Robotic Manipulators

“Industrial Arms”, incl. End-Effectors

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Context

Manipulação

Polimento / Remoção de Material

Paletização

Carregamento de Máquinas

Soldadura

Montagem

Images adapted from publicity of the brand:

Kawasaki Robotics

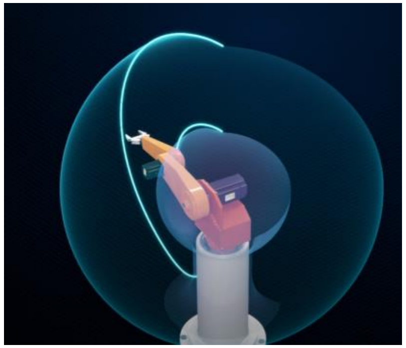
Sala Limpa / Medico-Farmacêutico

Dispensação de colas ou pastas

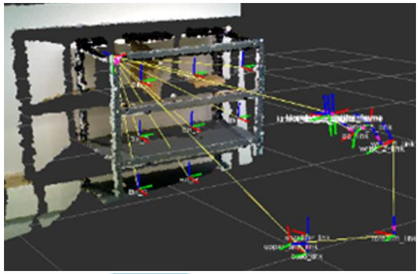
Pintura

More Context

https://www.youtube.com/watch?v=_canCYWZPsc



- Streamlining Automated Processes
- Bin-Picking Operations
- Transportation and Handling
- Storage
- Repetitive and Harsh Operations
- Precision Operations
- ….
- _Manipulators and ROS (external presentation)_
- _Amazon Picking Challenge by team MIT-Princeton_

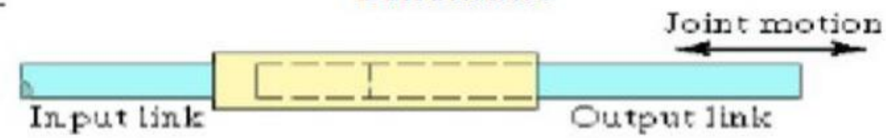
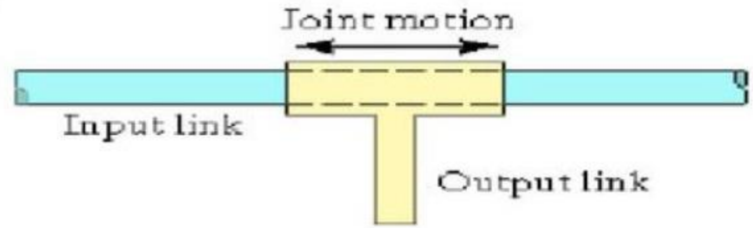
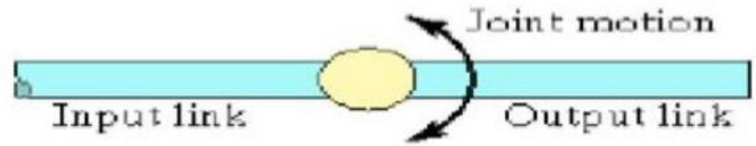
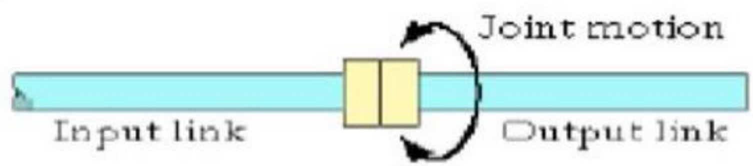
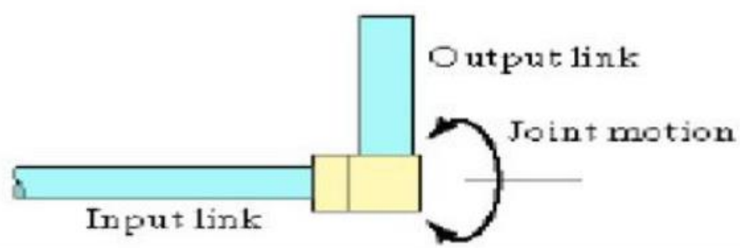


