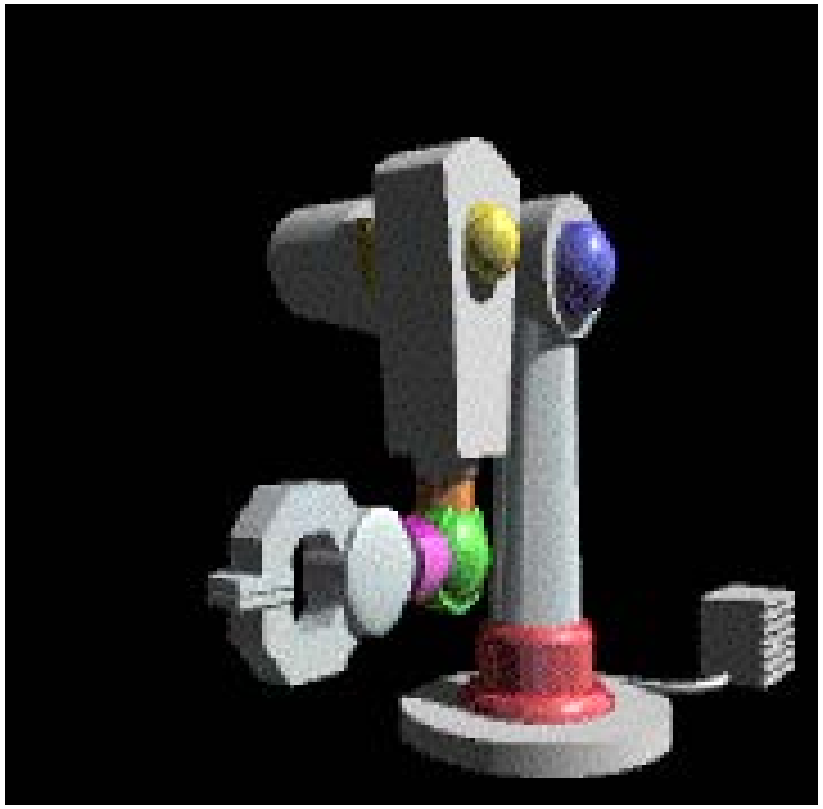
CMU Nursebot

Robot Anatomy



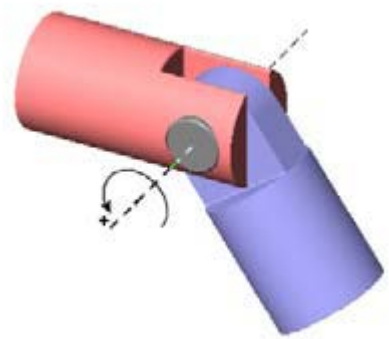
- Joints & Links
- Motors & Transmissions
- End-effector
- Drivers
- Sensors
- Control System

