Robotics Fundamentals

Dr. Mustafa Shiple

Module Agenda

- **Robot Definition**
- **Robot Actuators and Effectors**
- **Robot Sensors**
- **Robot Computation and Communication**
- **Robot Design**

Module Agenda

- Robot Definition
- Robot Actuators and Effectors
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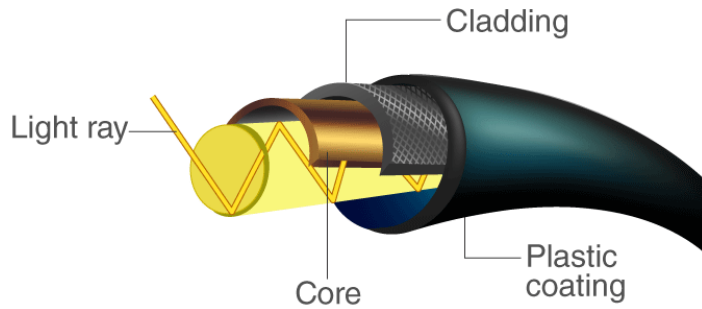- **Robot Computation and Communication**
- Robot Design

Robot Communications
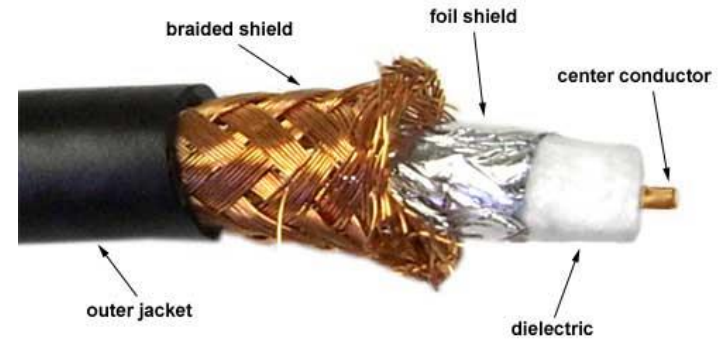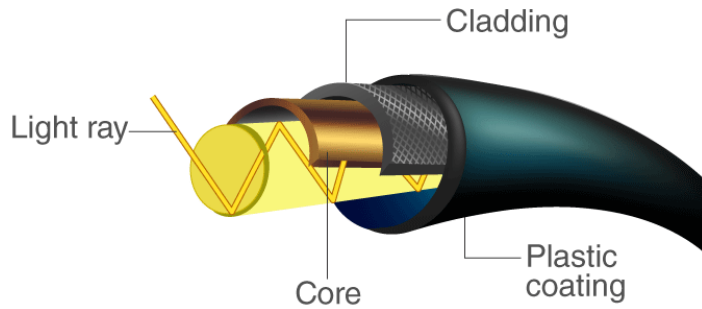
Wired communication : Tether

Light ray — Core — Cladding — Plastic coating

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COAXIAL CABLE

braided shield — foil shield — center conductor — outer jacket — dielectric

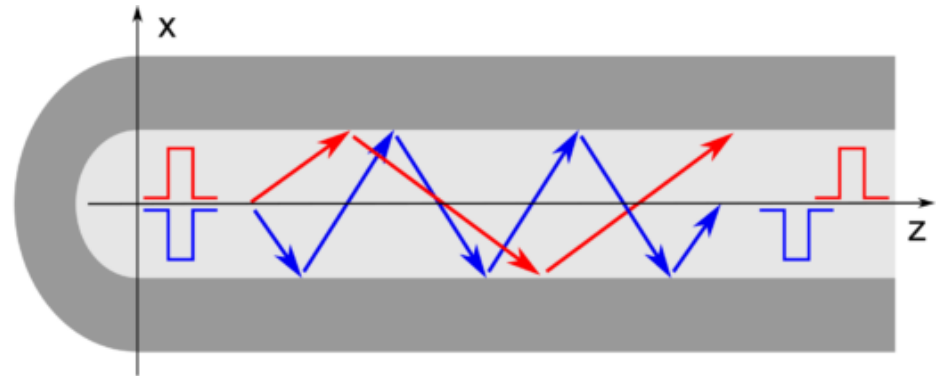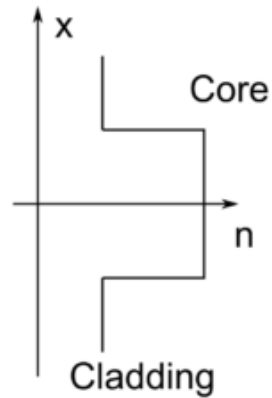| Basis	Optical Fiber	Coaxial Cable
transmission signal	light form.	electrical form.
Efficiency	High	Low
Losses in cable	Dispersion, bending, absorption and attenuation.	Resistive, radiated and dielectric loss.
Composition of the cable	Plastics and Glass	Metal foil, Plastic and metal wire.
Bending effect	Can affect the signal transmission.	does not affect.

