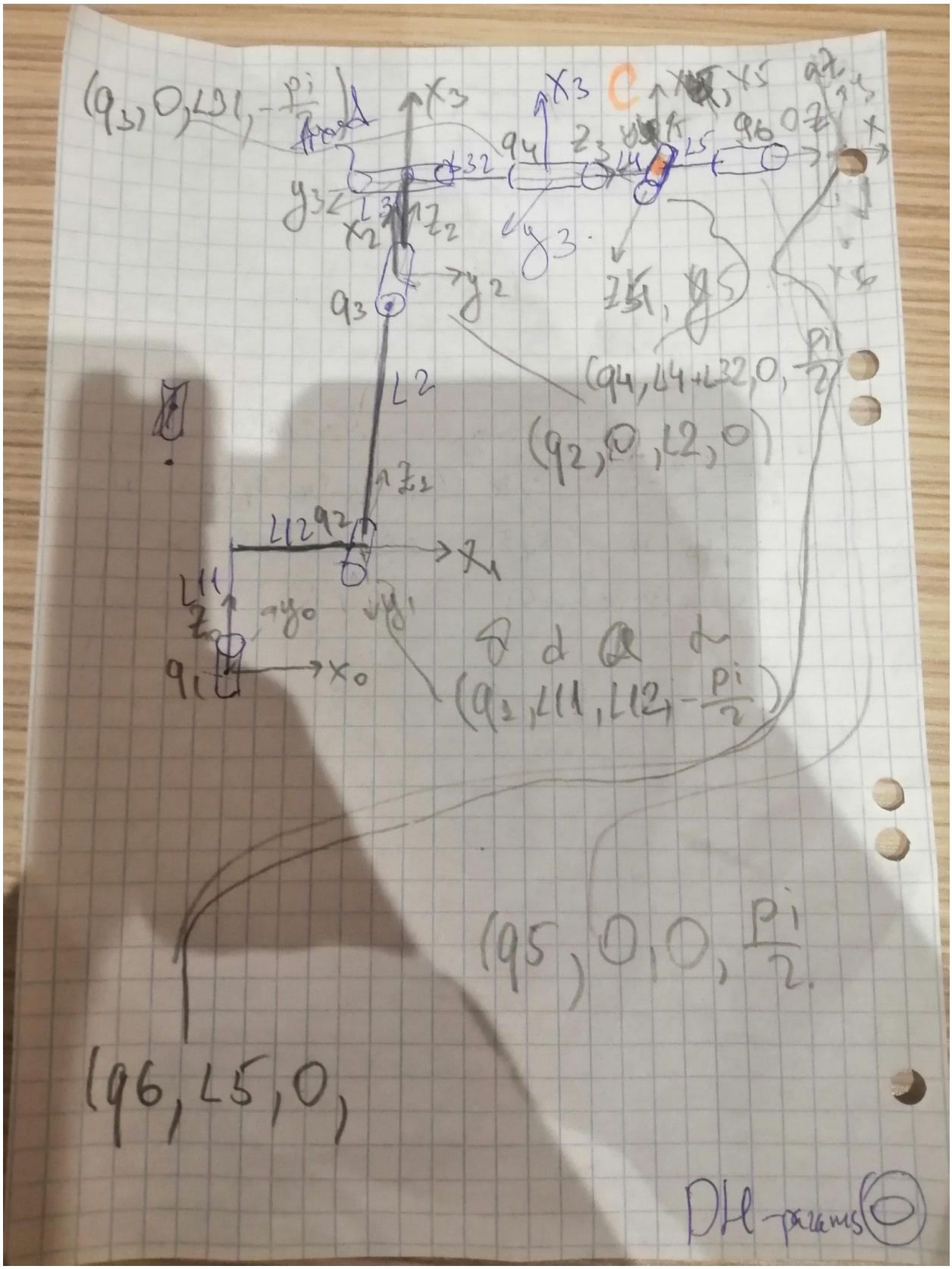
HomeWork1 Report

Main file is R2000i.m

Calculation of DH-parameters



I had to add one additional axis (4th) to plot my model and in order to be able to calculate IK and decouple it. This axis doesn't rotate. So, below we have 7 axises. Point C(orange) is the point where 3 axis coincide.

Direct Kinematics

I created DK function that have angles of axis as inputs and T marix (HM) as output.

