KINEMATICS

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KINEMATICS

Studies the motion of a body, or a system of bodies, without considering its mass or the forces acting on it

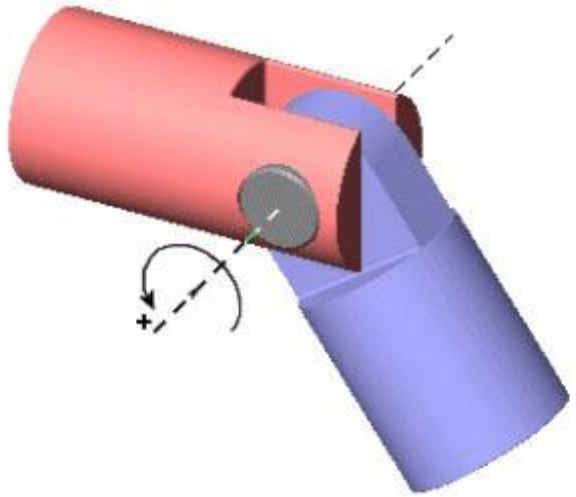
ROBOT ARM

A robot arm, more formally a serial-link manipulator, comprises a chain of rigid links and joints


EVA

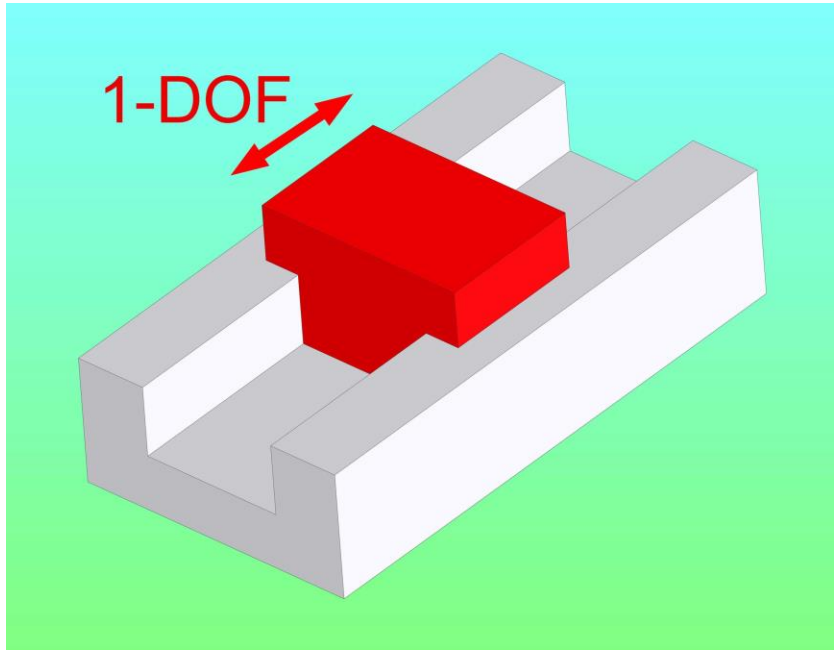
JOINT TYPES

Revolute: the attached links rotate about a common axis.