KUKA

INESCTEC
TECHNOLOGY & SCIENCE
ASSOCIATE LABORATORY
PORTUGAL

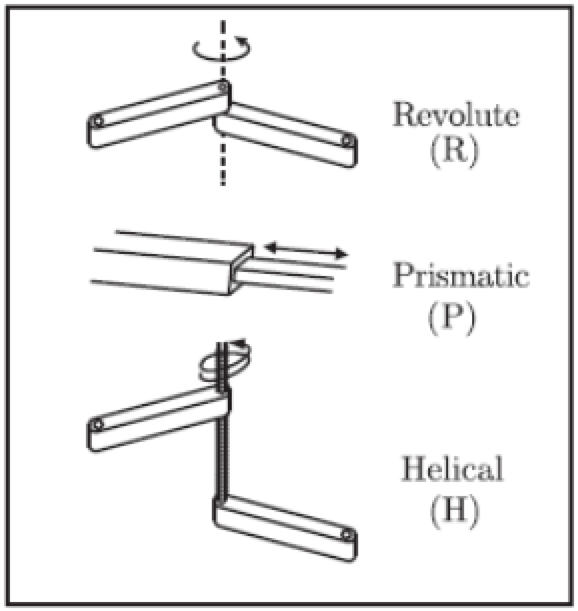
Mechanical Joints

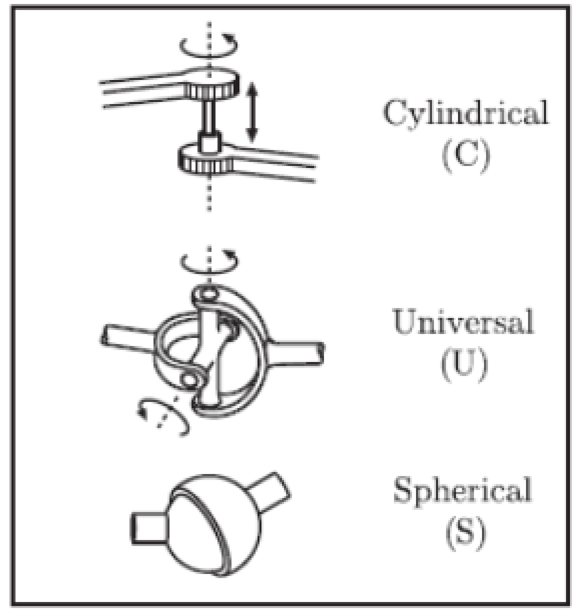
Mechanical Joints

Joint	Description	Schematic
Linear joint	Type L joint; the relative movement between the input link and the output link is a translational sliding motion, with the axes of the two links parallel.	
Orthogonal joint	Type O joint; the relative movement between the input link and the output link is a translational sliding motion, but the output link is perpendicular to the input link.	
Rotational joint	Type R joint; this provides rotational relative motion, with the axis of rotation perpendicular to the axes of the input and output links.	
Twisting joint	Type T joint; this provides rotary motion, but the axis of rotation is parallel to the axes of the two links.	
Revolving joint	Type V joint; the axis of the input link is parallel to the axis of rotation of the joint, and the axis of the output link is perpendicular to the axis of rotation.	

https://slideplayer.com/slide/14385961/

Mechanical Joints

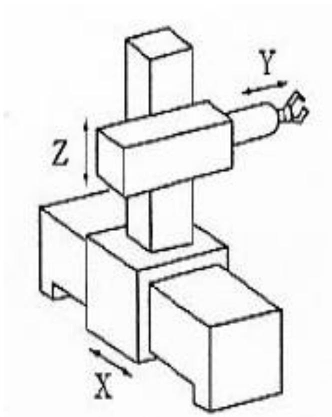




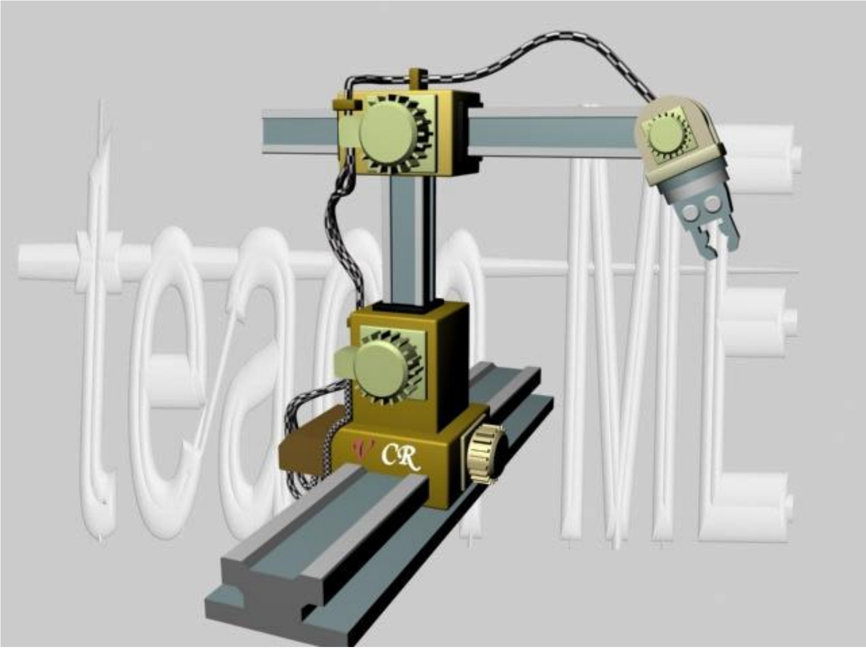
https://ettron.com/how-to-make-a-robotic-arm-with-arduino/