Wired communication : Tether

COAXIAL CABLE

Cladding

Light ray

Core

Plastic coating

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braided shield

foil shield

center conductor

outer jacket

dielectric

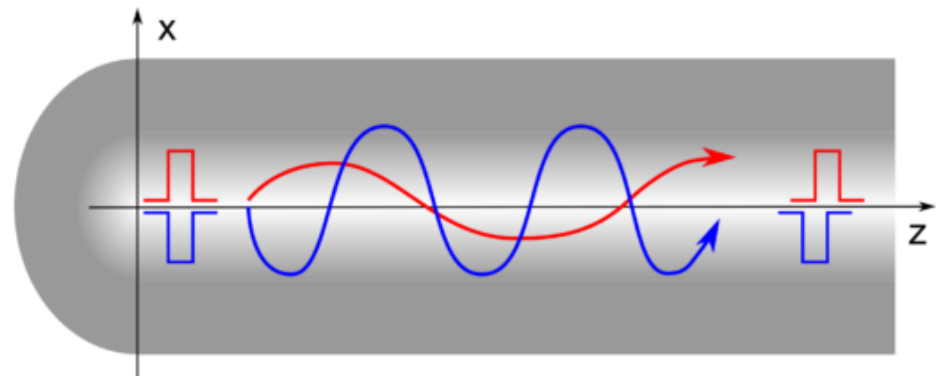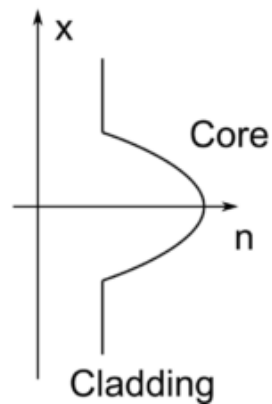| Basis	Optical Fiber	Coaxial Cable
Cost	Highly expensive	Less expensive
Installation of the cable	Difficult	Easy
Data transmission rate	2 Gbps	44.736 Mbps
External magnetic field	Doesn't affect the cable	Affects the cable
Bandwidth provided	Very high	Moderately high
Noise immunity	High	Intermediate
The diameter of the cable	Smaller	Larger
The weight of the cable	Lighter	Heavier comparatively

(a) Step-index fiber

(b) Graded-index fiber

Wireless: Microwave

Main Microwave

Microwave Relay Station

Microwave Relay Station

Line of Sight (about 30 miles)
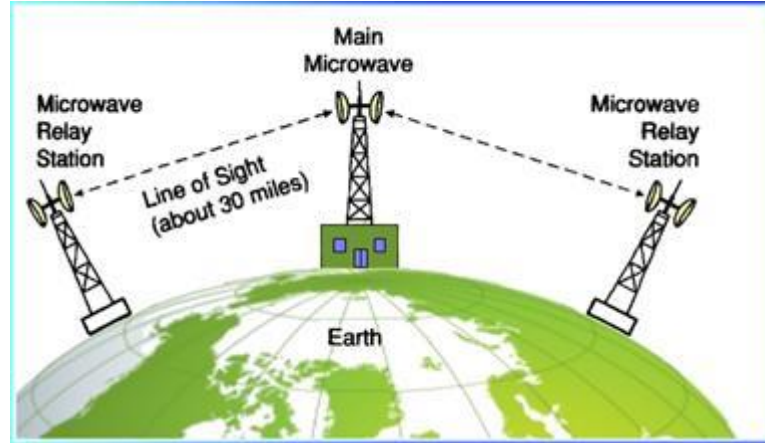
Earth

Radio waves travel in narrow beams confined to a **line-of-sight** path from one antenna to the other

