EEL5667 Robot Kinematics and Dynamics

Dr. Roberts, A360
rroberts@eng.fsu.edu

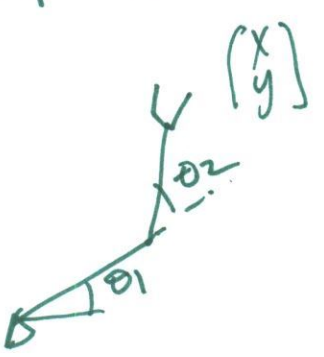
Reading Assignment – Chap 1

Look over Chap 2

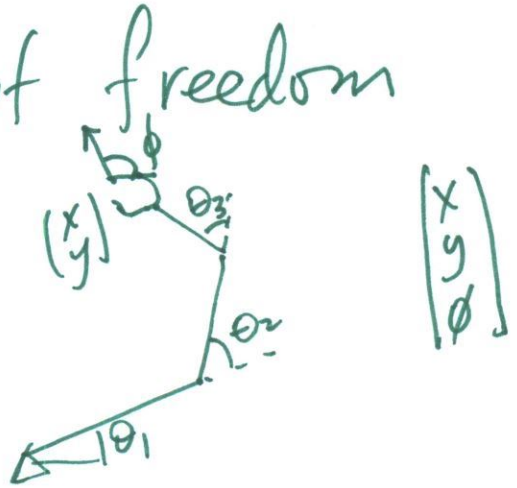
Terminology

DOF ≡ degree of freedom

Example



Planar 2R robot (2DOF)



Planar 3R Robot (3DOF)

Work Space DOF's are typically 2, 3, 5, or 6

There are 7 DOF in a human arm

3 - shoulder
1 - elbow
3 - wrist

Joints 1.) Revolute (R)

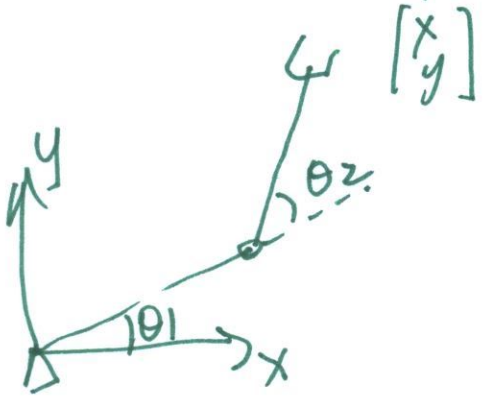
2.) Prismatic (P)

slides in and out

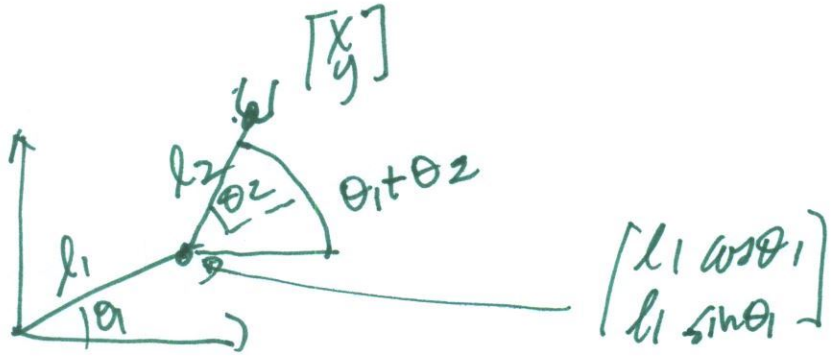
In this course, we will study the following problems:

1.) Forward Kinematics

Consider a planar 2R manipulator



Given a configuration $\underline{\theta} = \begin{bmatrix} \theta_1 \\ \theta_2 \end{bmatrix}$, find the end-effector (hand) position $\begin{bmatrix} x \\ y \end{bmatrix}$



$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{bmatrix} l_1\cos\theta_1 + l_2\cos(\theta_1+\theta_2) \\ l_1\sin\theta_1 + l_2\sin(\theta_1+\theta_2) \end{bmatrix}$$

$$= \begin{bmatrix} l_1 c_1 + l_2 c_{12} \\ l_1 s_1 + l_2 s_{12} \end{bmatrix}$$

where $c_1 = \cos\theta_1 \qquad c_{12} = \cos(\theta_1+\theta_2)$

$s_1 = \sin\theta_1 \qquad s_{12} = \sin(\theta_1+\theta_2)$

2.) Inverse Kinematics

Given an end-effector position $\begin{bmatrix} x \\ y \end{bmatrix}$

find the necessary joint configuration

$$\underline{\theta} = \begin{bmatrix} \theta_1 \\ \theta_2 \end{bmatrix}$$

$$x = l_1 c_1 + l_2 c_{12}$$
$$y = l_1 s_1 + l_2 s_{12}$$