

EE366L/CE366L: Introduction to Robotics Lab

Dr Basit Memon

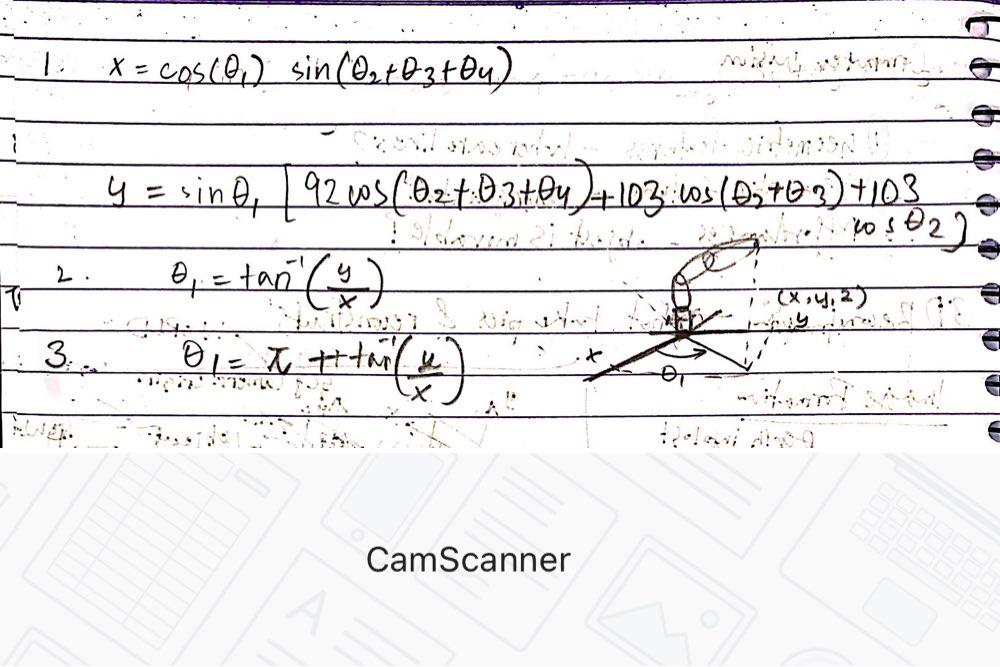
Muhammad Hassan Shah

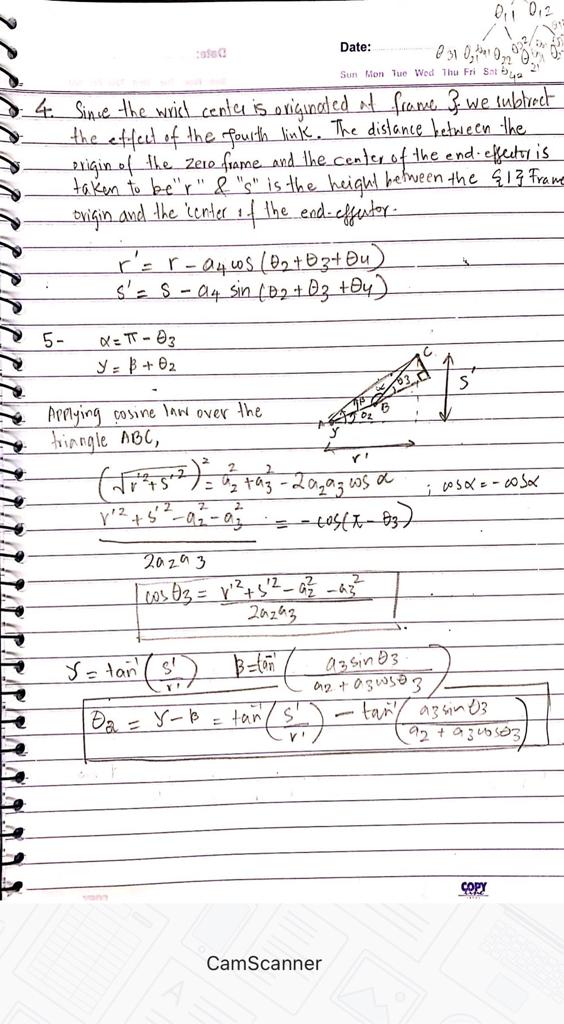
Lab 6: Inverse Kinematics

Sadaf Shaikh and Mohammad Hasan Tariq

March 9th 2022

Task 6.1



v

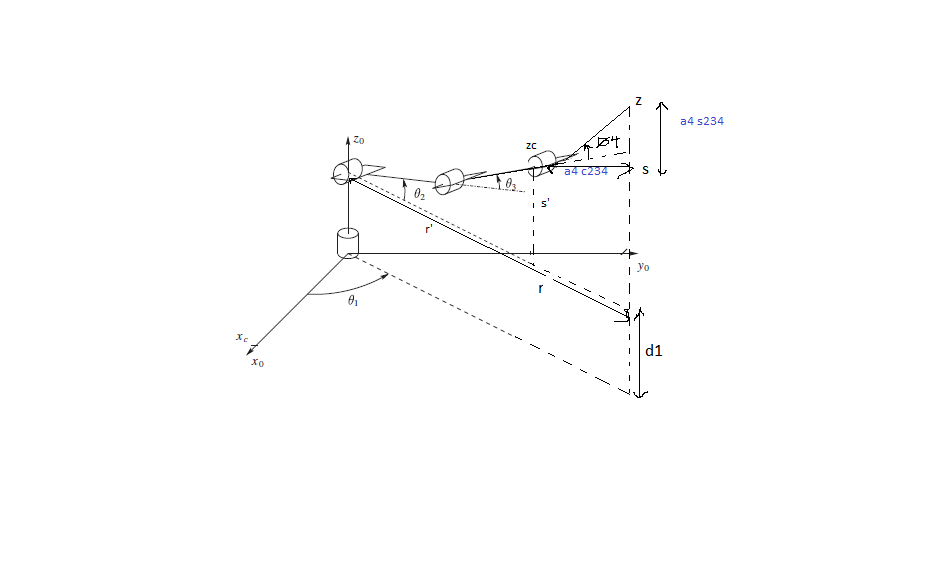


Figure 1: Determination of joint angles using Geometric Approach

6 –

There are four total solutions. For each , we have two, pairs.

7 –

= - -

Task 6.2

function solutions = findJointAngles(x,y,z,phi)

% x, y and z are the coordinates of the center of teh end-effector that is

% the 4th frame

theta\_1\_1 = atan2(y,x);

theta\_1\_2 = - pi + atan2(y,x);

d\_1 = 141;

a\_4 = 92;

a\_3 = 103;

a\_2 = 103;

r = sqrt(x^2 + y^2);

s = z - d\_1;

r\_2 = r - a\_4\*cos(phi);

s\_2 = s - a\_4\*sin(phi);

alpha = acos((-(r\_2^2 + s\_2^2) + a\_2^2 + a\_3^2)/(2\*a\_2\*a\_3));

temp = (a\_2^2 + s\_2^2 + r\_2^2 - a\_3^2)/ (2 \* a\_2 \* sqrt(s\_2^2 + r\_2^2));

