2-1 로봇

이전 강의 요약

01

모션 플래닝의 활용 사례

"로봇" 으로
"환경" 에서
"작업" 을 수행

02

작업

Pick & Place
Driving
Walk
...

03

로봇

Manipulator (로봇팔)
자동차
휴머노이드

04

환경

Workspace
Obstacle
Static vs. Dynamic

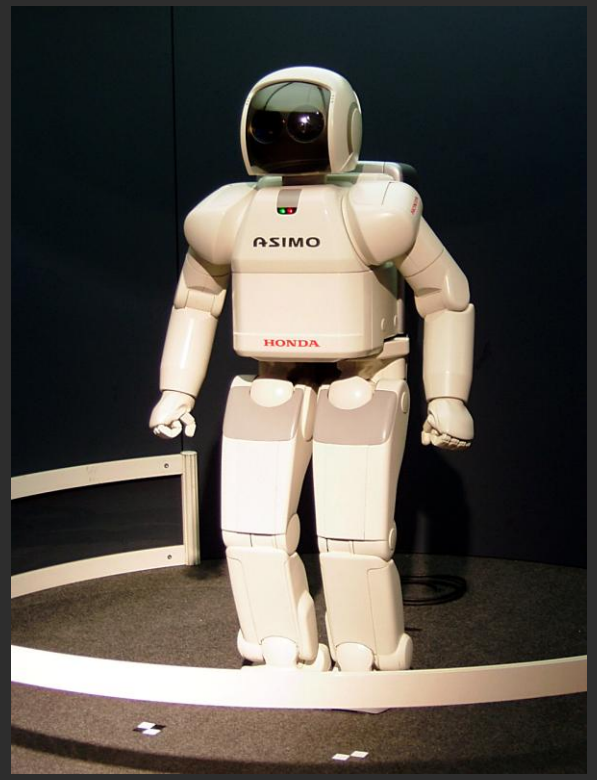
로봇

로봇의 구성요소

공통점?

로봇의 구성요소

공통점?

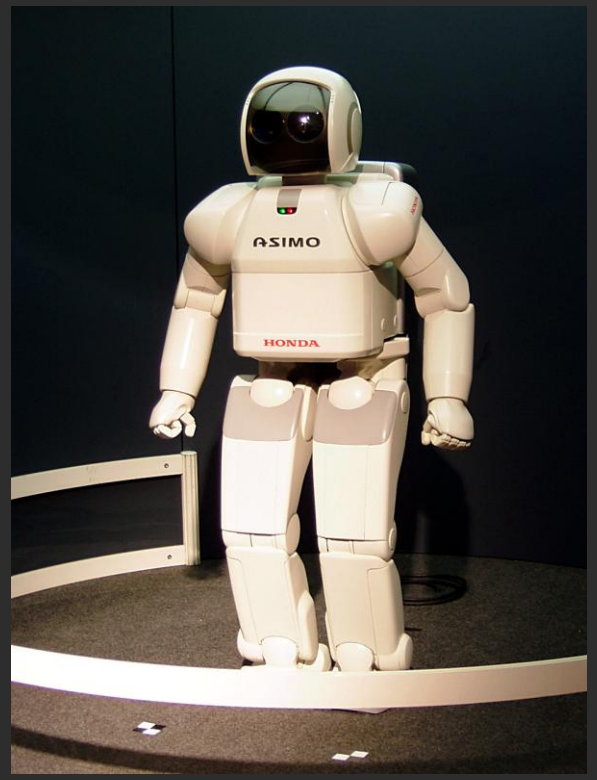


로봇의 구성요소

동체

관절

모터

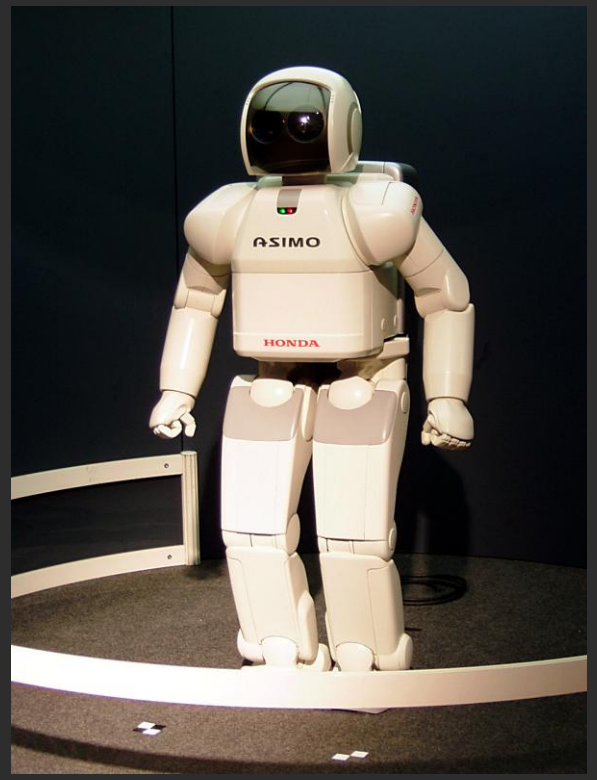


로봇의 구성요소

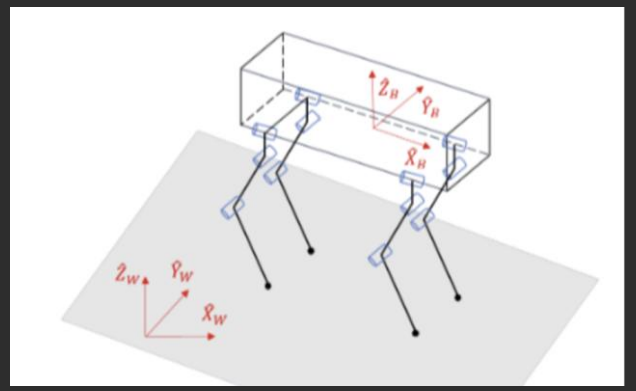
Link

Joint

Actuator



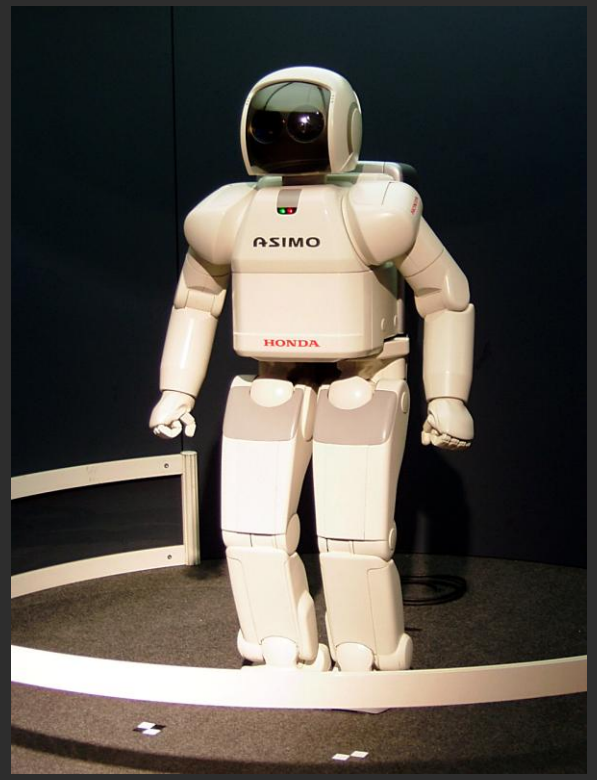
로봇의 구성요소



Link

Joint

Actuator



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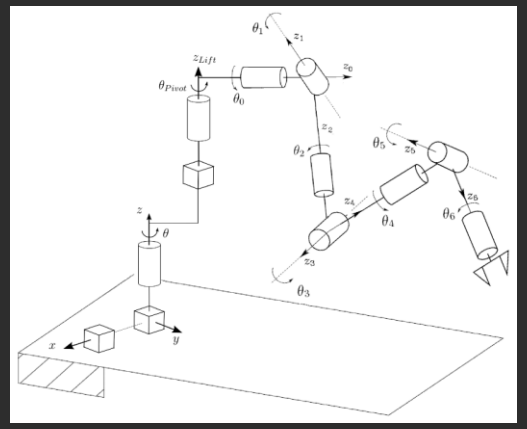