Degrees of Freedom

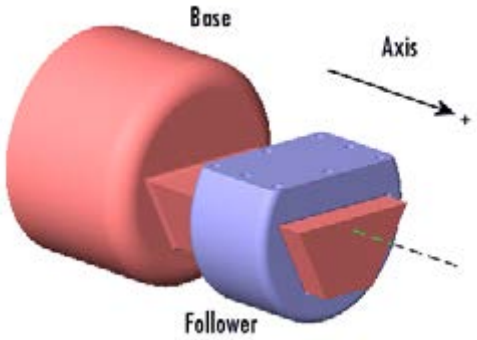


- ROTATE BASE OF ARM
- PIVOT BASE OF ARM
- BEND ELBOW
- WRIST UP AND DOWN
- WRIST LEFT AND RIGHT
- ROTATE WRIST

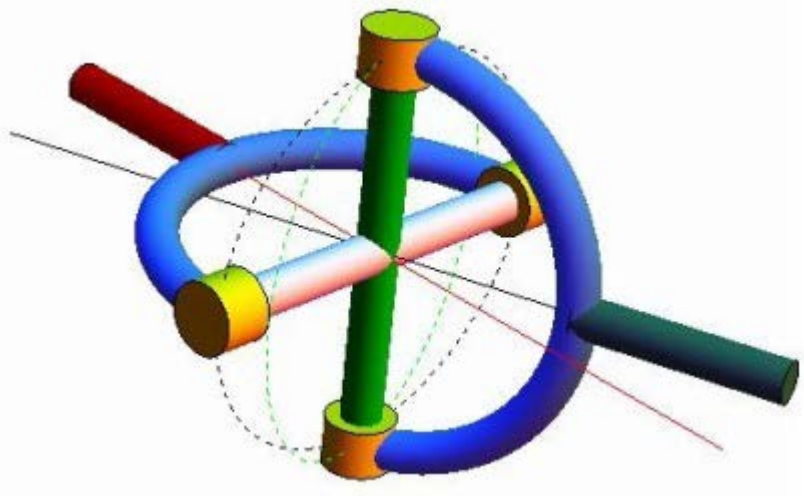
Type of Joints



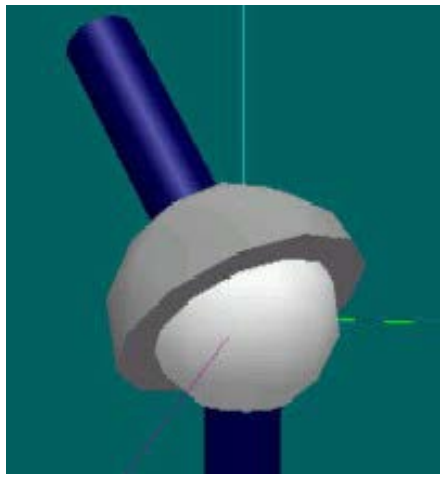
Revolute Joint



Prismatic Joint



Universal Joint



Spherical Joint

Description of Manipulators

Position and Orientation

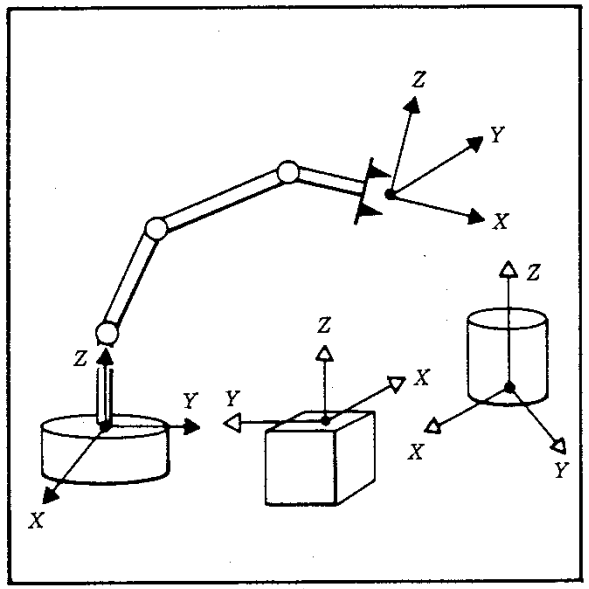


FIGURE 1.5 Coordinate systems or "frames" are attached to the manipulator and objects in the environment.