Configurations of Manipulators

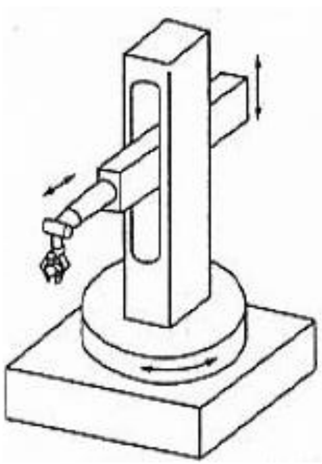
Industrial Manipulator



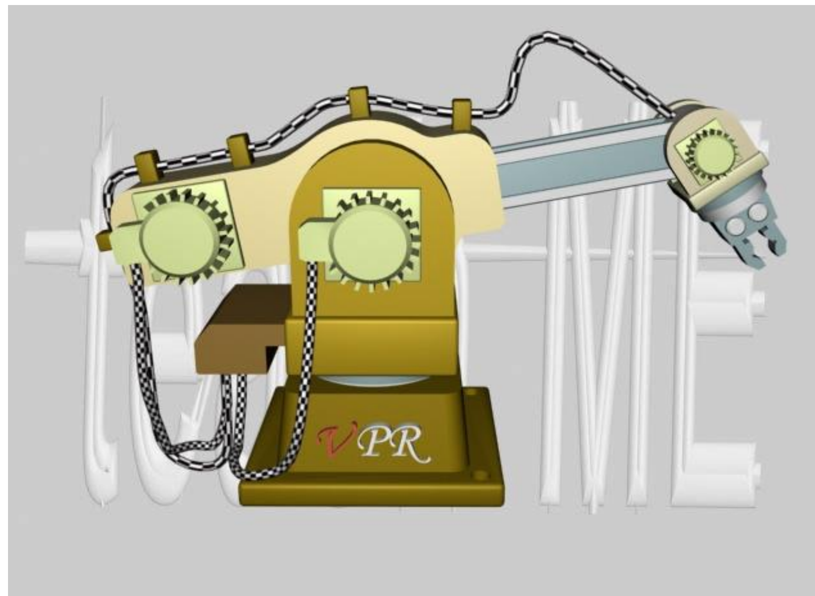
Cartesiano



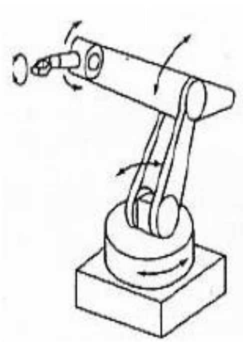
Industrial Manipulator



Cilíndrico
=
Polar

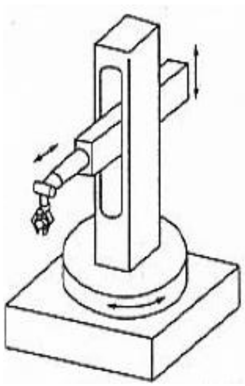


Industrial Manipulator

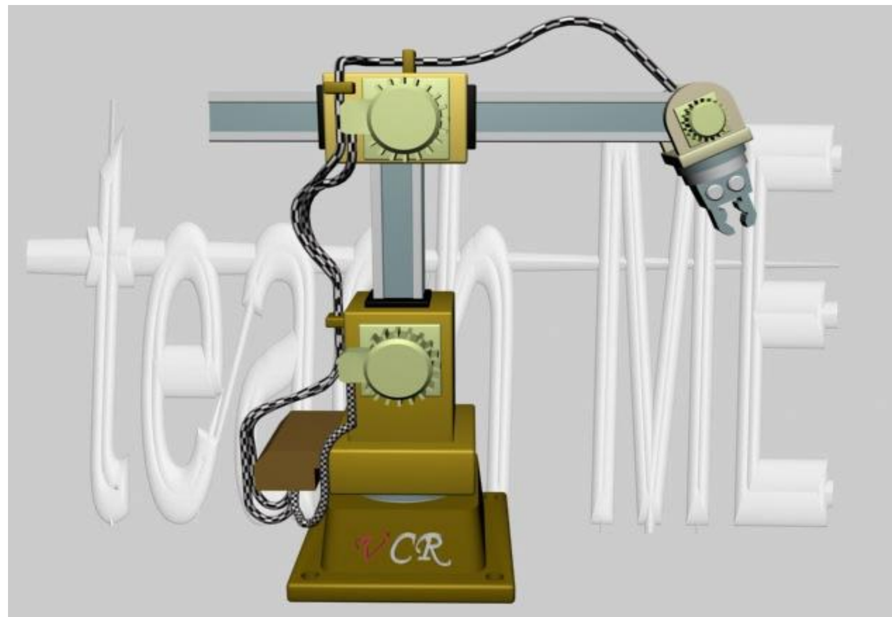


Articulado

Industrial Manipulator

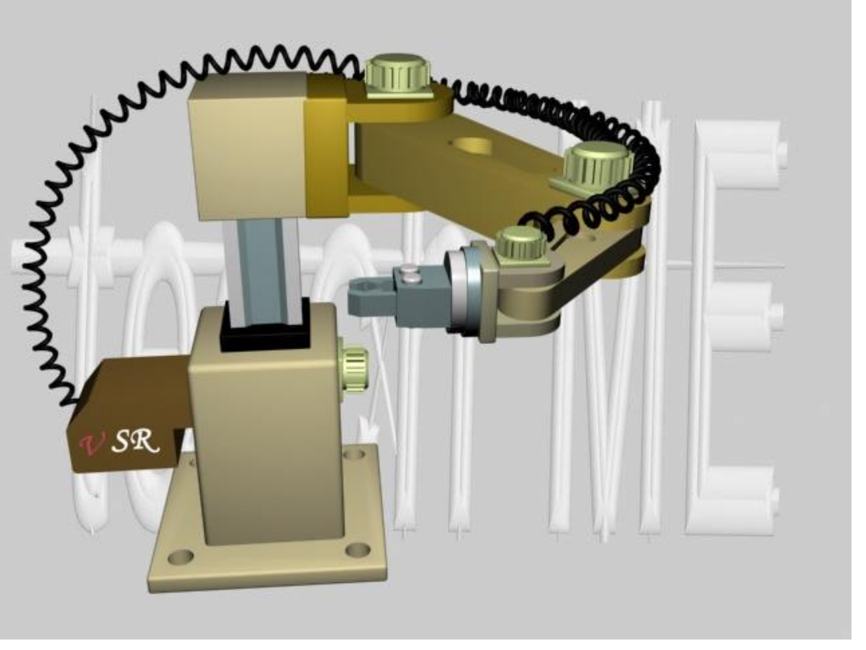


Cilíndrico



Industrial Manipulator

SCARA
Selection
Compliance
Assembly
Robot
Arm



