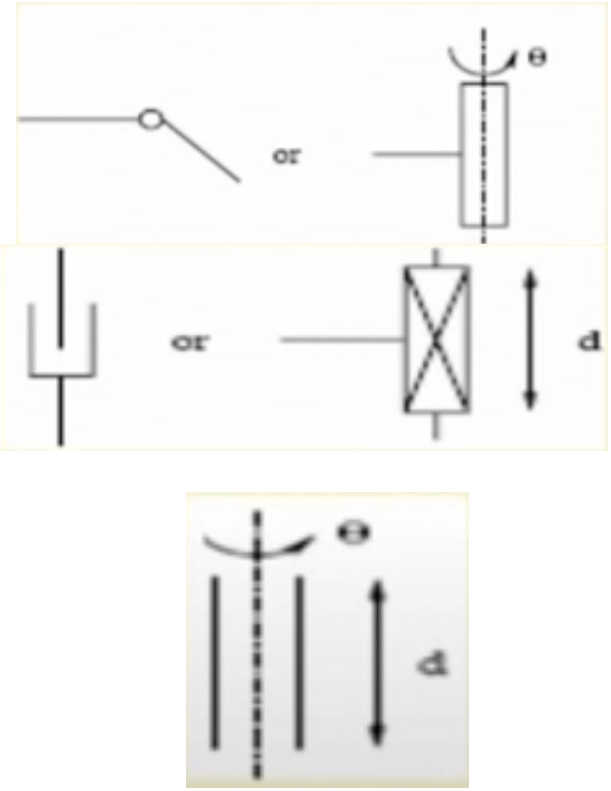
Introduction to robots and robotics

Representation of the joints

Revolute Joint ®

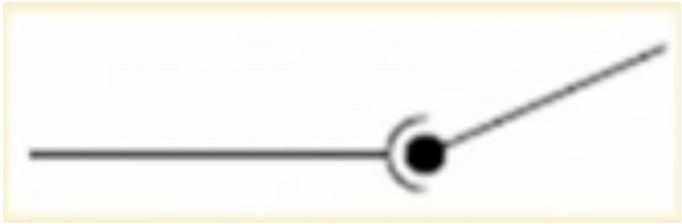
Prismatic Joint (p)

Cylindrical Joint (C)

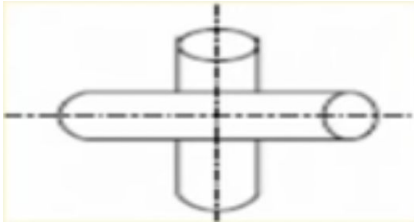


Representation of the Joints

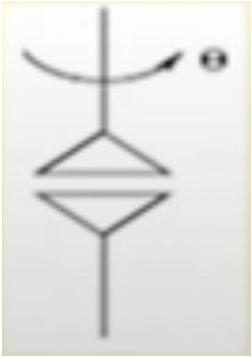
Spherical Joint (S’)



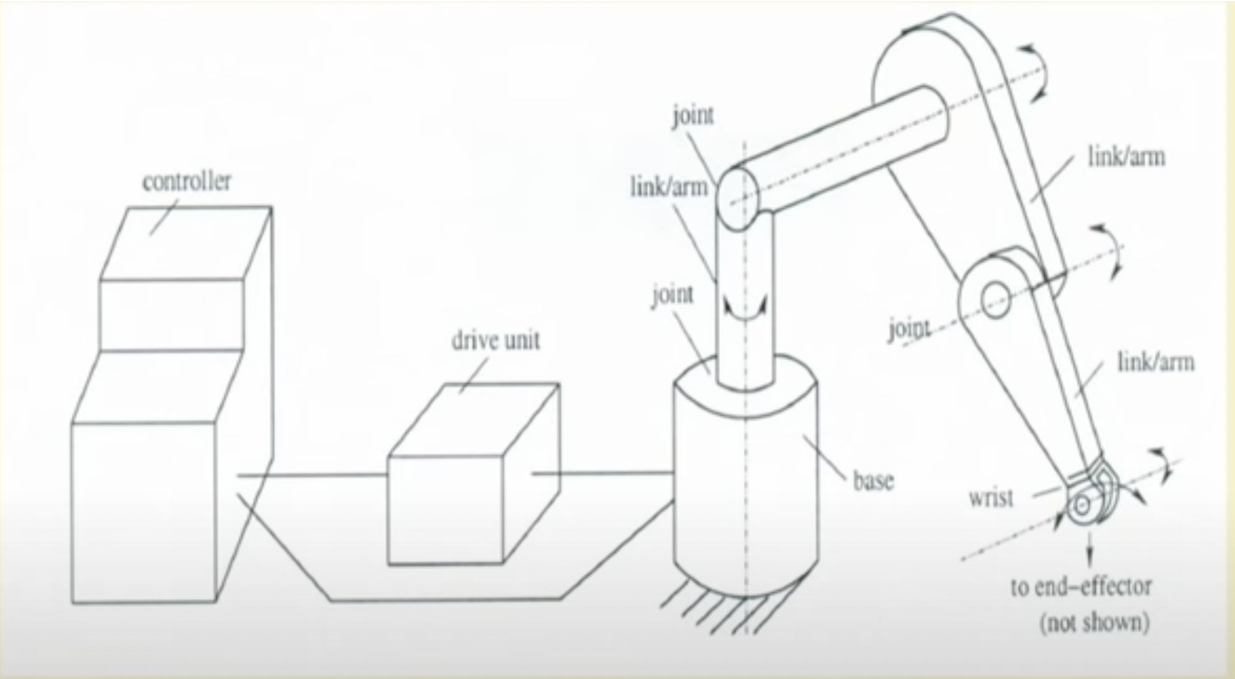
Hooke Joint (U)