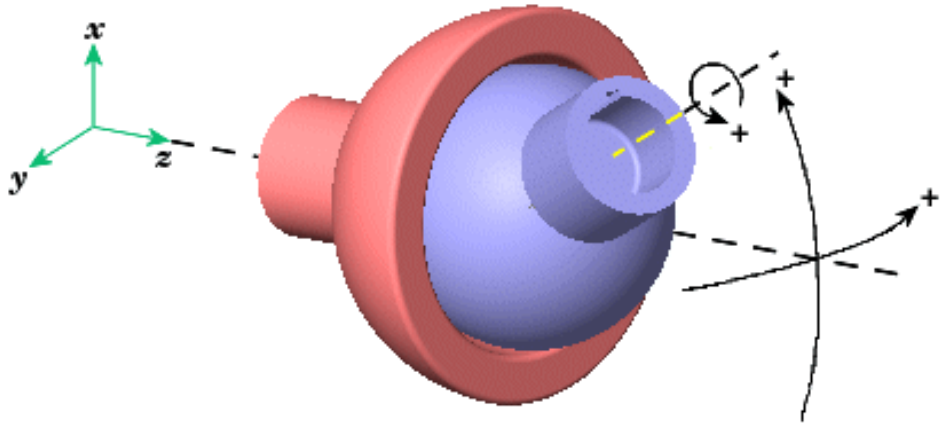
JOINT TYPES

Prismatic: the attached links translate about a common axis



JOINT TYPES

Spherical: the attached links rotate about a point



ROBOT ARM

Each joint has one degree of freedom, either translational (a sliding or prismatic joint) or rotational (a revolute joint).

CONFIGURATION

Robot's configuration: a specification of the positions of all points of the robot.

CONFIGURATION

described by one of two methods:

1. A list of coordinates for each joint (typically an angle or translation distance) expressed relative to some reference frame, aka zero position.
2. A spatial representation of its links in the 2D or 3D world in which it operates

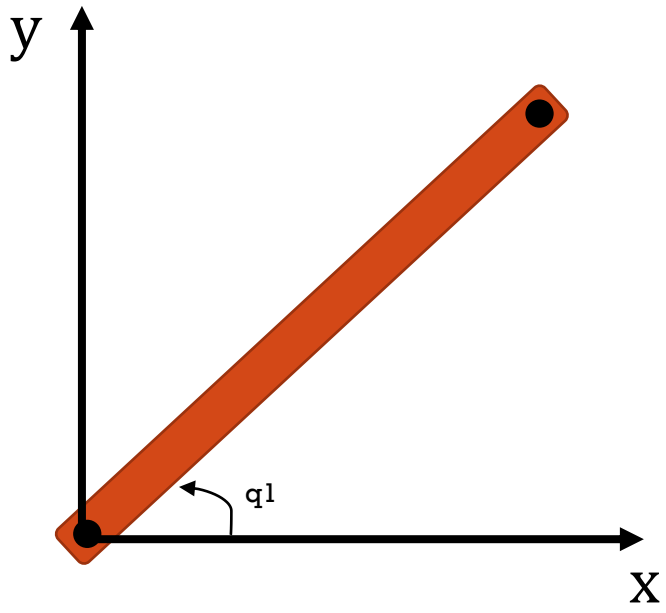
WORKSPACE

The 2D or 3D world in which the robot lives is known as its workspace

DEGREE OF FREEDOM (DOF):

the smallest number n of real-valued coordinates needed to represent the robot's configuration

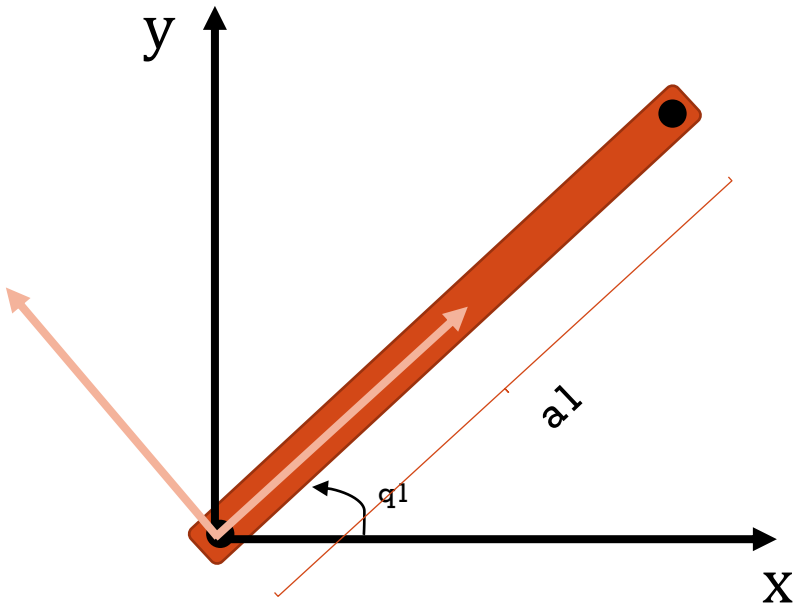
1-JOINT ROBOT ARM



How many dof does this robot have?