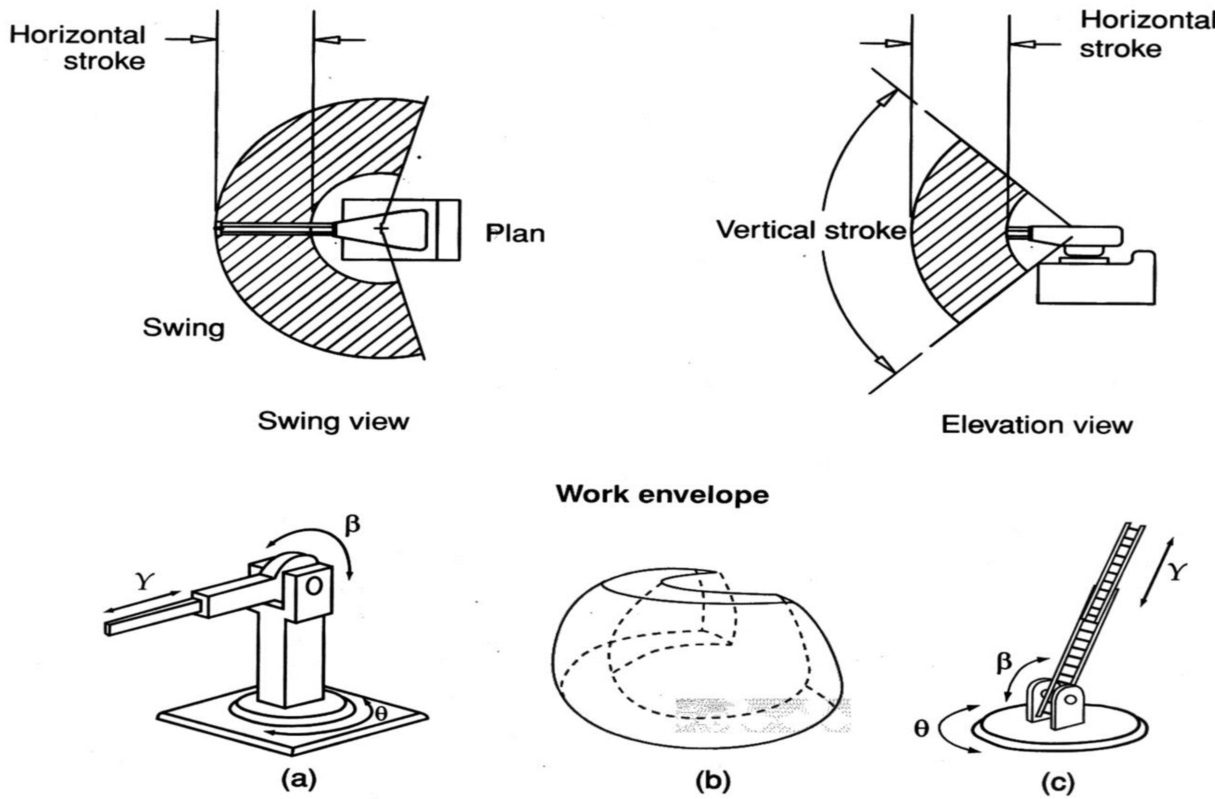


Figure 3.2.5 Spherical- or polar-coordinated robot: (a) A polar- or spherical-coordinated manipulator rotates about its base and shoulder and moves linearly in and out. (b) The work envelope of a polar-coordinated manipulator is the space between the two hemispheres. (c) A ladder on a hook-and-ladder truck has movements similar to those of a polar-coordinated manipulator.

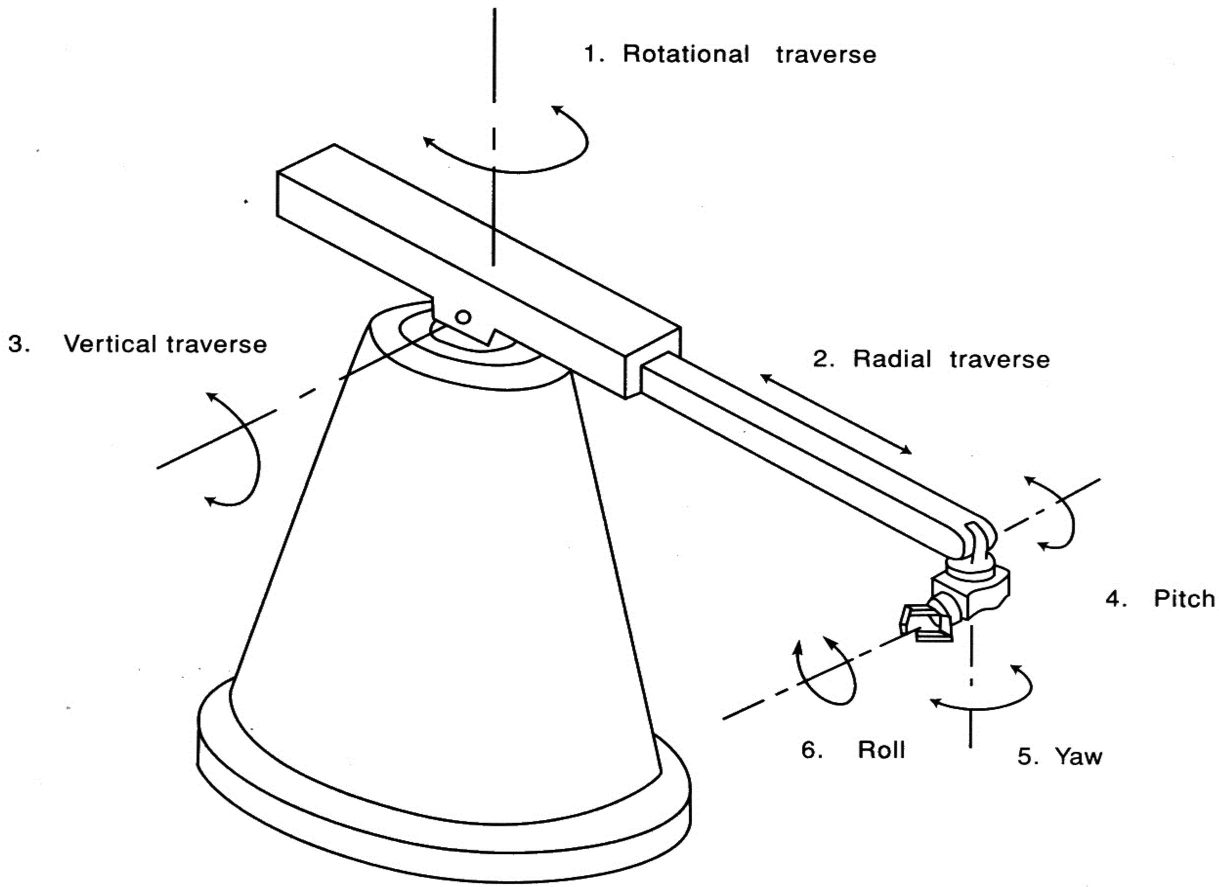
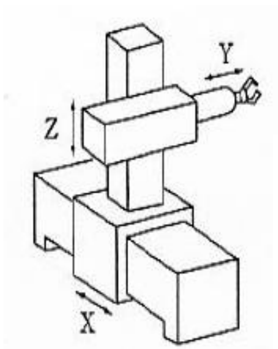
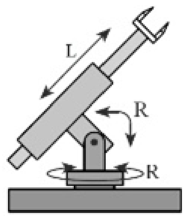