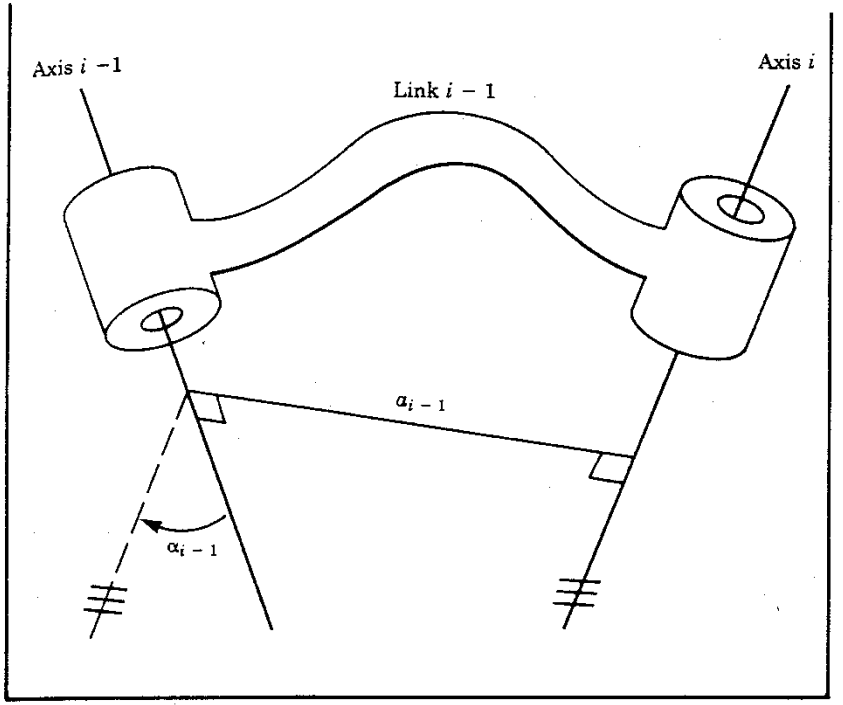


FIGURE 3.2 The kinematic function of a link is to maintain a fixed relationship between the two joint axes it supports. This relationship can be described with two parameters, the link length, a, and the link twist, α.

Geometrical Analysis

Forward and Inverse Kinematic Tasks

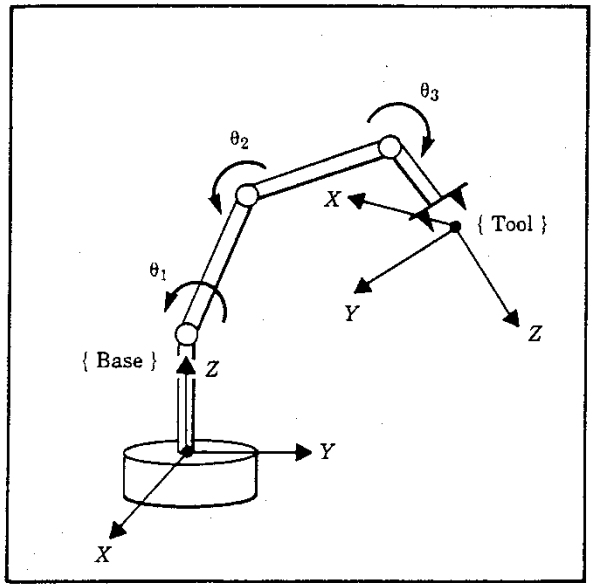


FIGURE 1.6 Kinematic equations describe the tool frame relative to the base frame as a function of the joint variables.

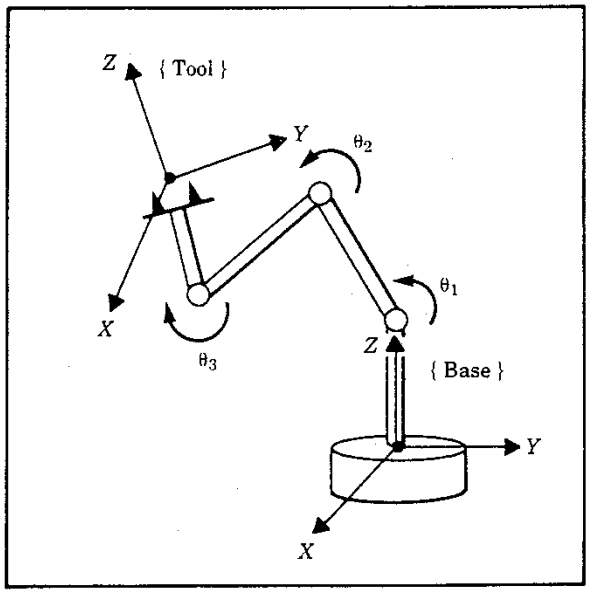


FIGURE 1.7 For a given position and orientation of the tool frame, values for the joint variables can be calculated using the inverse kinematics.

Geometrical Analysis

Multiple Solution and Environment

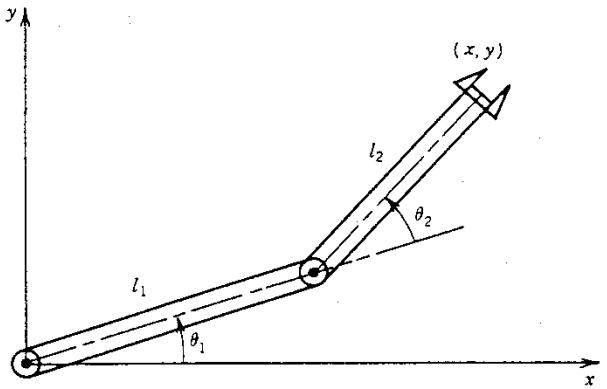


Figure 1-9 : A two-link articulated planar manipulator. Desired end-effector positions are reached by moving the two motors located at the joints.