Twisting Joint (T)



Kinematic Diagram



Degrees of Freedom of a system

It is defined as the minimum number of independent parameters/variables/ coordinates needed to describe a system completely.

Notes:

- A point in 2-D: 2dof; In 3-D space:3 dof
- A rigid body in 3-D: 6 dof
- Spatial Manipulator:6 dof
- Planar Manipulator: 3 dof

Redundant Manipulator

Either a spatial manipulator with more than 6 dof or a planar manipulator with more than 3 dof

Under-actuated Manipulator

Either a spatial manipulator with less than 6 dof or a planar manipulator with less than 3 dof

- Mini Mover 5 dof

Mobility/ dof of spatial Manipulator

Let us consider a manipulator with n rigid moving links and m joints

Ci: connectivity of i-th joints;i=1,2,3,....m

No. of constraints put by i-th joint =6-Ci

Total number of constraints = **$\Sigma_{(i=1)}^{m}(6-Ci)$**

Mobility of the manipulator $M=6n-\Sigma_{(i=1)}^{m}(6-Ci)$

It is known as Grubler's criterion.

Mobility/ dof of planar Manipulator

Let us consider a manipulator with n rigid moving links and m joints

Ci: connectivity of i-th joints;i=1,2,3,....m

No. of constraints put by i-th joint =3-Ci

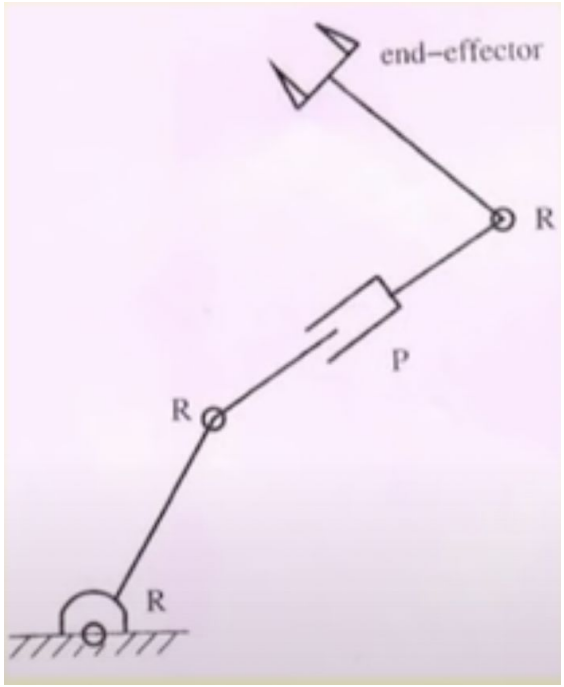
Total number of constraints = $\Sigma_{(i=1)}^{m}(3-Ci)$

Mobility of the manipulator $M=3n-\Sigma_{(i=1)}^{m}(3-Ci)$

It is known as Grubler's criterion.

Numerical example

Serial Planar Manipulator

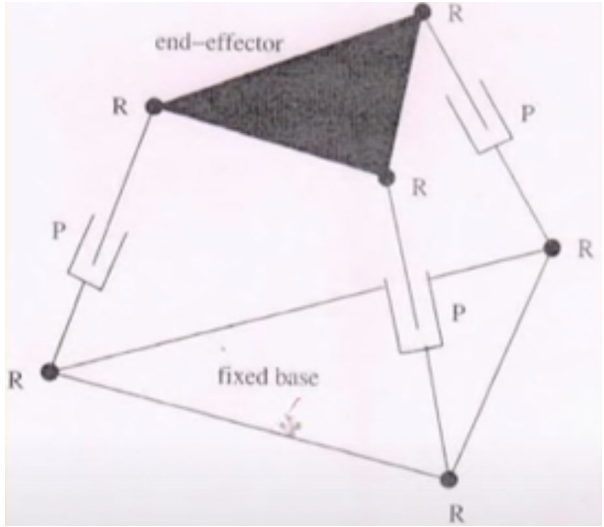


n=4, m=4
c1=c2=c3=c4=1

Mobility/dof:
M=3n-**Σ_(i=1)^m(3-Ci)=3*4-8=4**

Numerical example

Parallel I Planar Manipulator



n=7, m=9
c1=1 where i=1,..., 9

Mobility/dof:
M=3n-**Σ_(i=1)^m(3-Ci)=3*7-18=3**

References

- https://www.instructables.com/Arduino-Controlled-Robotic-Biped/
- https://www.youtube.com/watch?v=xrwz9IxpMJg&t=893s
- https://en.wikipedia.org/wiki/Optimus_(robot)