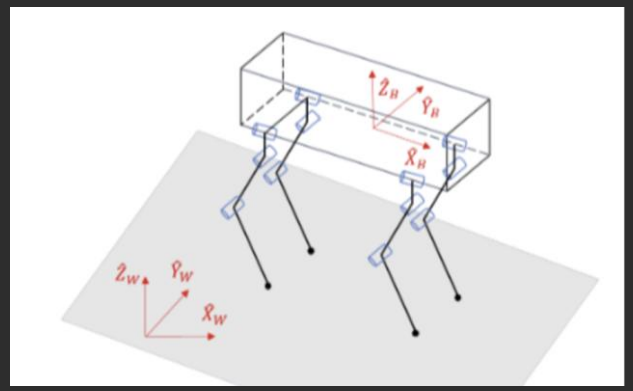

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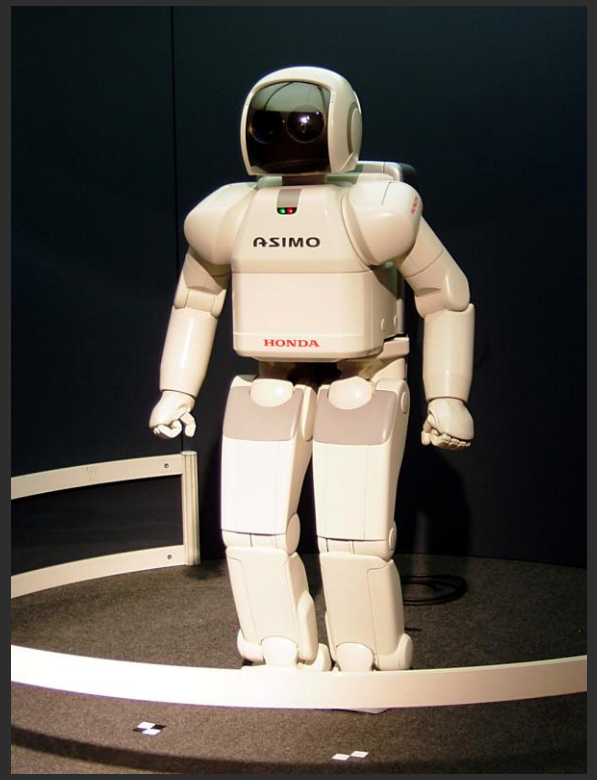
Joint

Actuator



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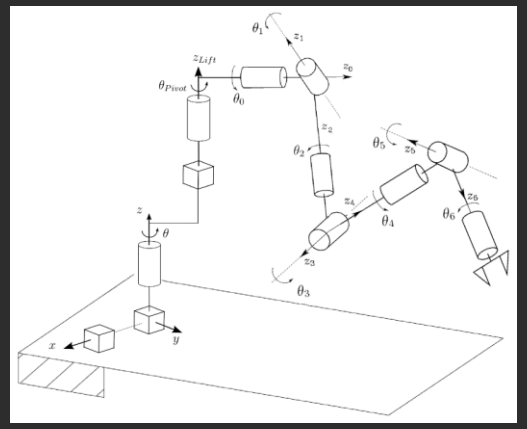

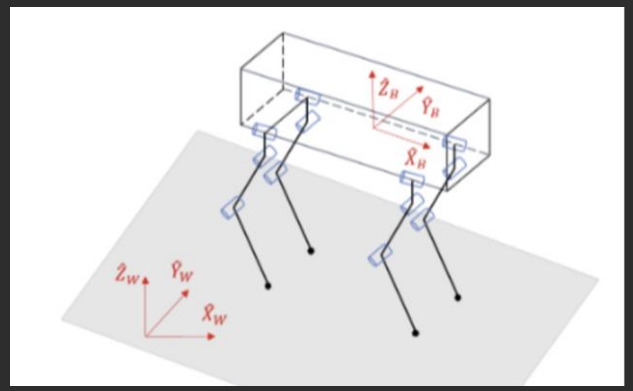

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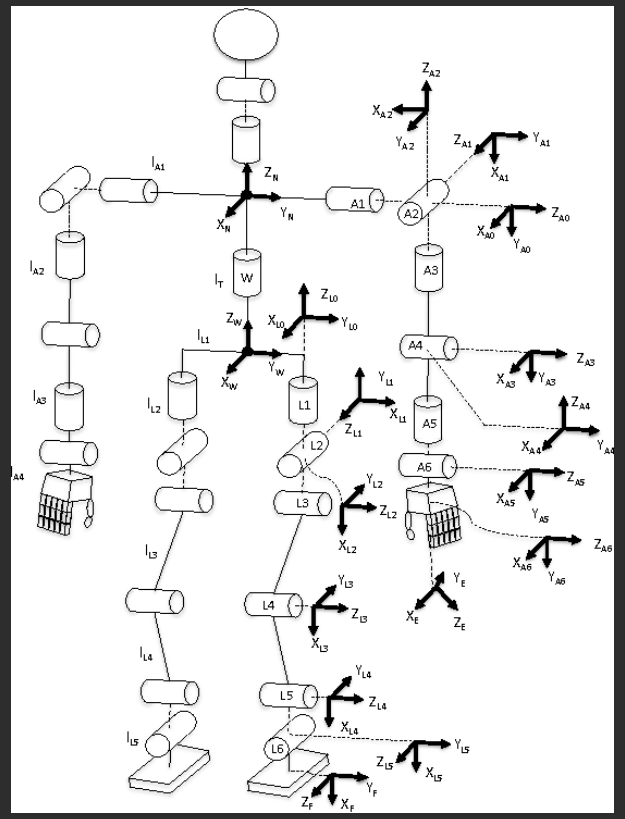
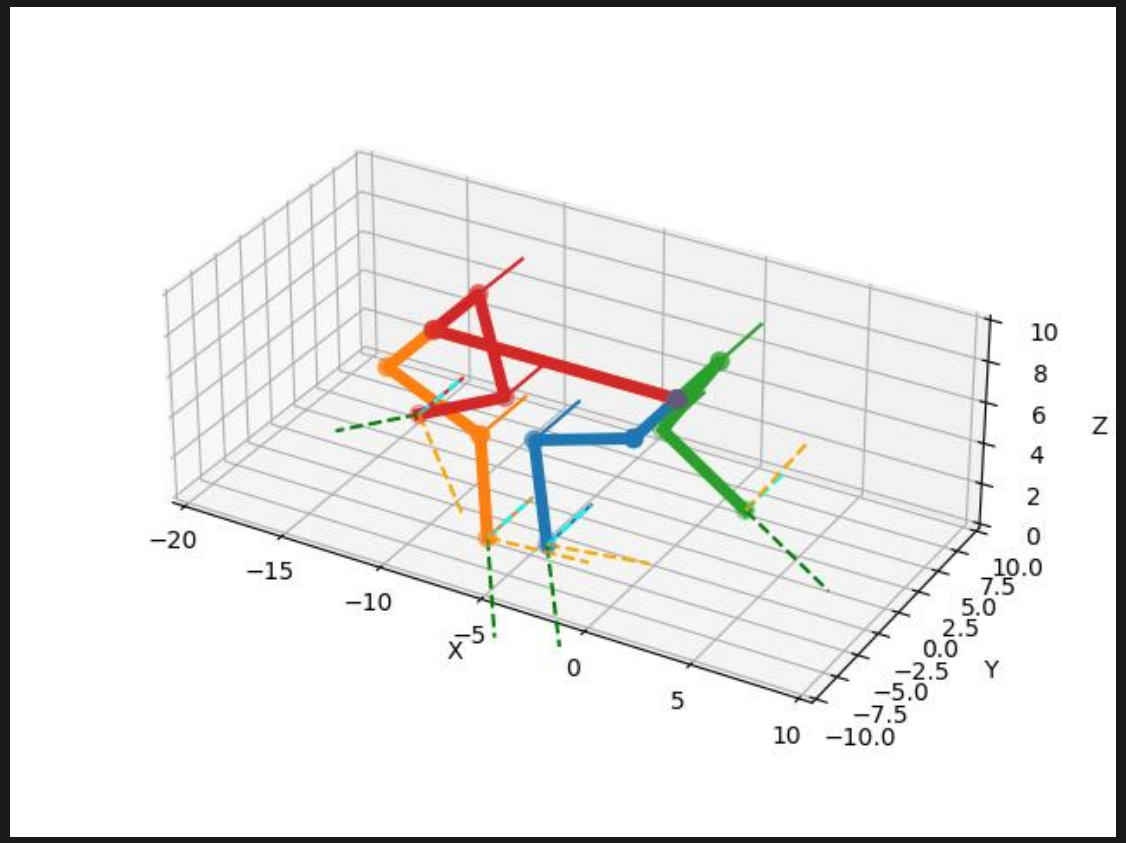
Actuator