sky wave

ionosphere

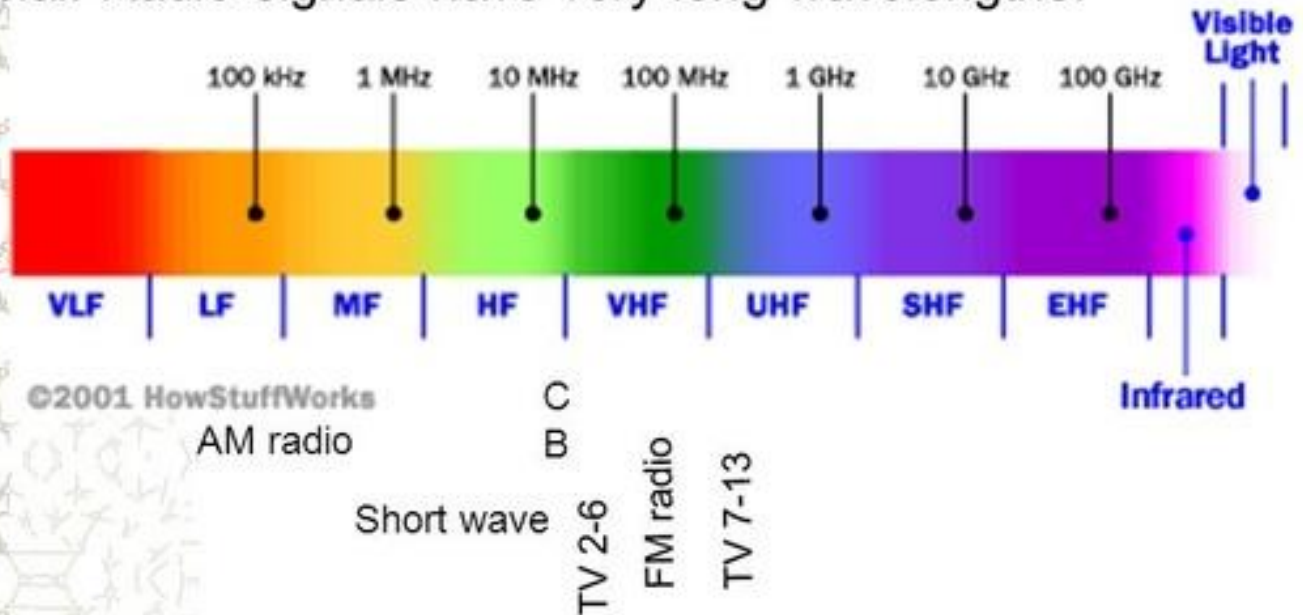ground wave
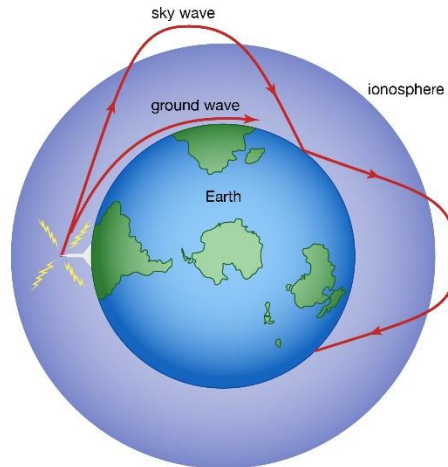
Earth

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at low frequency (below approximately 3 MHz) due to diffraction follow the contour of the Earth. This enables AM, FM radio stations to transmit beyond the horizon