Figure 3.3.2 Six major degrees of freedom of a robotic system

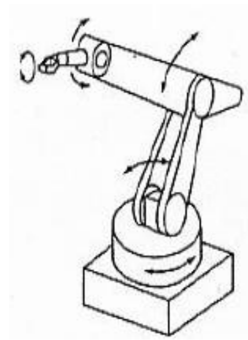
Industrial Manipulator



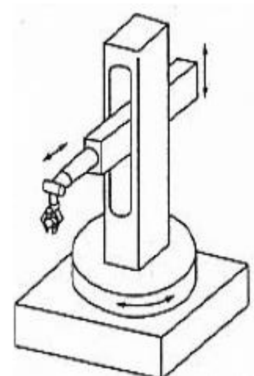
Cartesiano



Esférico



Articulado



Cilíndrico

SCARA
Selection
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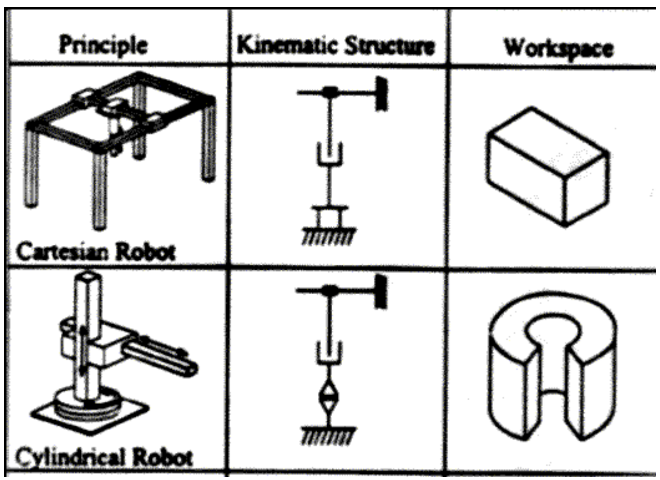
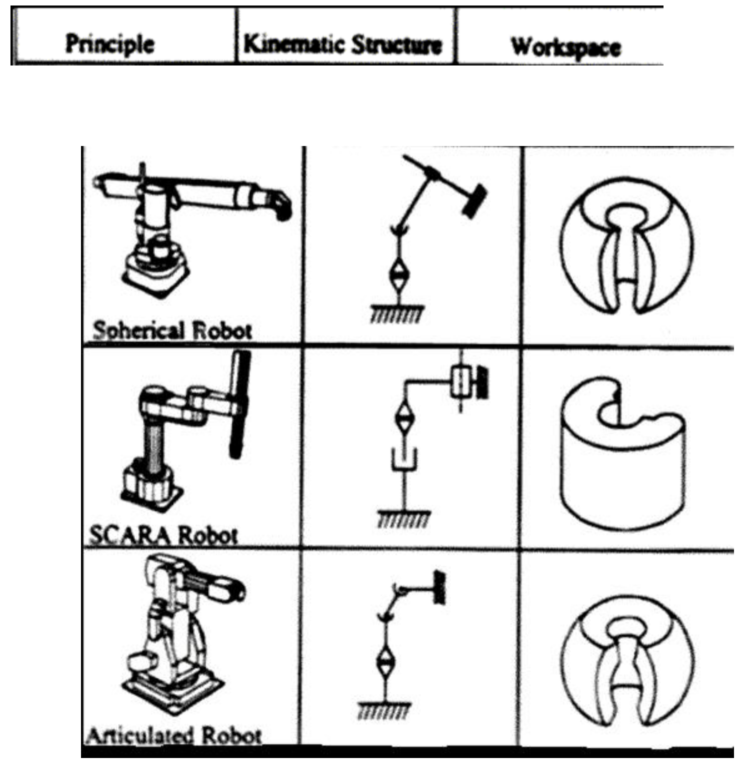
Industrial Manipulator



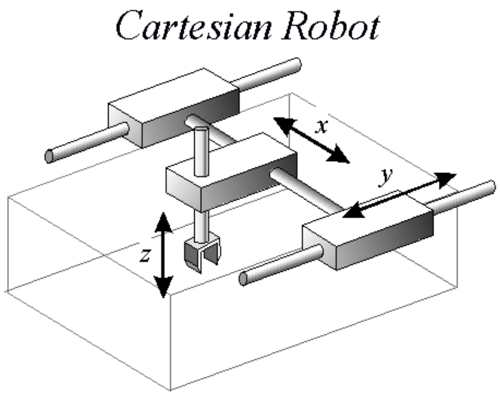


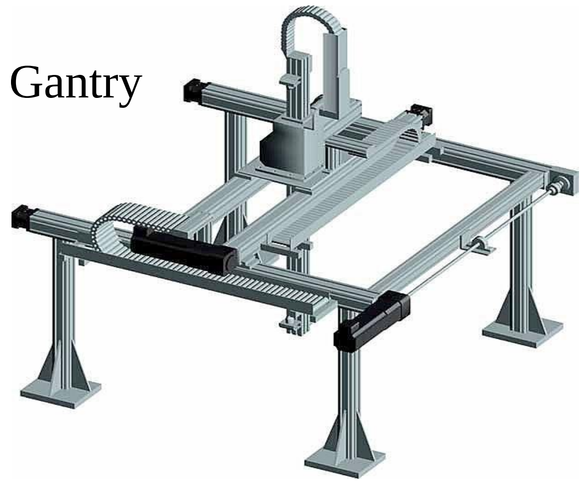
Types of robots - http://prime.jsc.nasa.gov/ROV/types.html