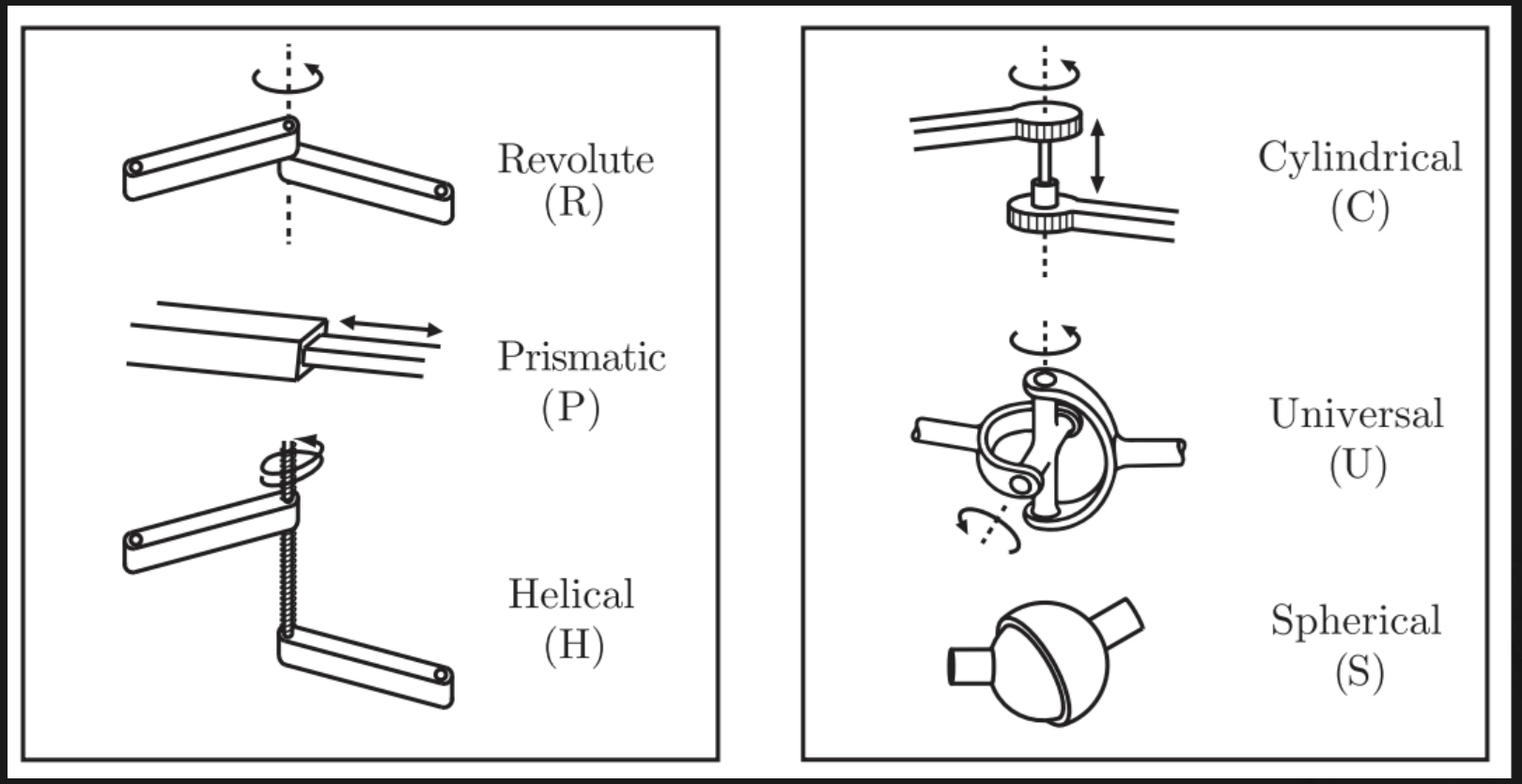


Link (링크)



- 길이
- 모양
- 물리적 특성

Joint (조인트)


Revolute
(R)
Prismatic
(P)
Helical
(H)
Cylindrical
(C)
Universal
(U)
Spherical
(S)

Joint (조인트)

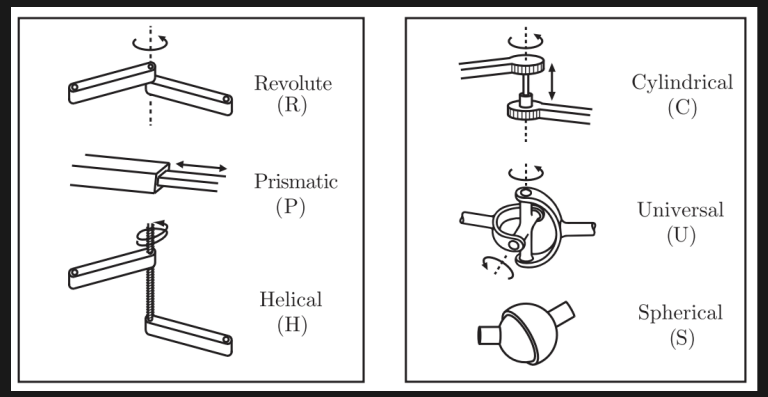
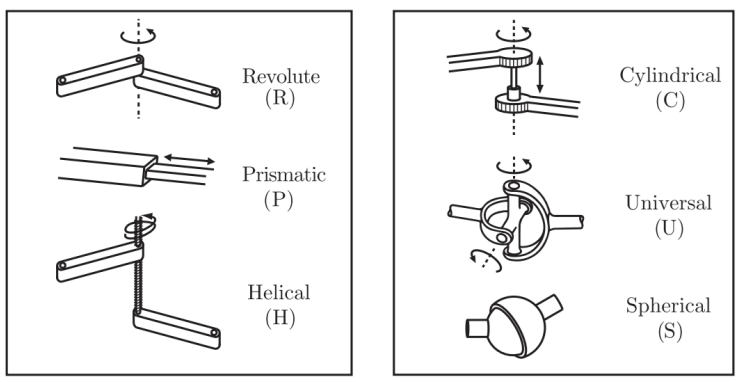

Revolute
(R)
Prismatic
(P)
Helical
(H)
Cylindrical
(C)
Universal
(U)
Spherical
(S)

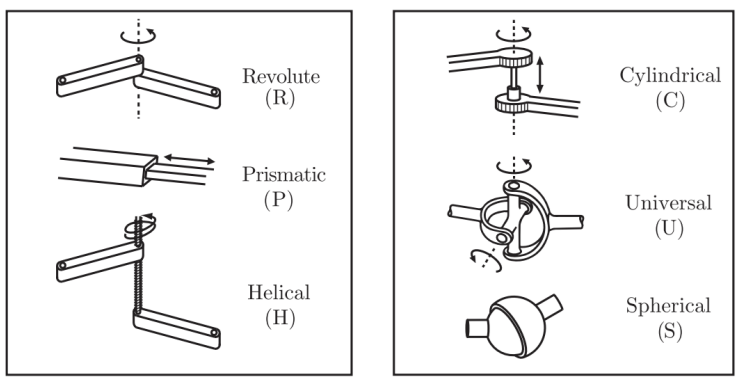

ABB
ABB
ABB

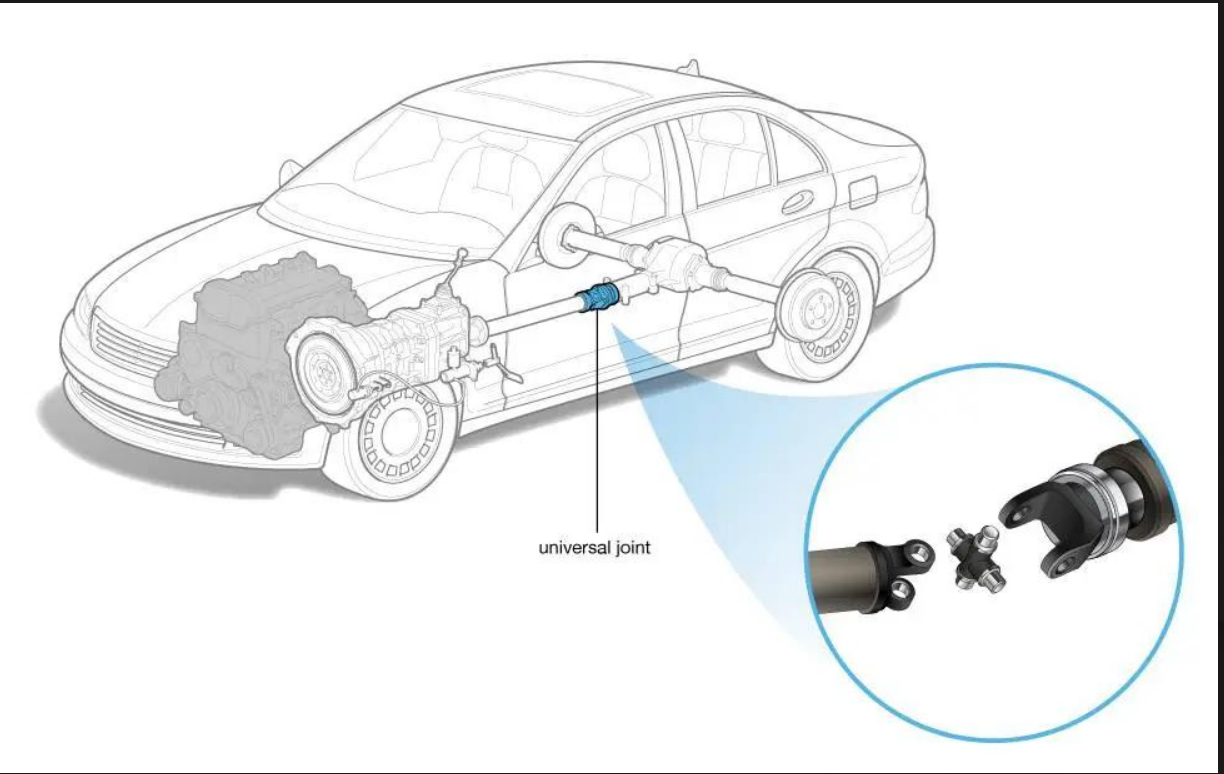
Joint (조인트)