Wavelength spectrum

Radio Waves

A radio wave is an **electromagnetic wave** propagated by an **antenna**. Radio waves have different **frequencies**, and by tuning a radio receiver to a specific frequency you can pick up a specific signal. Radio signals have very long wavelengths.
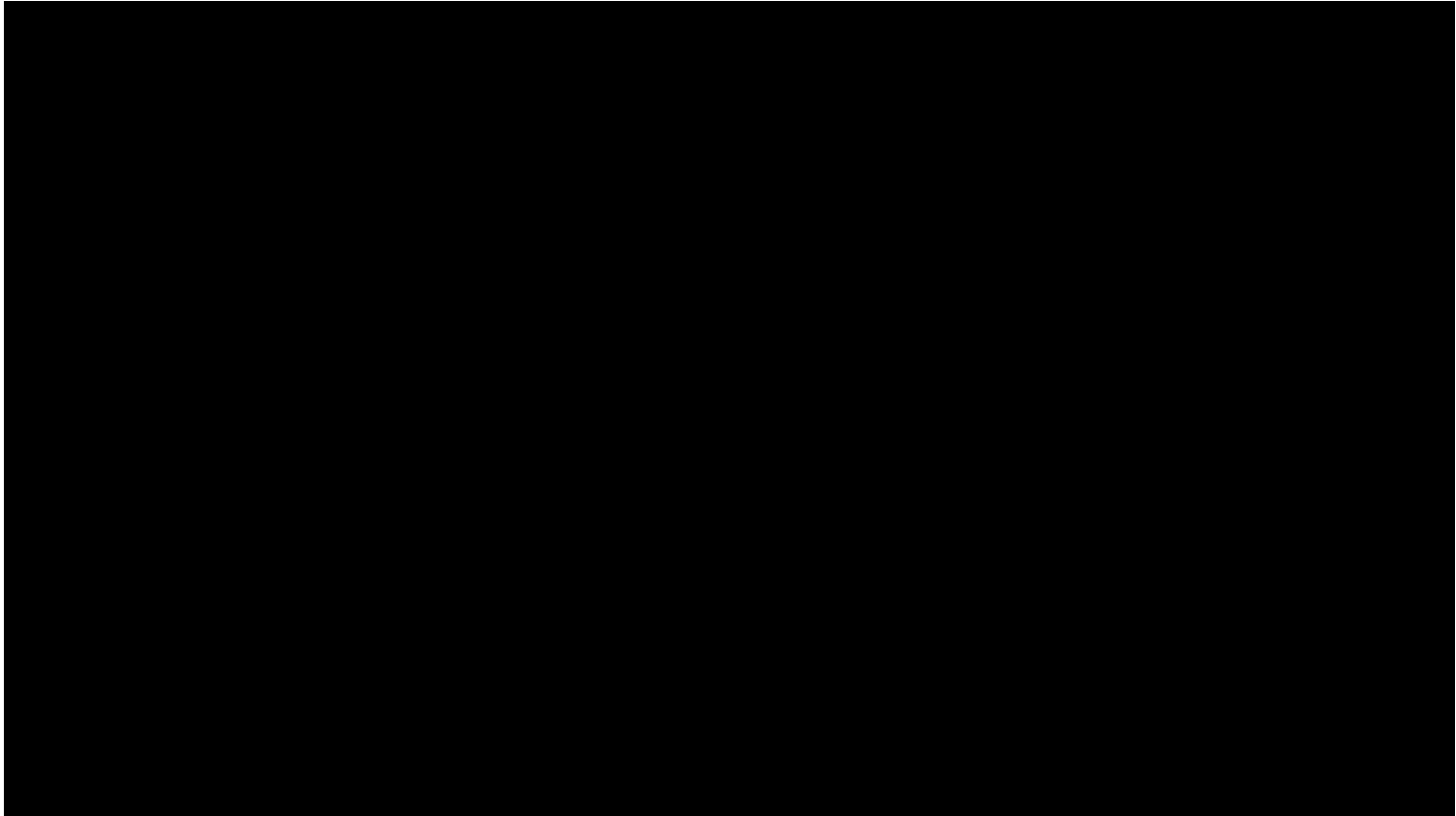
Visible Light