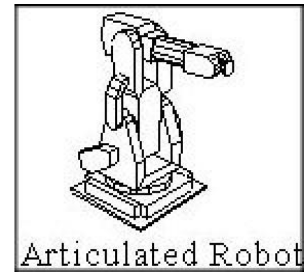
- Cartesian robot /Gantry robot: Used for pick and place work, application of sealant, assembly operations, handling machine tools and arc welding. It's a robot whose arm has three prismatic joints, whose axes are coincident with a Cartesian coordinator.
- Cylindrical robot: Used for assembly operations, handling at machine tools, spot welding, and handling at diecasting machines. It's a robot whose axes form a cylindrical coordinate system.
- Spherical/Polar robot: Used for handling at machine tools, spot welding, diecasting, fettling machines, gas welding and arc welding. It's a robot whose axes form a polar coordinate system.
- SCARA robot: Used for pick and place work, application of sealant, assembly operations and handling machine tools. It's a robot which has two parallel rotary joints to provide compliance in a plane.
- Articulated robot: Used for assembly operations, diecasting, fettling machines, gas welding, arc welding and spray painting. It's a robot whose arm has at least three rotary joints.
- Parallel robot: One use is a mobile platform handling cockpit flight simulators. It's a robot whose arms have concurrent prismatic or rotary joints.

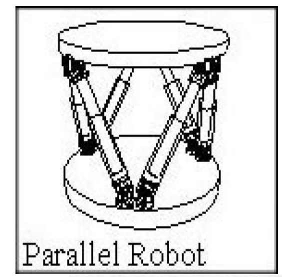
Types of robots -

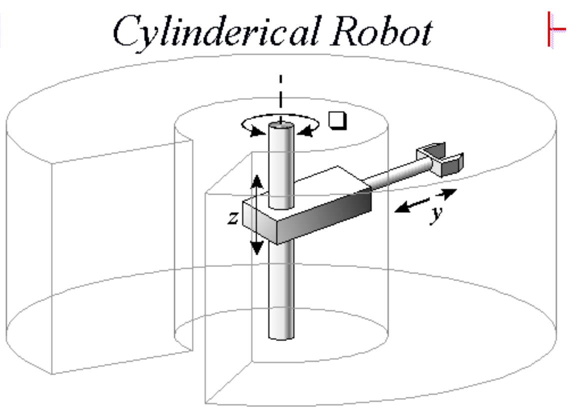
http://prime.jsc.nasa.gov/ROV/types.html

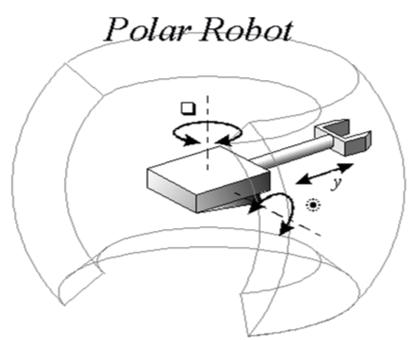


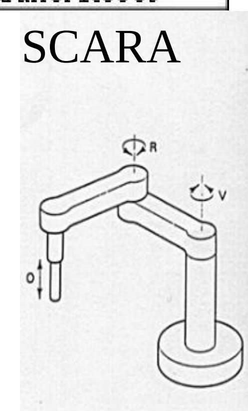




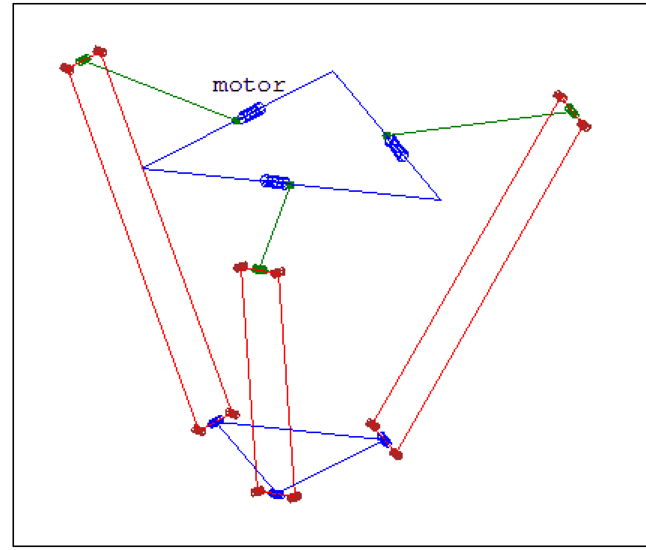








- https://www.youtube.com/watch?v=v9oeOYMRvuQ – Pancake
- https://www.youtube.com/watch?v=disekkn8YoQ - Macarons