Revolute
(R)
Prismatic
(P)
Helical
(H)
Cylindrical
(C)
Universal
(U)
Spherical
(S)

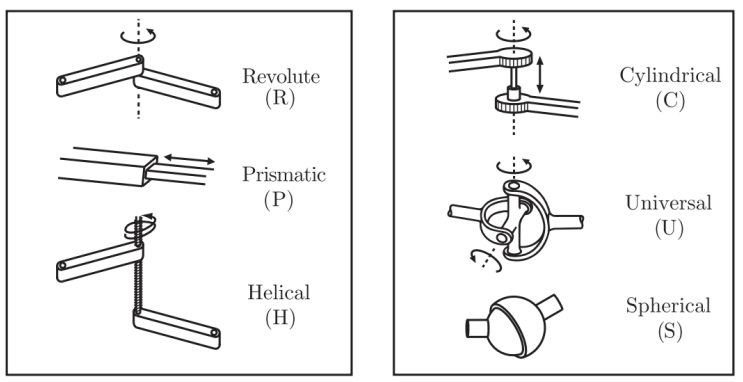

hello robot
hello robot

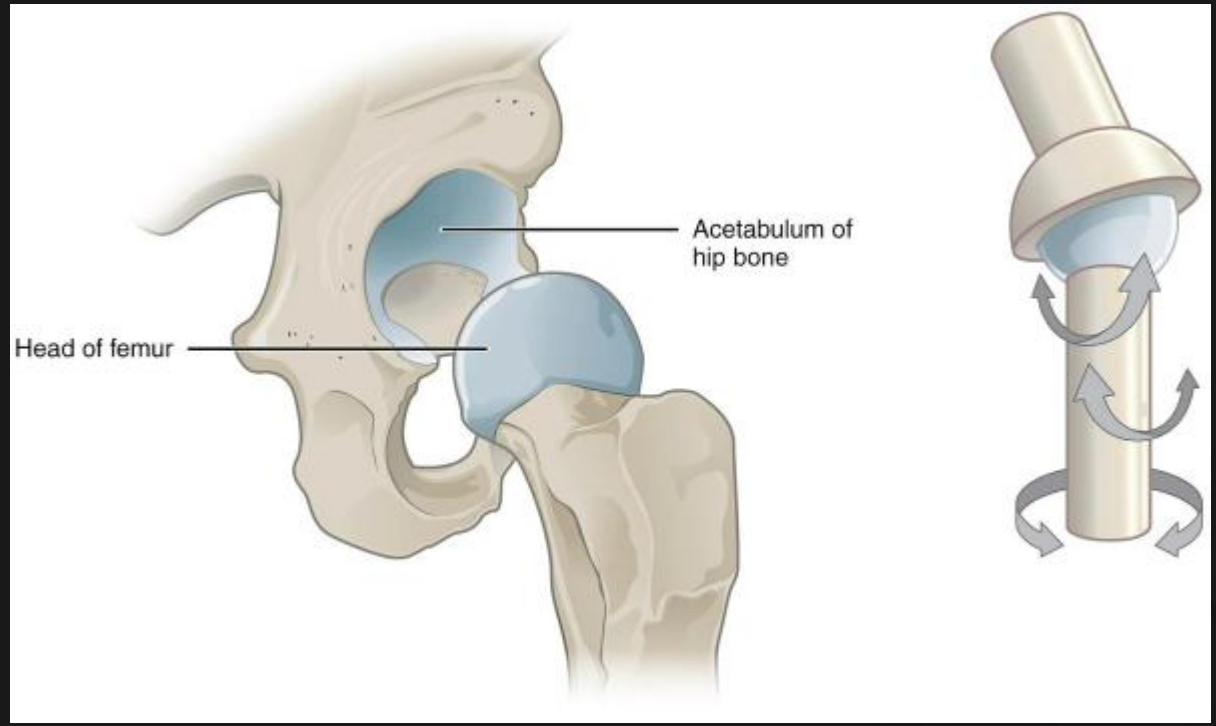
Joint (조인트)


Revolute
(R)
Prismatic
(P)
Helical
(H)
Cylindrical
(C)
Universal
(U)
Spherical
(S)

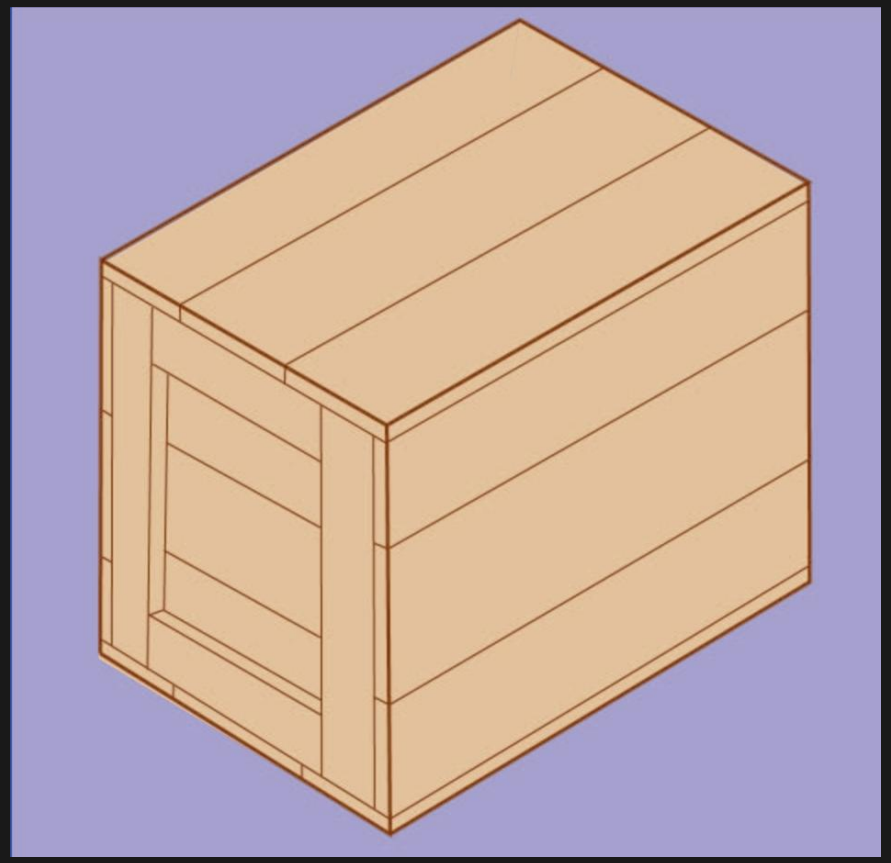

universal joint

Joint (조인트)


Revolute
(R)
Prismatic
(P)
Helical
(H)
Cylindrical
(C)
Universal
(U)
Spherical
(S)


Acetabulum of
hip bone
Head of femur

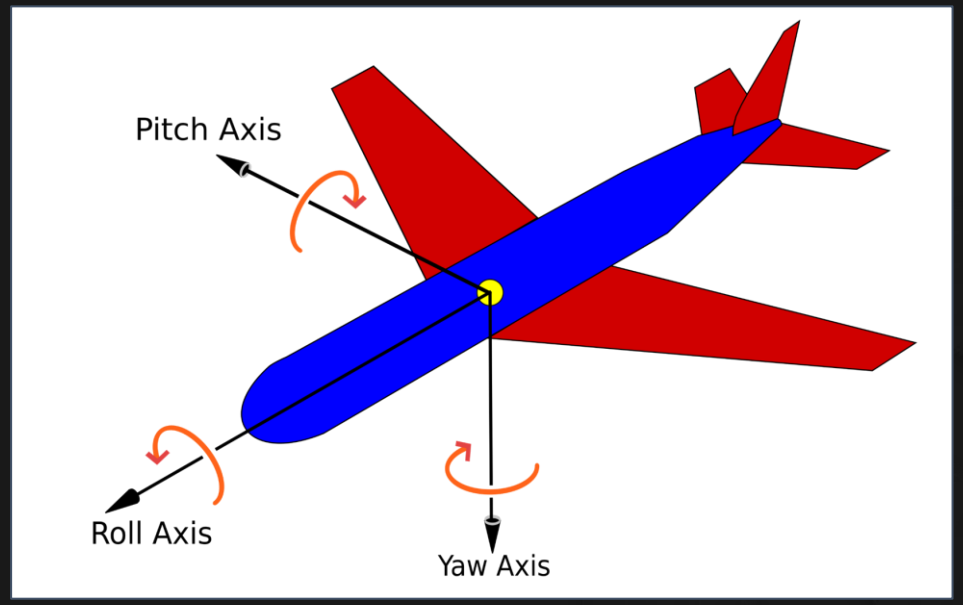
Joint (조인트) - Degree of Freedom (Dof, 자유도)