| 100 kHz | 1 MHz | 10 MHz | 100 MHz | 1 GHz | 10 GHz | 100 GHz |

VLF | **LF** | **MF** | **HF** | **VHF** | **UHF** | **SHF** | **EHF**

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AM radio

C
B

Short wave

TV 2-6

FM radio

TV 7-13

Infrared

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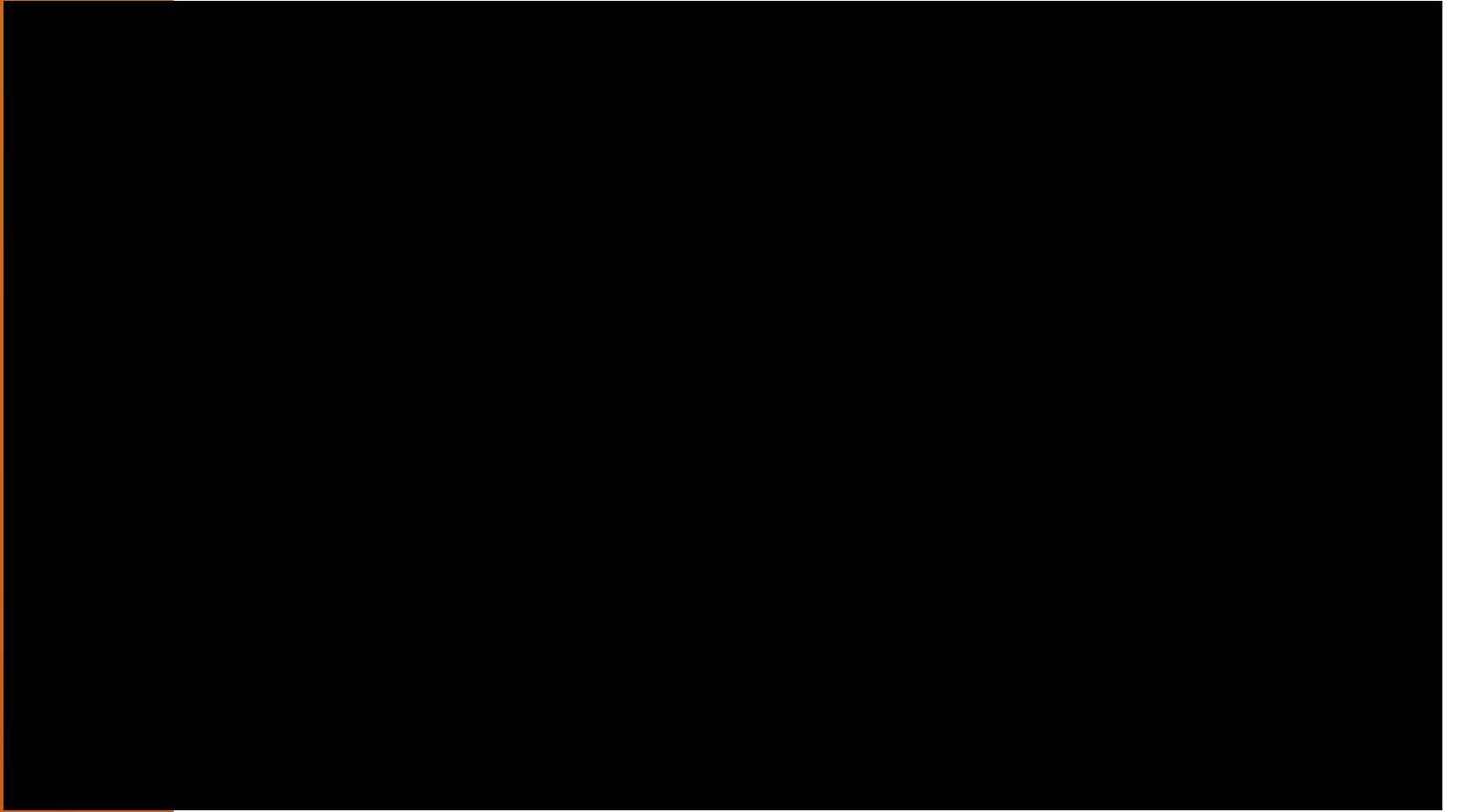
Nanorobots