beta = atan2(sqrt(1 - temp^2),temp);

gamma = atan2(s\_2,r\_2);

theta\_2\_1 = gamma - beta;

theta\_2\_2 = gamma + beta;

theta\_3\_1 = pi - alpha;

theta\_3\_2 = - pi + alpha;

theta\_4\_1 = phi - theta\_3\_1 - theta\_2\_1;

theta\_4\_2 = phi - theta\_3\_2 - theta\_2\_2;

solutions = [theta\_1\_1 theta\_2\_1 theta\_3\_1 theta\_4\_1;

theta\_1\_1 theta\_2\_2 theta\_3\_2 theta\_4\_2;

theta\_1\_2 pi-theta\_2\_1 -theta\_3\_1 -theta\_4\_1;

theta\_1\_2 pi-theta\_2\_2 -theta\_3\_2 -theta\_4\_2];

end

Task 6.3

Yes. We used the configuration (x,y,z, phi) = (120,120,250,1)

Task 6.4

|  |  |  |  |
| --- | --- | --- | --- |
| Model Coordinates (units) | Actual Coordinates (mm) | Absolute Error(mm) | Euclidean error (mm) |
| (50,-20,180,0) | (61-20,180,0) | (11,0,0,0) | 11 |
| (103,-140,193,0) | (119,-146,180,0) | (16,6,13,0) | 21.471 |
| (100.27,-136.2925,180.2773,0) | (119,-152,172,0) | (18.73,15.7075,8.2773,0) | 25.81 |

Mean error is calculated as:

Task 6.5