Parallel Robot
Quattro

SCARA Robot
eCobra

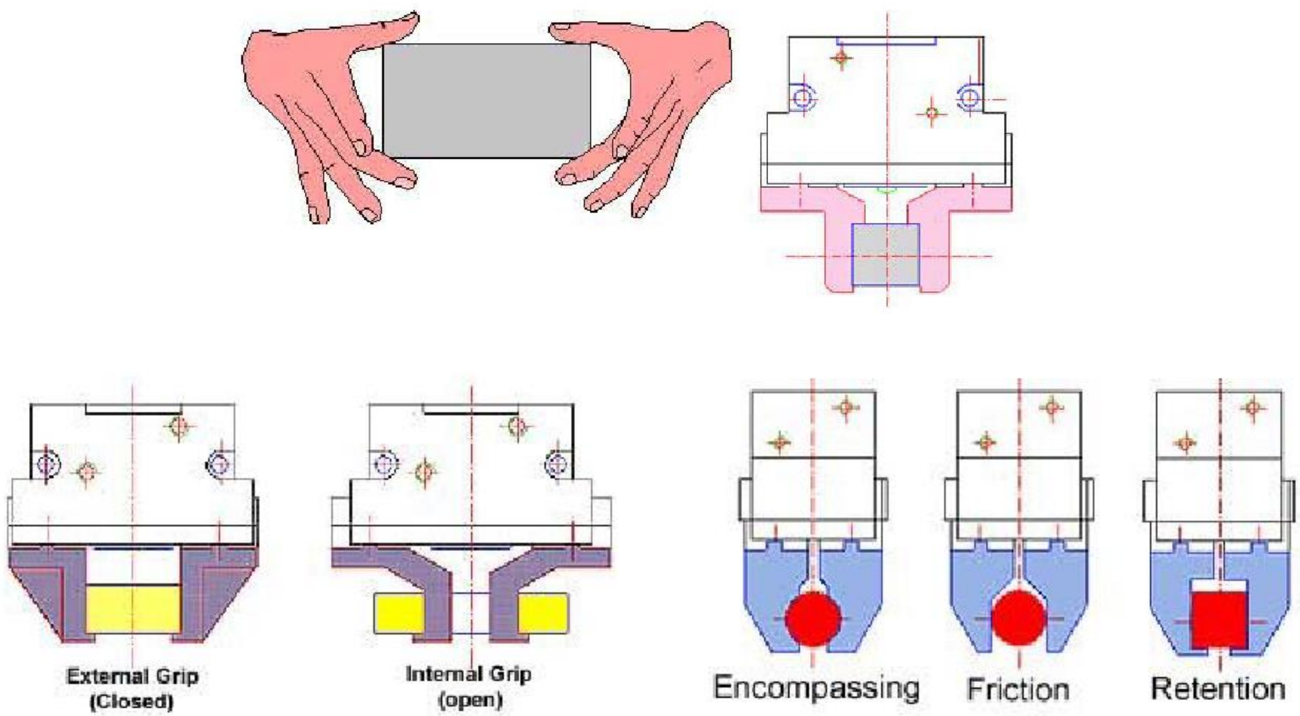
Articulated Robot
Viper

End-Effectors

(For Manipulators)

[Sometimes “grippers”]

“Grippers” are also actuator chain(s)



Does the tool center point move during the grip operation?

“Effector” – arm – complex actuator chain

Fig. 6: One of *Pneuman’s* robotic arms.

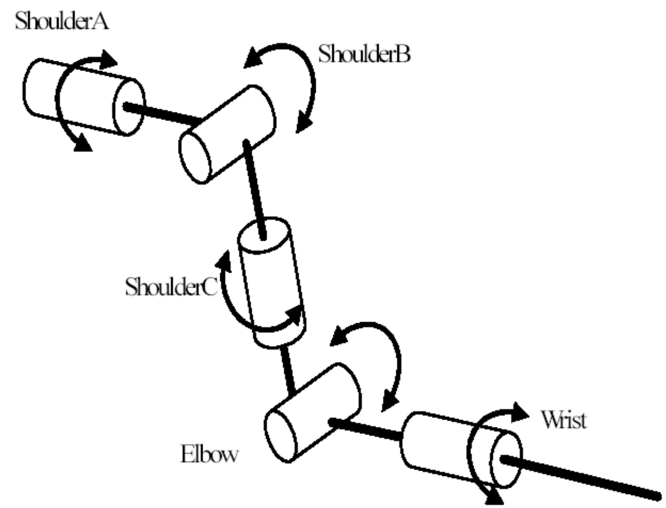
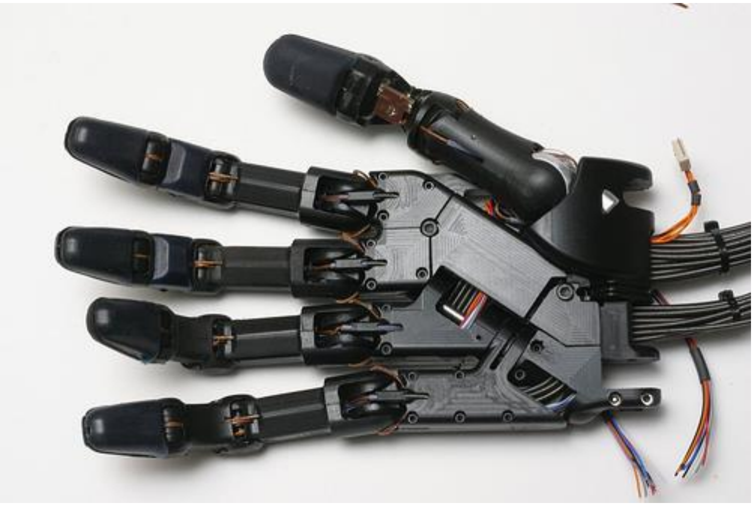


Figure 2-11: Kinematic representation of *Pneuman’s* arms.

Robotic Hand – not simple...



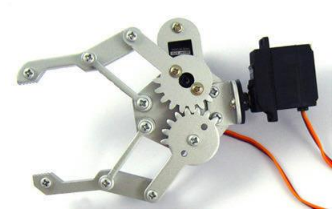
http://en.wikibooks.org/wiki/File:Shadowhand.jpg

Many actuators per robot

- Robot “Kaka”

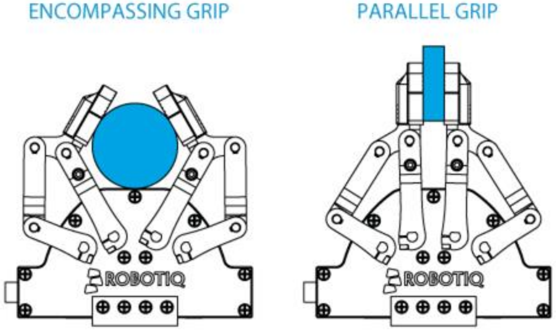
End Effectors / Grippers

Example Manufacturer: [http://**robotiq**.com/](http://robotiq.com/)
Other Images: https://www.cs.rpi.edu/twiki/pub/RoboticsWeb/ReadingGroup/Manipulator_End_Effectors.pdf