End effector ideas

Swarm robot

Swarm II

Three Generations of Robots

Generation 1: Playback robot. It can repeat actions taught by humans, but is unaware of the outside environment.

Generation 2: Robot with feelings. It has feelings similar to humans. For example, it can judge a force through the sense of force, touch, and hearing.

Generation 3: Intelligent robot. It is the highest pursuit of robot development. An intelligent robot is expected to be able to do what people ask it to. Now it remains to be a concept.

Classification of Intelligent Robots

- There is no unified definition of AI research in the world. Currently, intelligent machines are classified into four types:

➢ "Think like people": Weak AI, such as Watson and AlphaGo

➢ "Act like people": Weak AI, such as Android, iRobot, and Atlas of Boston Dynamics

➢ "Think rationally": Strong AI, which is yet unavailable due to the bottlenecks in brain science

➢ "Act rationally": Strong AI
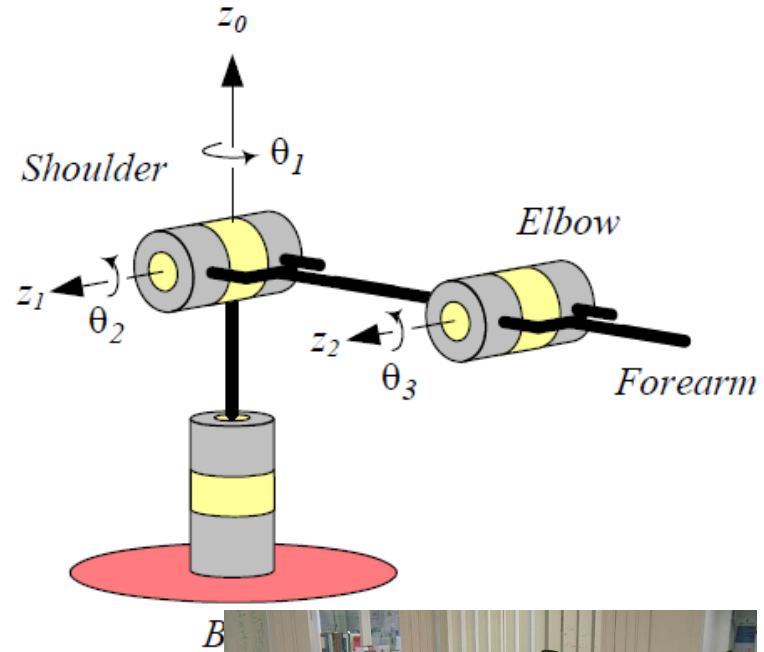
Selective Compliant Articulated Robot for Assembly