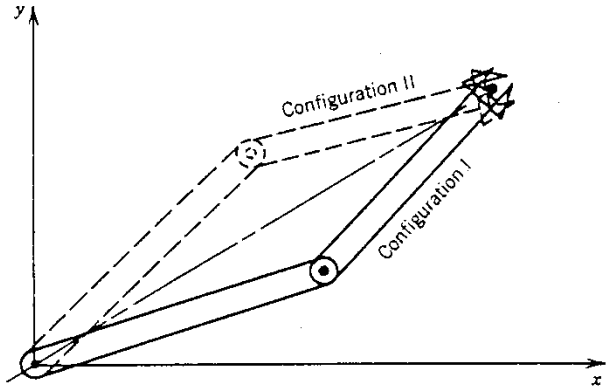
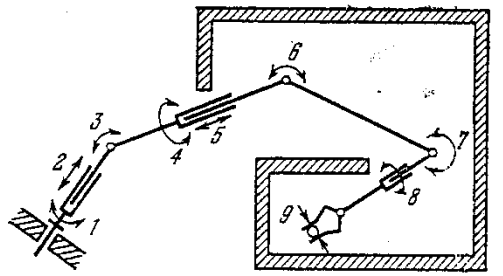


Figure 1-10 : The two inverse kinematics solutions.



Control Problems

Position and Force Control

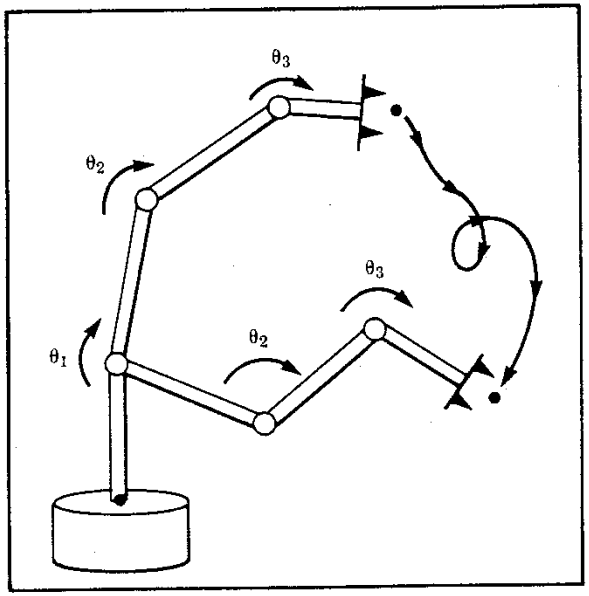


FIGURE 1.12 In order to cause the manipulator to follow the desired trajectory, a position control system must be implemented. Such a system uses feedback from joint sensors to keep the manipulator on course.