What is the workspace of this robot?

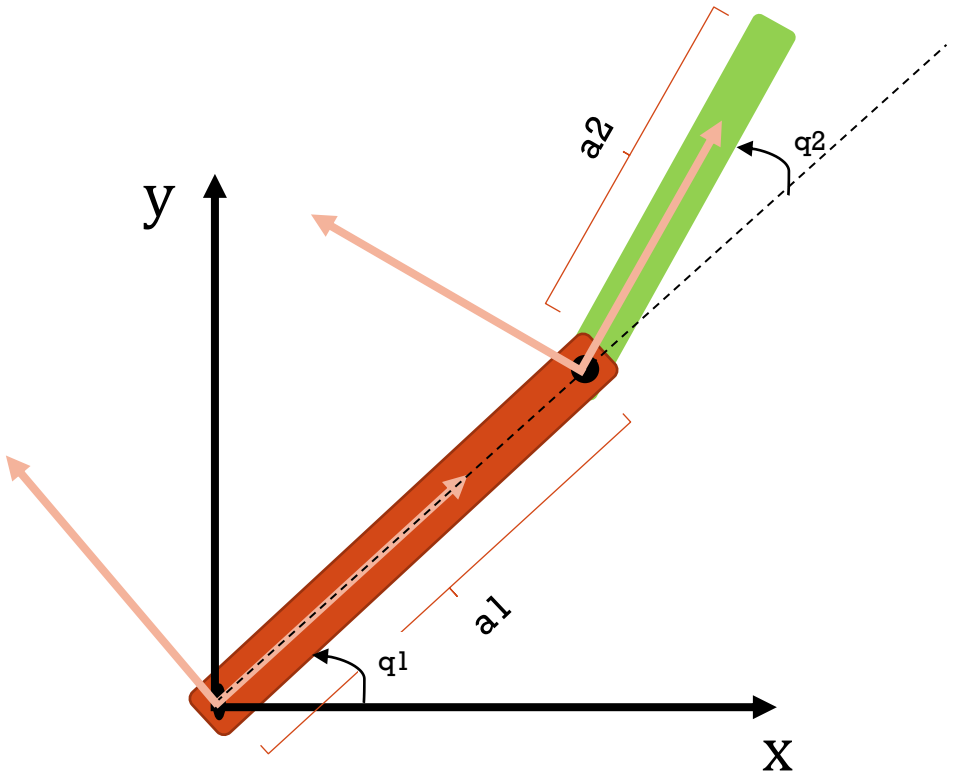
1-JOINT PLANAR ROBOT ARM



Pose of the end effector

$R(q1)\ T_x(a1)$

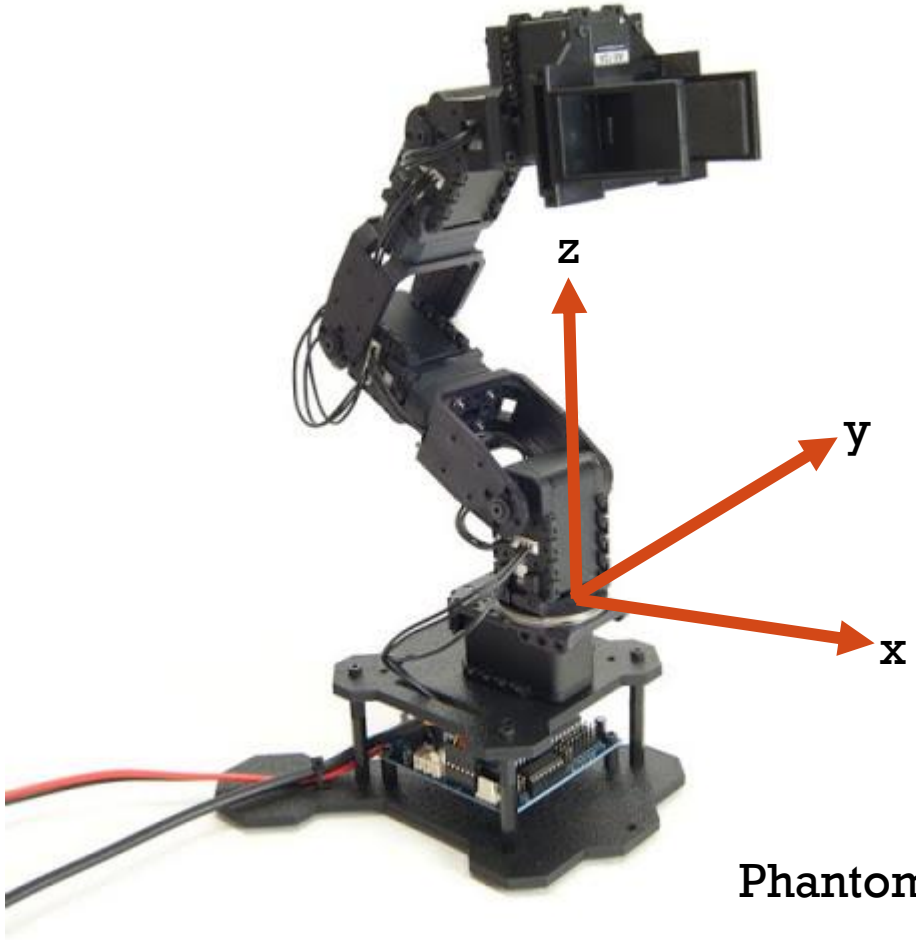
2-JOINT PLANAR ROBOT ARM



Pose of the end effector