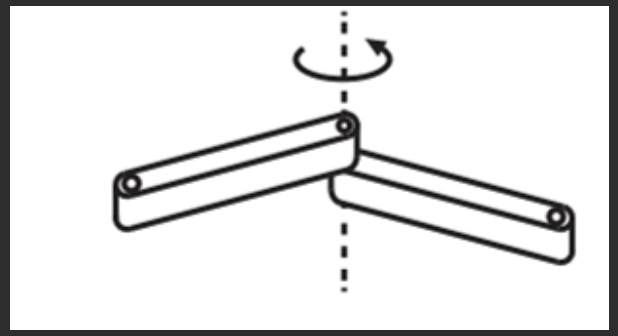


박스의 상태를 정의하기 위해서 필요한 정보의 개수는?

→ x, y, z

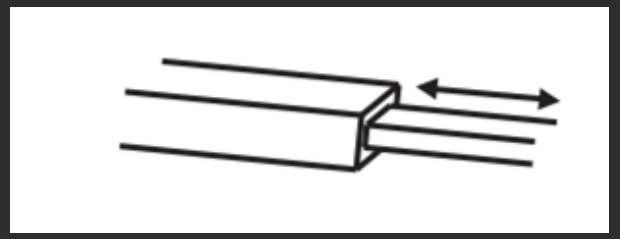
→ roll, pitch, yaw





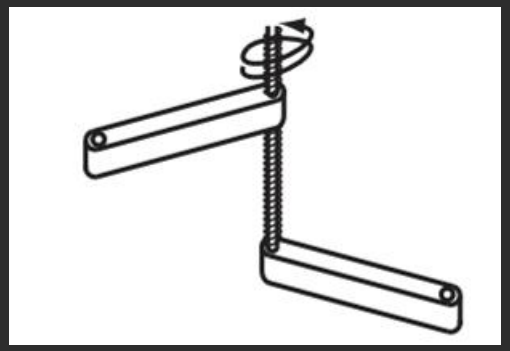
Revolute Joint

Dof: 1



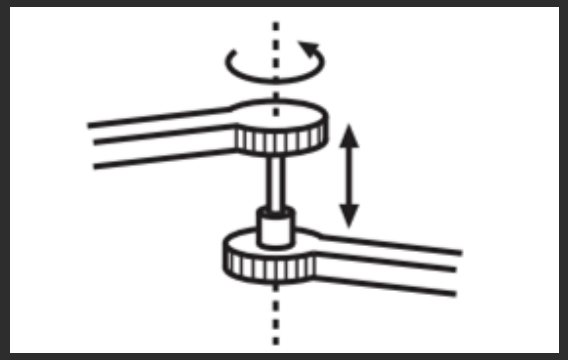
Prismatic Joint

Dof: 1



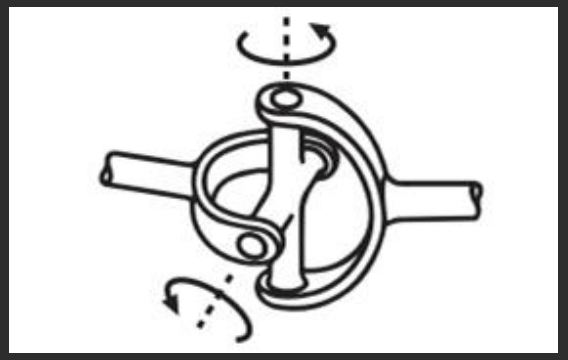
Helical Joint

Dof: 1



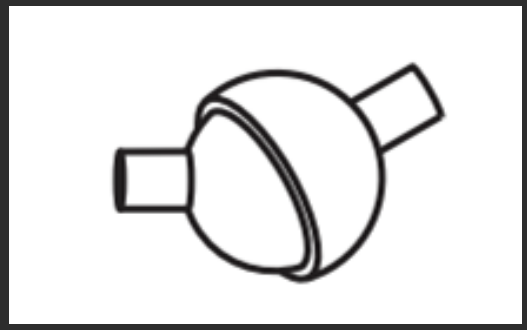
Cylindrical Joint

Dof: 2



Universal Joint

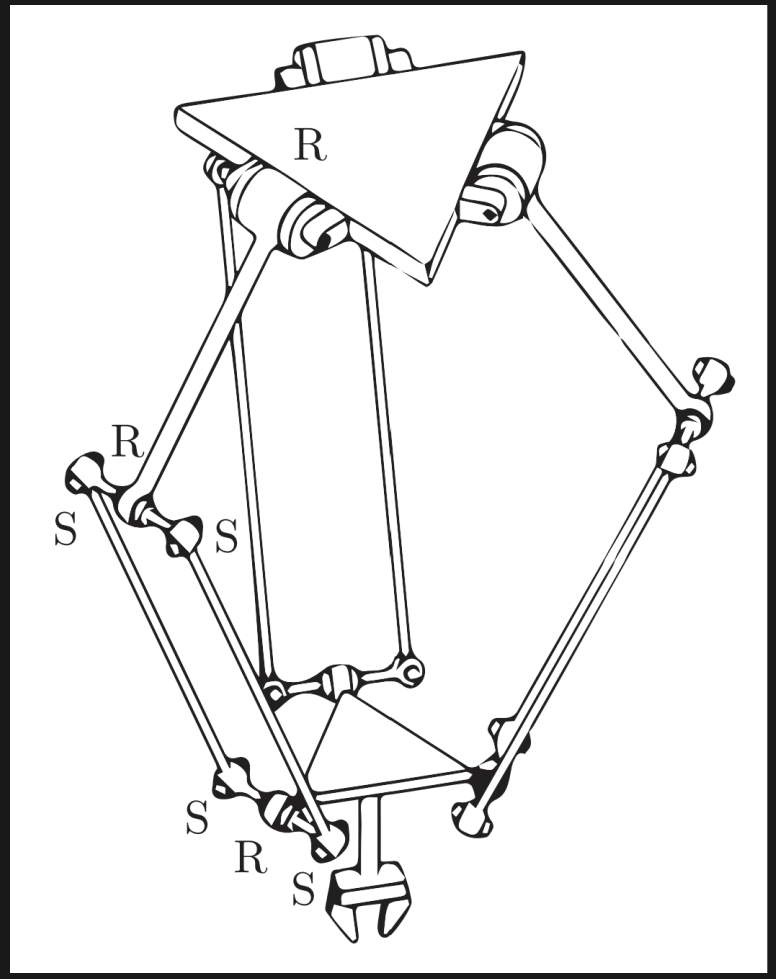
Dof: 2



Spherical Joint

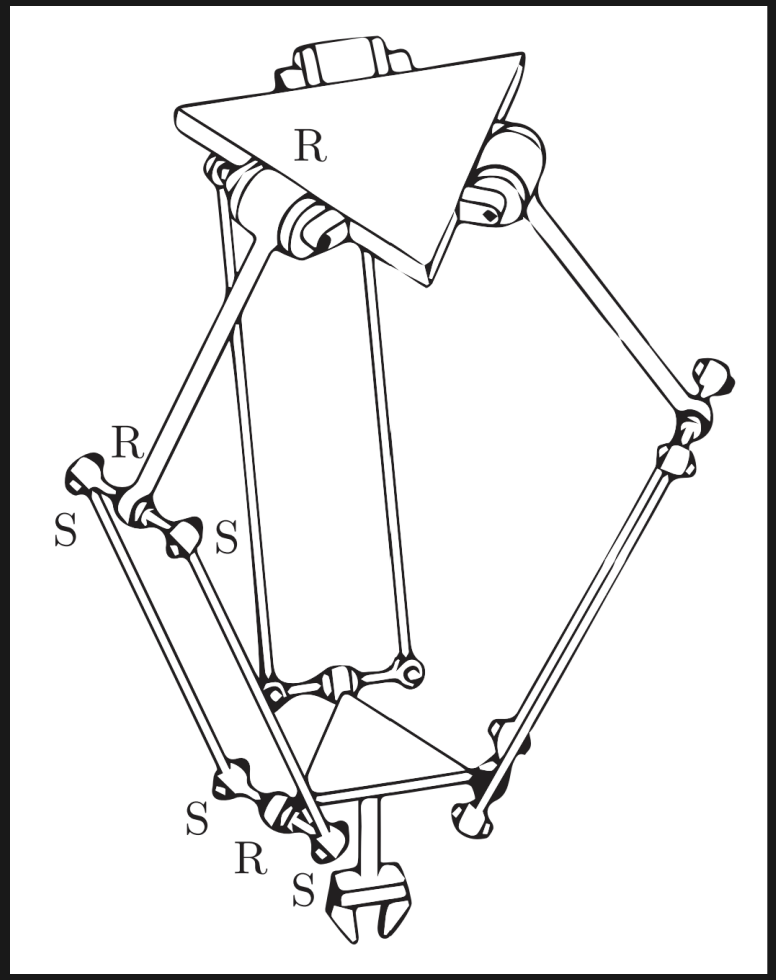
Dof: 3

Joint (조인트) - Degree of Freedom (DoF, 자유도)