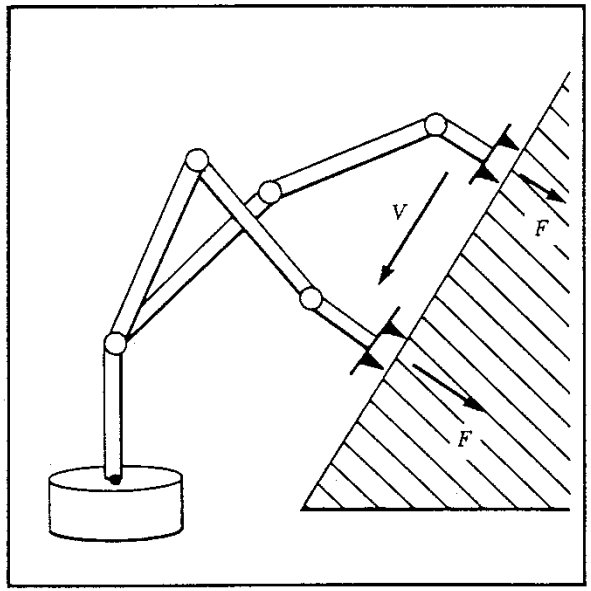
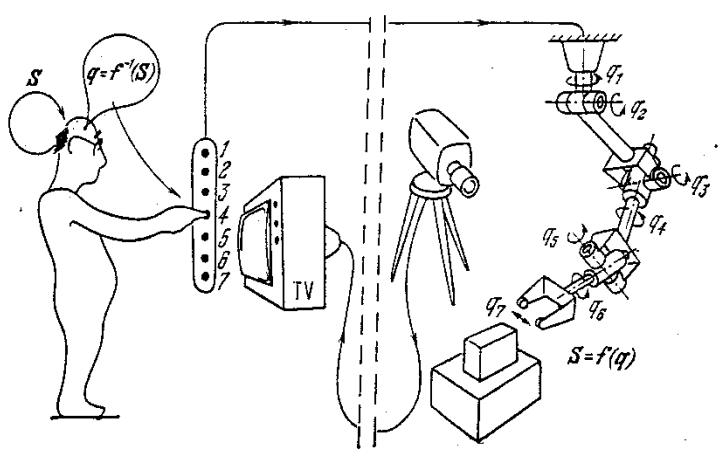
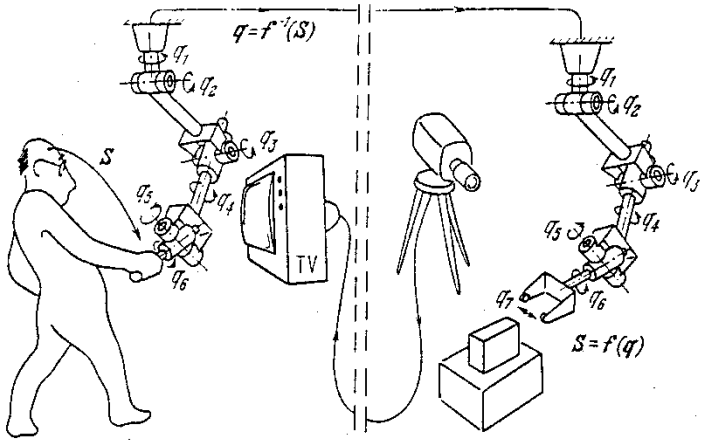


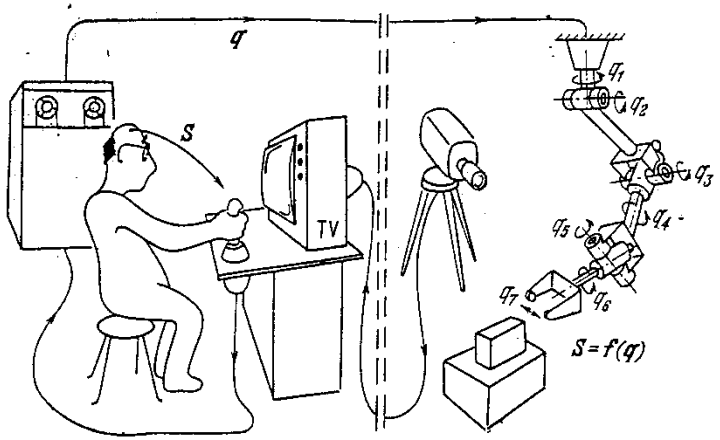
FIGURE 1.13 In order for a manipulator to slide across a surface while applying a constant force, a hybrid position-force control system must be used.