SCARA arm (R‖R‖P manipulator VVP)
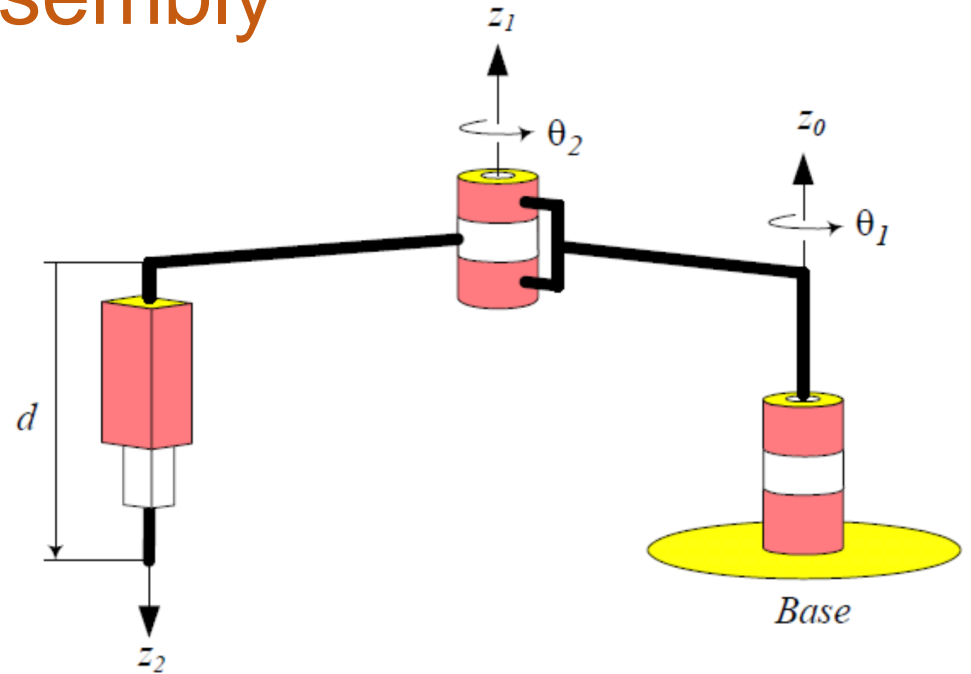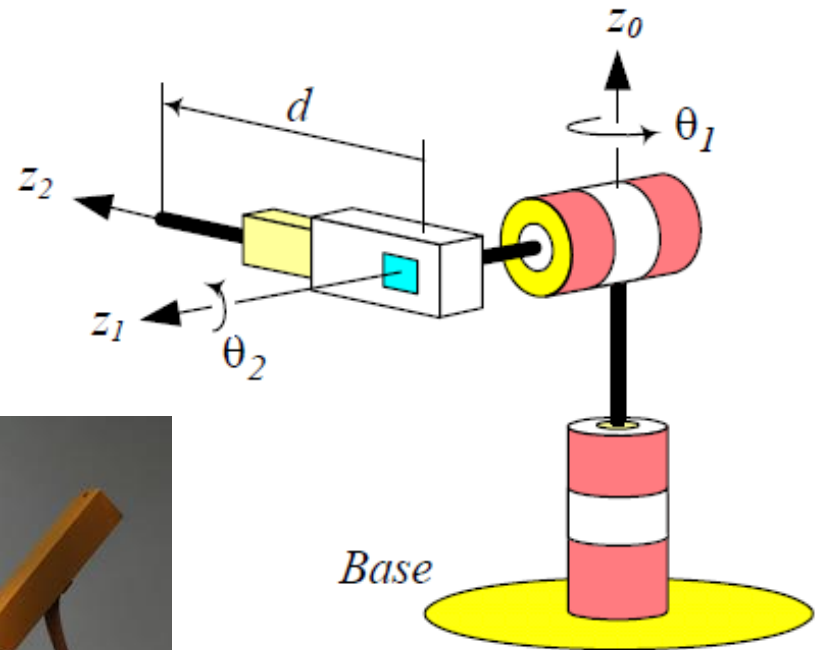
Elbow, revolute, articulated, or anthropomorphic

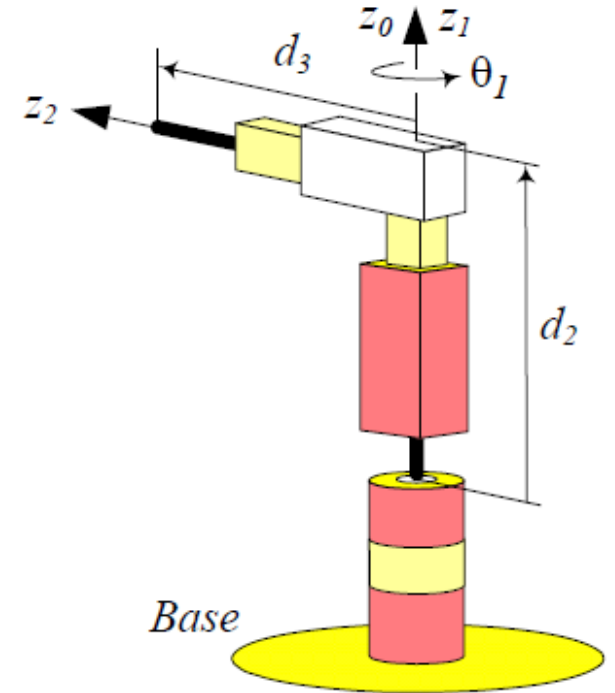R⊢R⊥R (TVV)