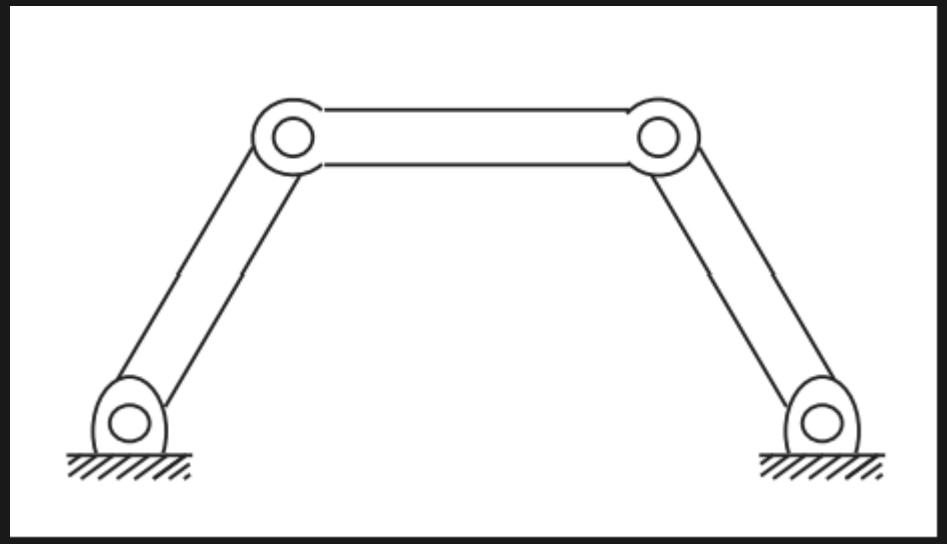
조인트가 조합된 로봇에 대한 자유도는?

Joint (조인트) - Grubler’s Formula



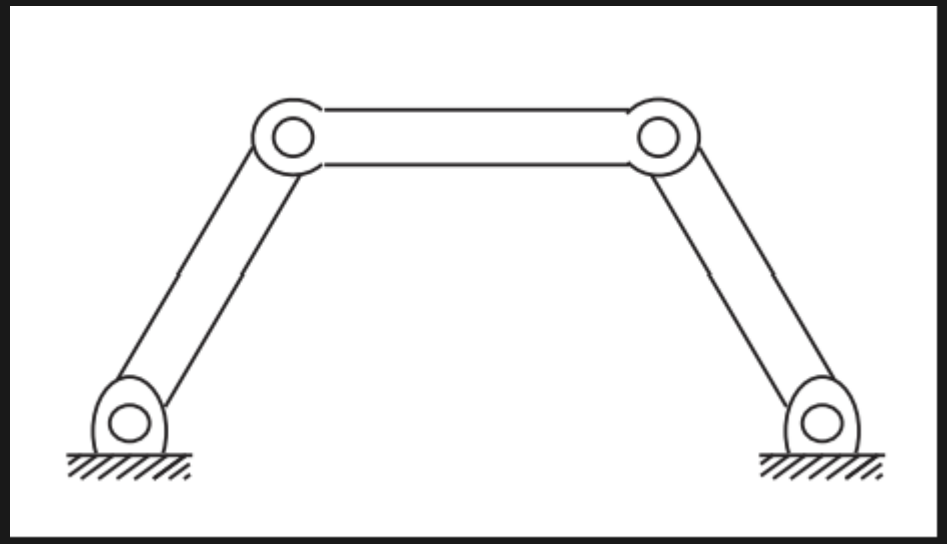
$$\text{dof} = m(N - 1 - J) + \sum_{i=1}^{J} f_i$$