Force Torque Sensor:

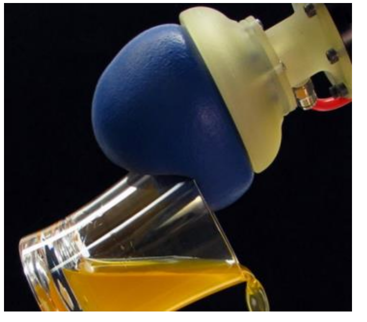
Two, Three, N “Fingers”:



Parallel Gripping:

Grippers

- VersaBall - https://www.youtube.com/watch?v=_jDW0RI7gso
- " " - https://www.youtube.com/watch?v=ZKOI_lVDPpw
- FlexGripper - https://www.youtube.com/watch?v=m7l-87r4oOY
- Octopus Gripper - https://youtu.be/rKX3IKg5Qok
- Finn Gripper - https://www.youtube.com/watch?v=90cXfaFM4O8
- " " - https://www.youtube.com/watch?v=4MQmlvzE0i8
- " " - https://www.youtube.com/watch?v=Q1MBIaNuLa8 (egg crash...)



Collaborative robot: COBOT

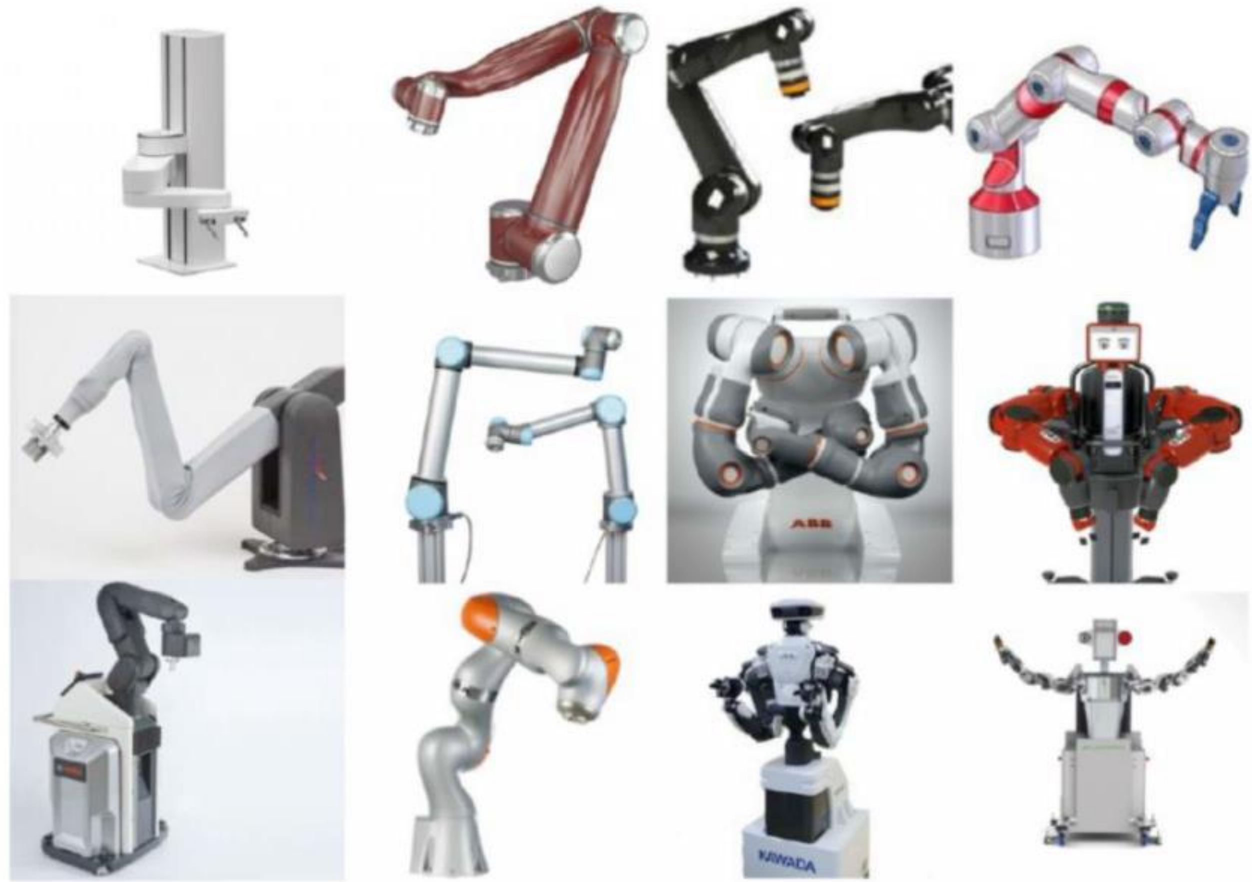


Figure 19: Example of Cobots

Cobots

As all the technologies, cobots are designed not only to work with humans but also to improve the productivity and efficiency. There are five characteristics a cobot should has:

- 1) **Safety**: The first essential characteristic is to be safe around human. It is realized by the collaborative features according to the standards.
- 2) **Light weight**: The second one is to be relatively light weight, so that they can be portable. In such a way that one cobot is suitable for multi tasks.
- 3) **Simplicity**: The third one is to be simple, which means operators do not need and background knowledge about programming to teach and work with them. Anyone, especially blue collar can easily work with a cobot.
- 4) **Low expenses**: The fourth one is to be cheaper for both acquirement of the cobot and the cost of maintenance and management than the traditional robots.
- 5) **Flexibility**: Last one is to be dexterous and flexible, with the innovation of new technologies, it allows cobot to have up to 7 dof, one more than what was strictly necessary. It is this plus one dof provides better configuration.

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