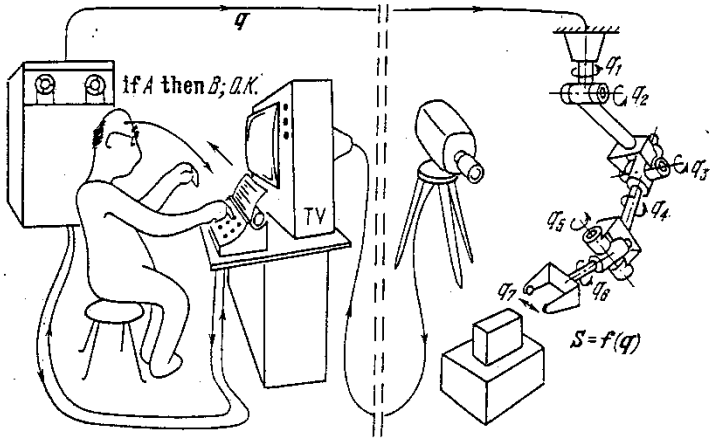
Robot Programming

Different Approaches









Robot Programming

Input Devices

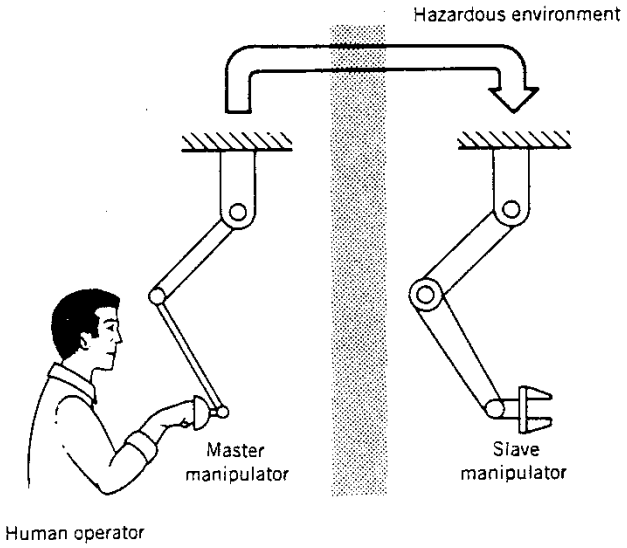
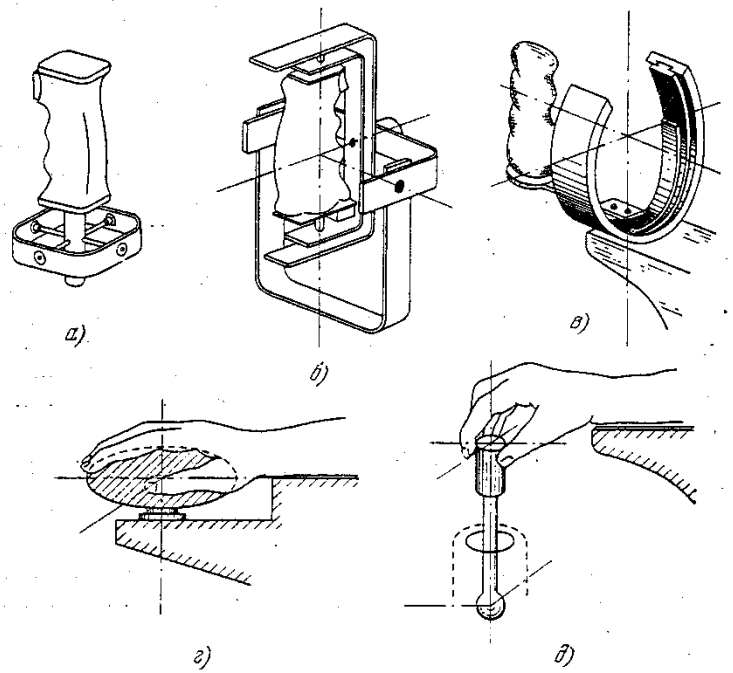


Figure 1-2 : Master-slave manipulator.



Robot Programming

Programming Languages and Off-line programming systems

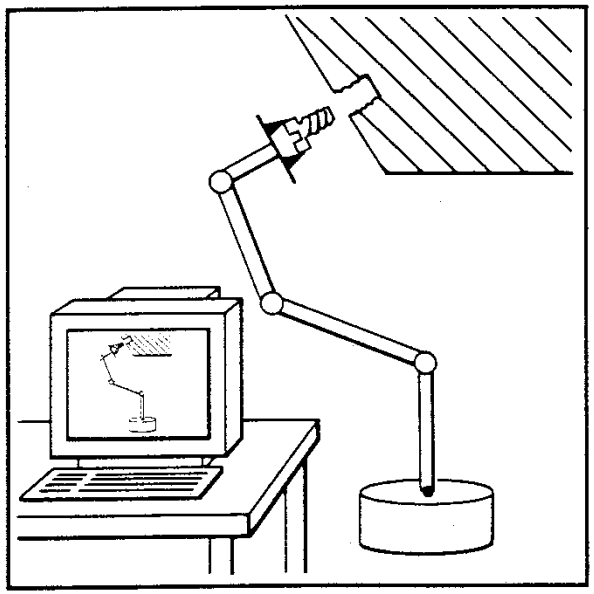


FIGURE 1.15 Off-line programming systems, generally providing a computer graphic interface, allow robots to be programmed without access to the robot itself during programming.