Joint (조인트) - Grubler’s Formula



$$\text{dof} = m(N - 1 - J) + \sum_{i=1}^{J} f_i$$

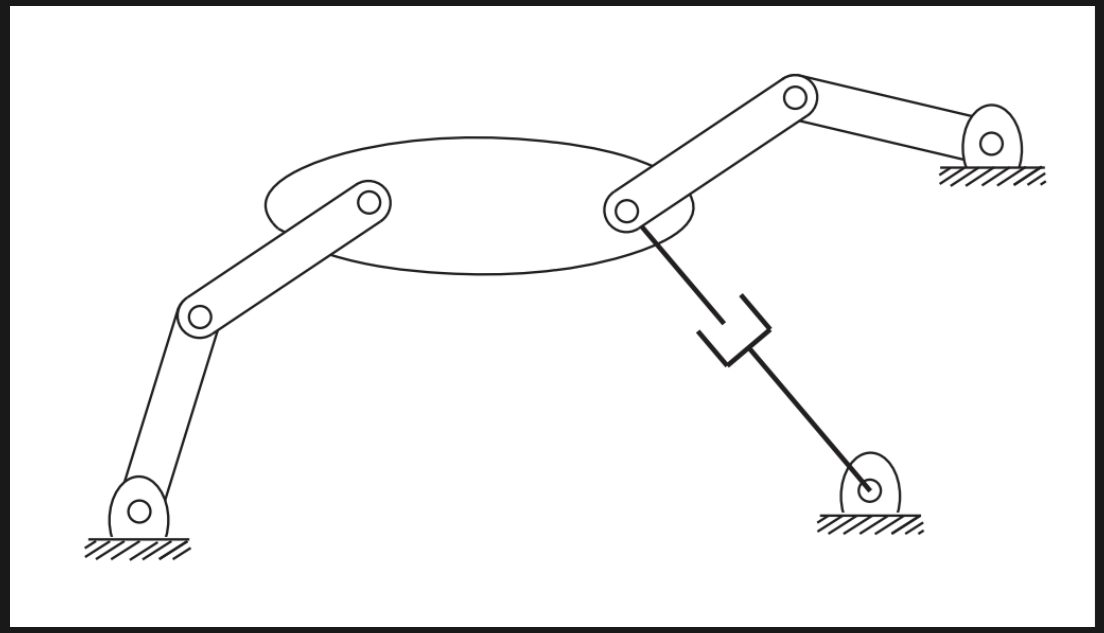
Joint (조인트) - Grubler’s Formula



$$\text{dof} = m(N - 1 - J) + \sum_{i=1}^{J} f_i$$

3 x (4 - 1 - 4) + (1 + 1 + 1 + 1) = 1

Joint (조인트) - Grubler’s Formula



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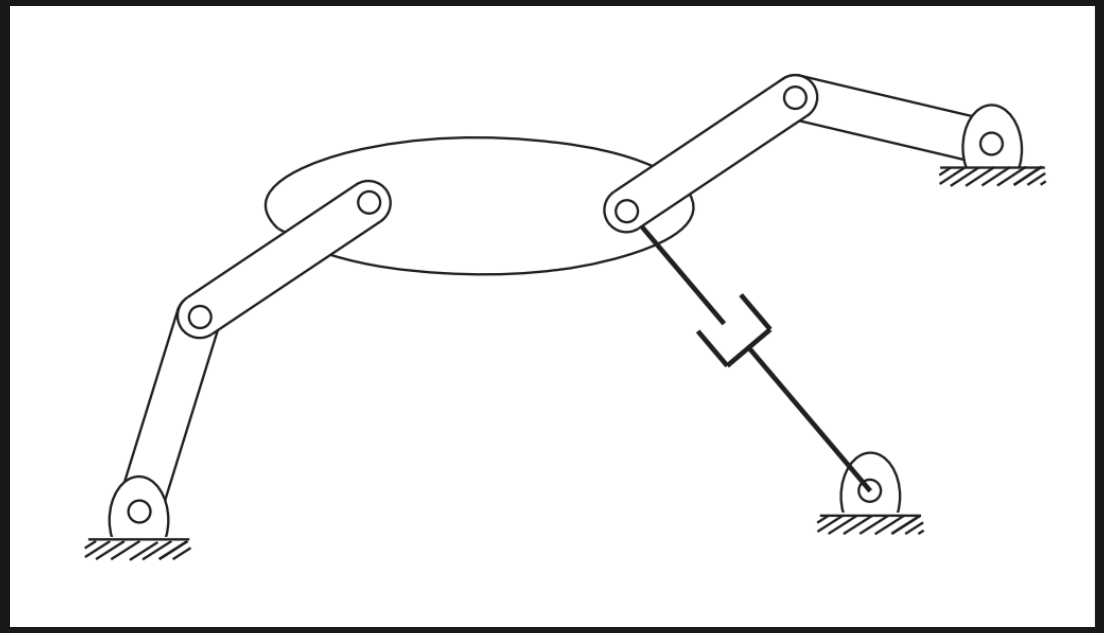
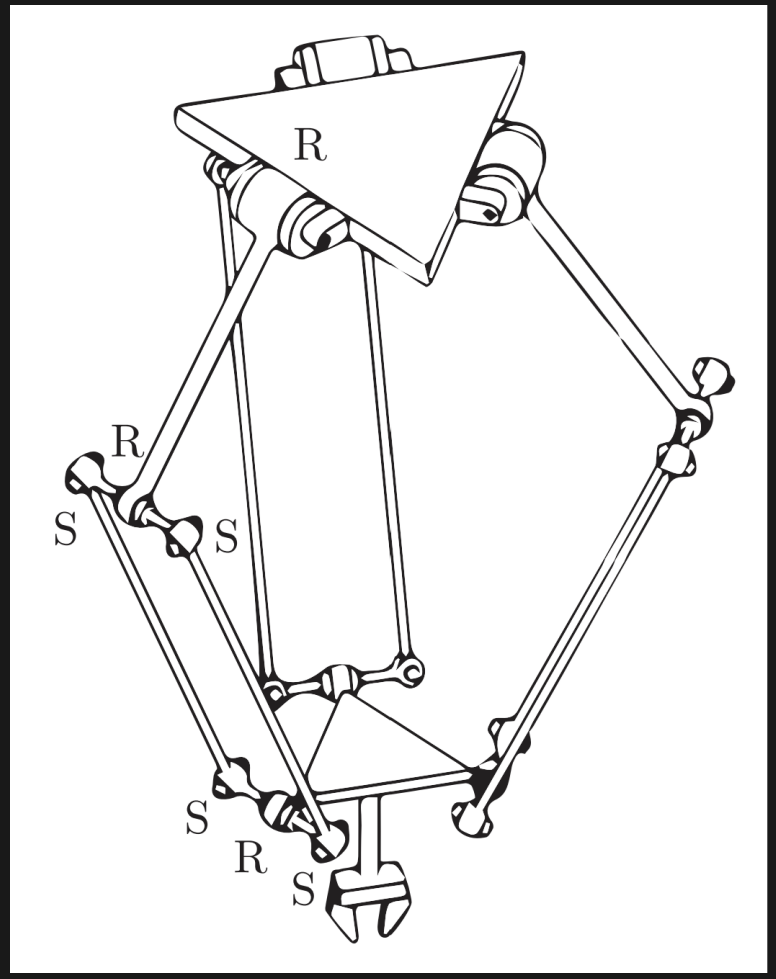
Joint (조인트) - Grubler’s Formula



$$\text{dof} = m(N - 1 - J) + \sum_{i=1}^{J} f_i$$

3 x (8 - 1 - 9) + (1 x 9) = 3

Joint (조인트) - Grubler’s Formula

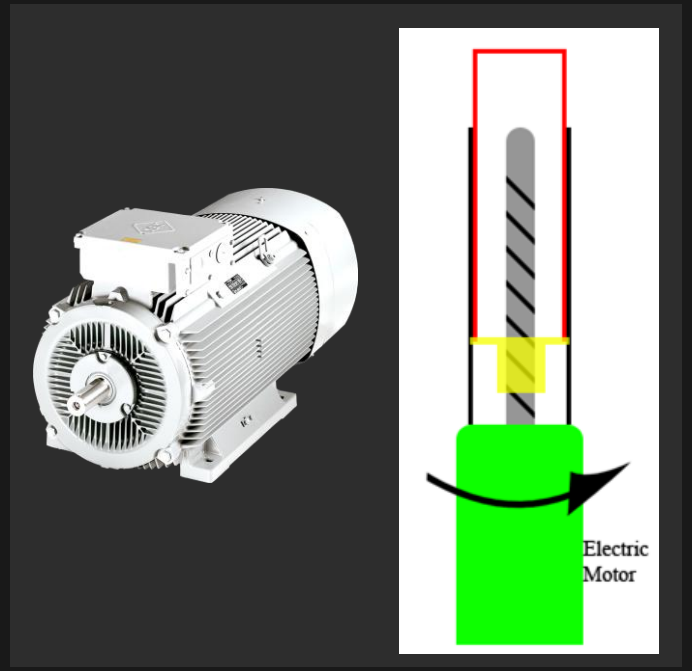


$$\text{dof} = m(N - 1 - J) + \sum_{i=1}^{J} f_i$$

6 x (17 - 1 - 21) + (1 x 9 + 3 x 12) = 15

Joint (조인트) - Degree of Freedom (DoF, 자유도)

Actuator (액추에이터)