$R(q1)\ T_x(a1)\ R(q2)\ T_x(a2)$

ROBOT ARM IN 3D

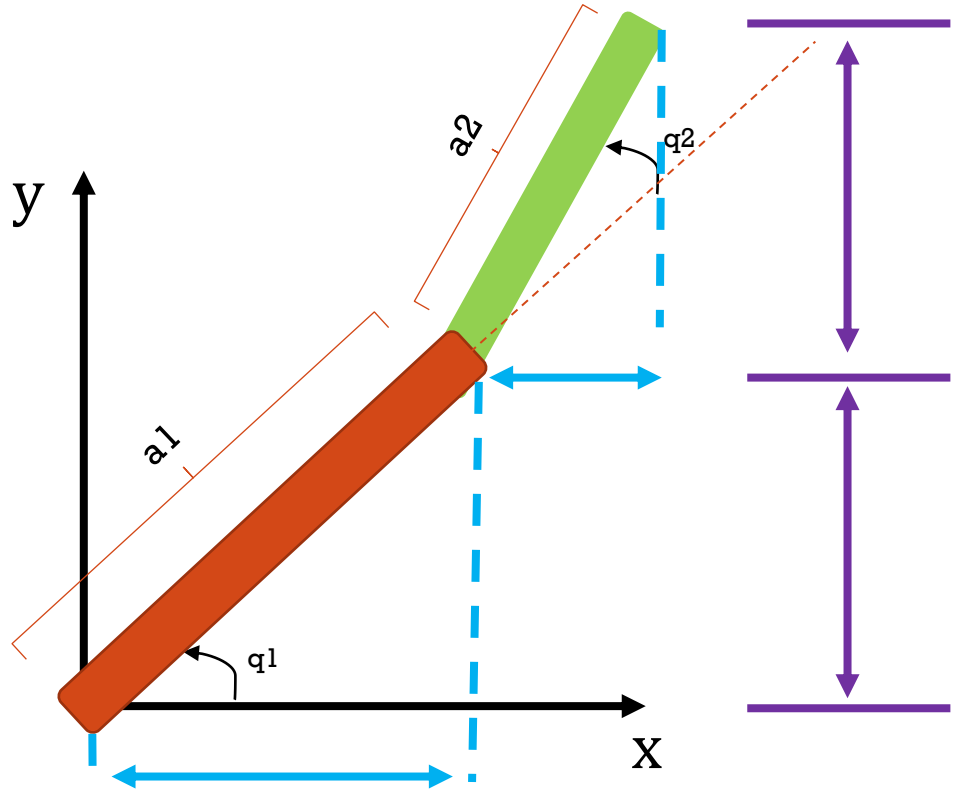


PhantomX Pincher Robot

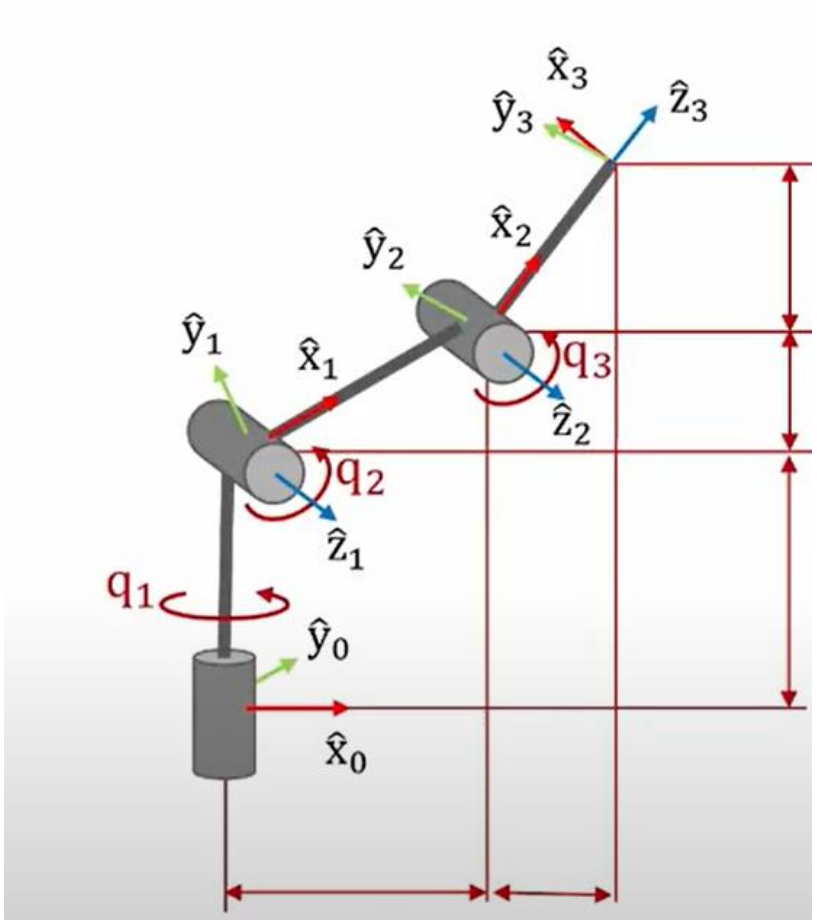
FORWARD KINEMATICS

Given a set of joint positions q, what is the pose of the robot tool-tip x?

FK OF A 2 DOF PLANAR ROBOT



FK IN 3 DOF


$\hat{x}_3$
$\hat{y}_3$
$\hat{z}_3$
$\hat{x}_2$
$\hat{y}_2$
$\hat{y}_1$
$\hat{x}_1$
q_3
$\hat{z}_2$
q_2
$\hat{z}_1$
q_1
$\hat{y}_0$
$\hat{x}_0$

INVERSE KINEMATICS