Spherical configuration

R⊢R⊥P (TVP)

Cylindrical coordinates

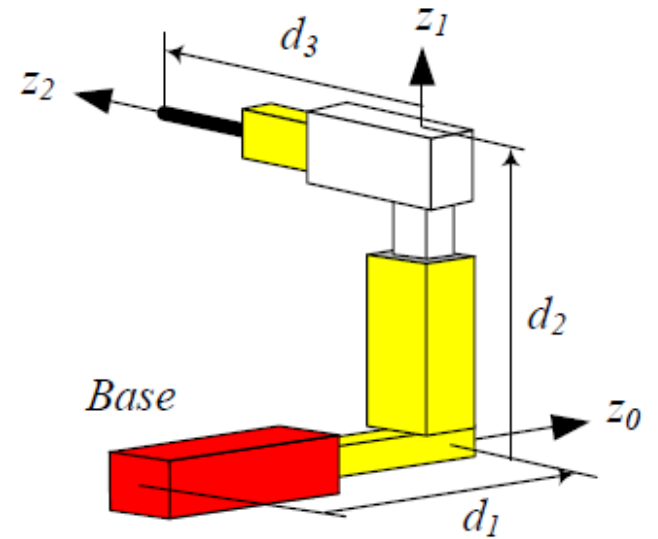R⊢P⊥P (TPP)

Cartesian configuration

P⊢P⊥P (PPP)

Ref.
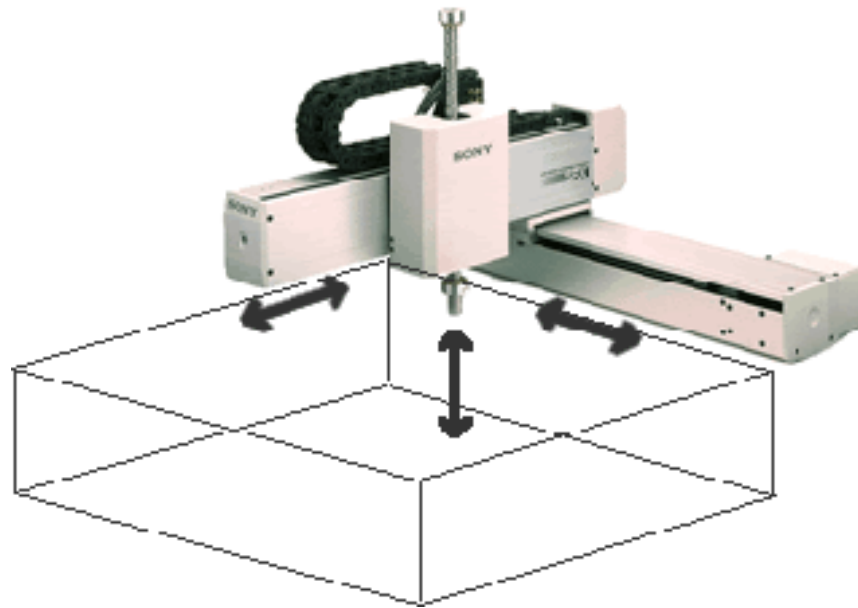
- https://www.redblobgames.com/pathfinding/a-star/introduction.html
- Theory of Applied Robotics_ Kinematics, Dynamics and Control, Reza N. Jazar