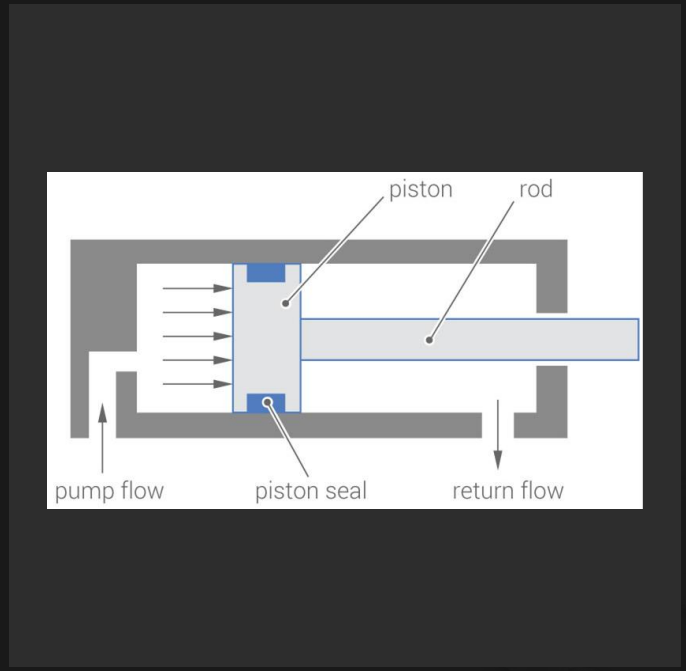


Mechanical

Electric motors

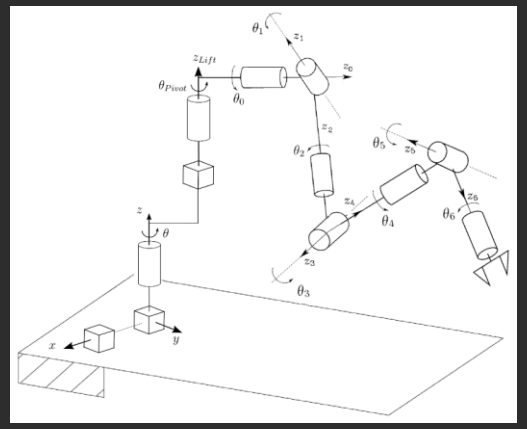
Linear actuators

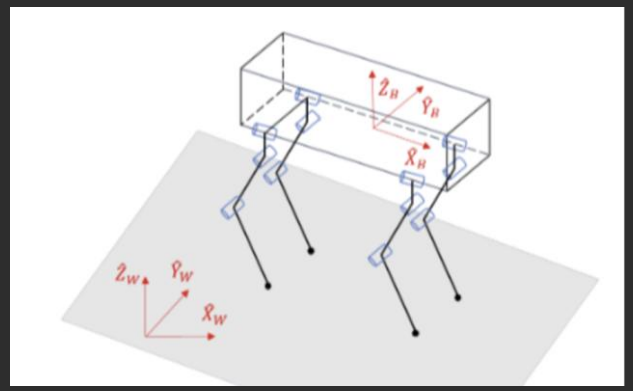
Pneumatic



Hydraulic

로봇의 구성요소

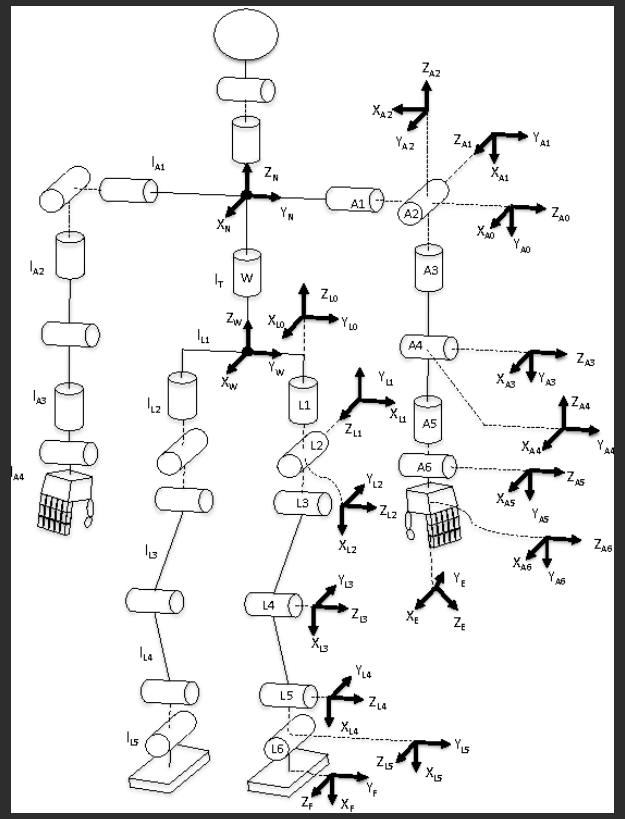




Link

Joint

Actuator

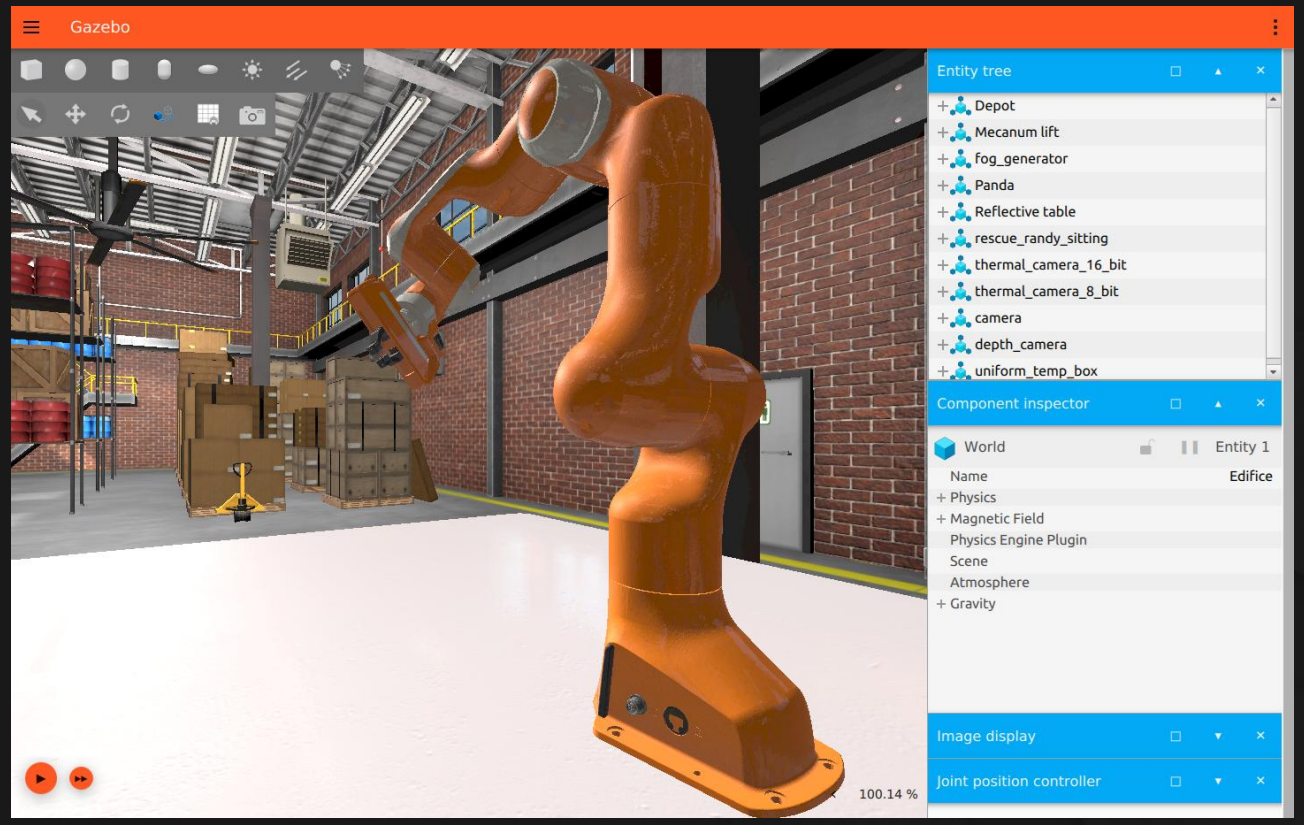


Universal Robot Description Format (URDF)

- 실제 로봇의 물리적 구조를 표현하는 설계도

Universal Robot Description Format (URDF)

- 실제 로봇의 물리적 구조를 표현하는 설계도
- 시뮬레이션에서 로봇 시각화 및 역학 계산



Universal Robot Description Format (URDF)

- 실제 로봇의 물리적 구조를 표현하는 설계도
- 시뮬레이션에서 로봇 시각화 및 역학 계산

- 대표 구성요소
  - Link
  - Joint
  - Inertial
  - Visual
  - Collision
  - Transmission
  - Material

```
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      <geometry>
        <box size="0.2 0.2 0.05"/>
      </geometry>
    </visual>
  </link>

  <link name="link1">
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      <mass value="1.0"/>
      <inertia ixx="0.01" ixy="0" ixz="0" iyy="0.01" iyz="0" izz="0.01"/>
    </inertial>
    <visual>
      <geometry>
        <cylinder length="1.0" radius="0.05"/>
      </geometry>
    </visual>
  </link>

  <joint name="joint1" type="revolute">
    <parent link="base_link"/>
    <child link="link1"/>
    <origin xyz="0 0 0.05" rpy="0 0 0"/>
    <axis xyz="0 0 1"/>
    <limit effort="10" velocity="1.0" lower="-1.57" upper="1.57"/>
  </joint>

</robot>
```
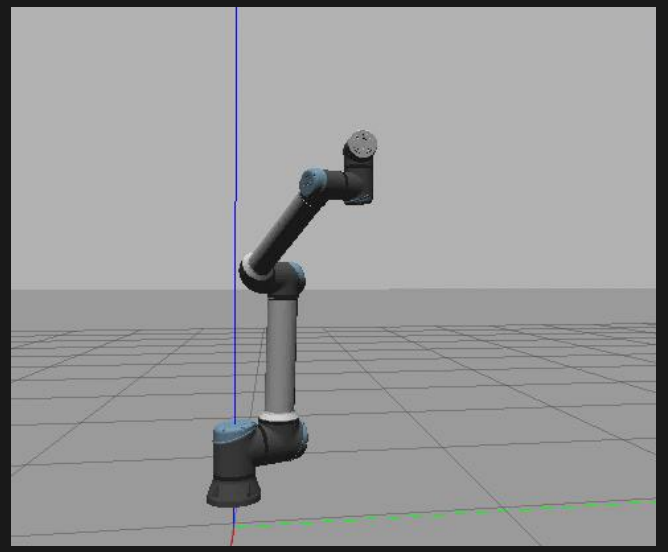
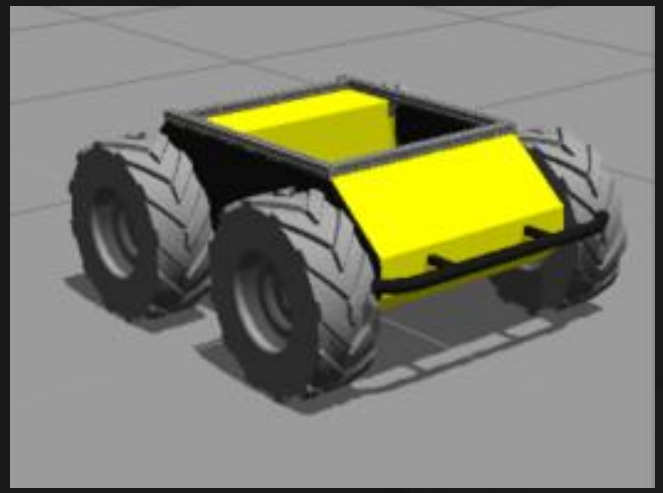

Universal Robot Description Format (URDF)

- 실제 로봇의 물리적 구조를 표현하는 설계도
- 시뮬레이션에서 로봇 시각화 및 역학 계산

- 대표 구성요소
  - Link
  - Joint
  - Inertial
  - Visual
  - Collision
  - Transmission
  - Material



Universal Robot Arm (UR5)



Clearpath Husky

강의 요약

01

링크

02

조인트

Degree of Freedom

Revolute - 1 dof

Prismatic - 1 dof

Helical - 1 dof

Cylindrical - 2 dof

Universal - 2 dof

Spherical - 3 dof

03

액추에이터

Mechanical

Pneumatic

Hydrilic

04

URDF

로봇의 설계도

시뮬레이션에 활용

Link

Joint

Transmission (Actuator)

Material

...