Algorithm:

1. Enters Configuration, DH-parameters
2. Sets limits
3. If 2 is okay, plot the robot. If 2 isn't okay, change angles and repeat (F5)
4. Exams the solution by the function of RTbox (fkine)
5. Converts angles from rad to deg
6. Uses function FK (Function calculates the T0_7 matrix)
7. Outputs it

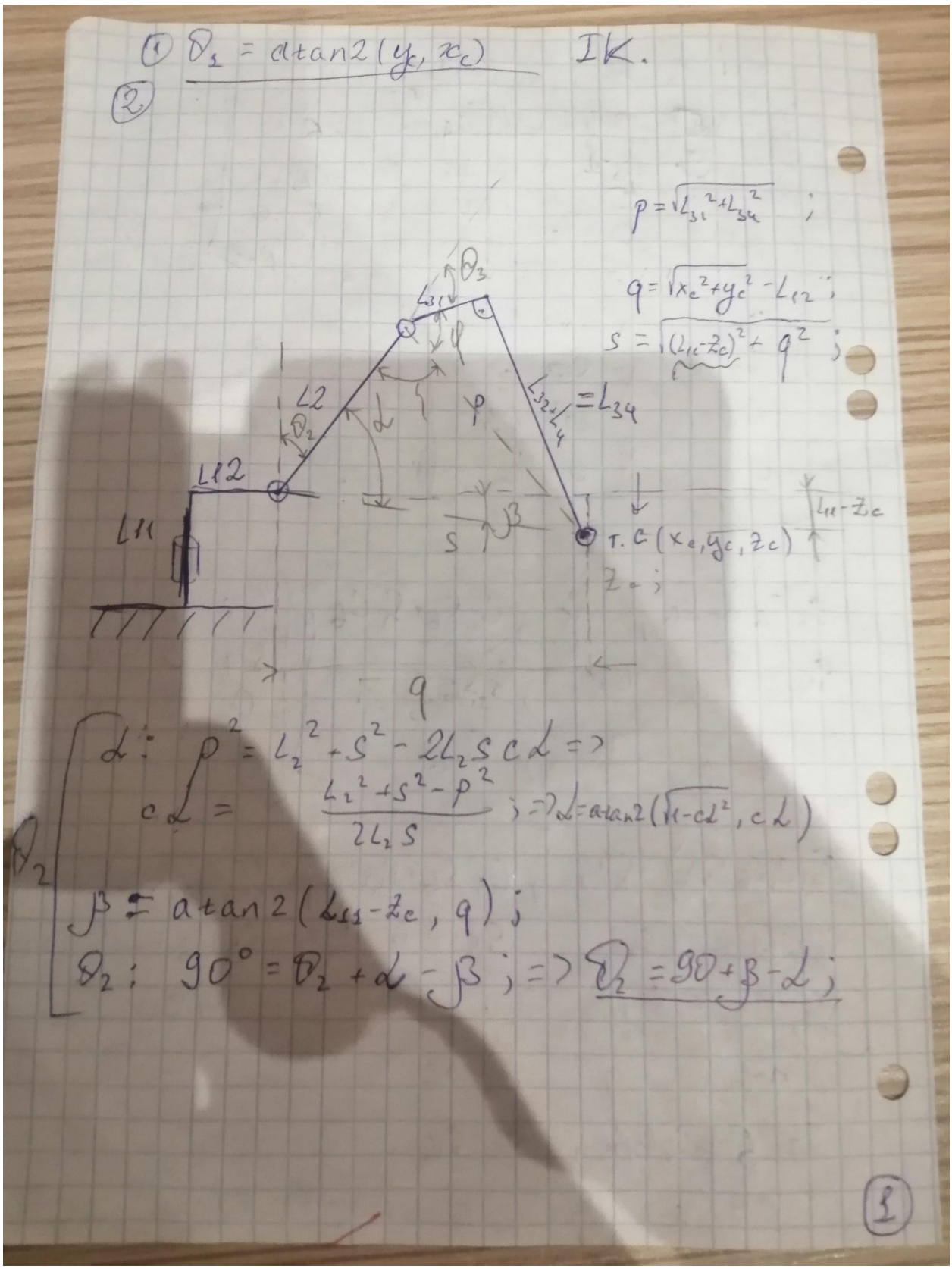
Inverse Kinematics

I created IK function that have T matrix as input and angles of rotations as outputs.

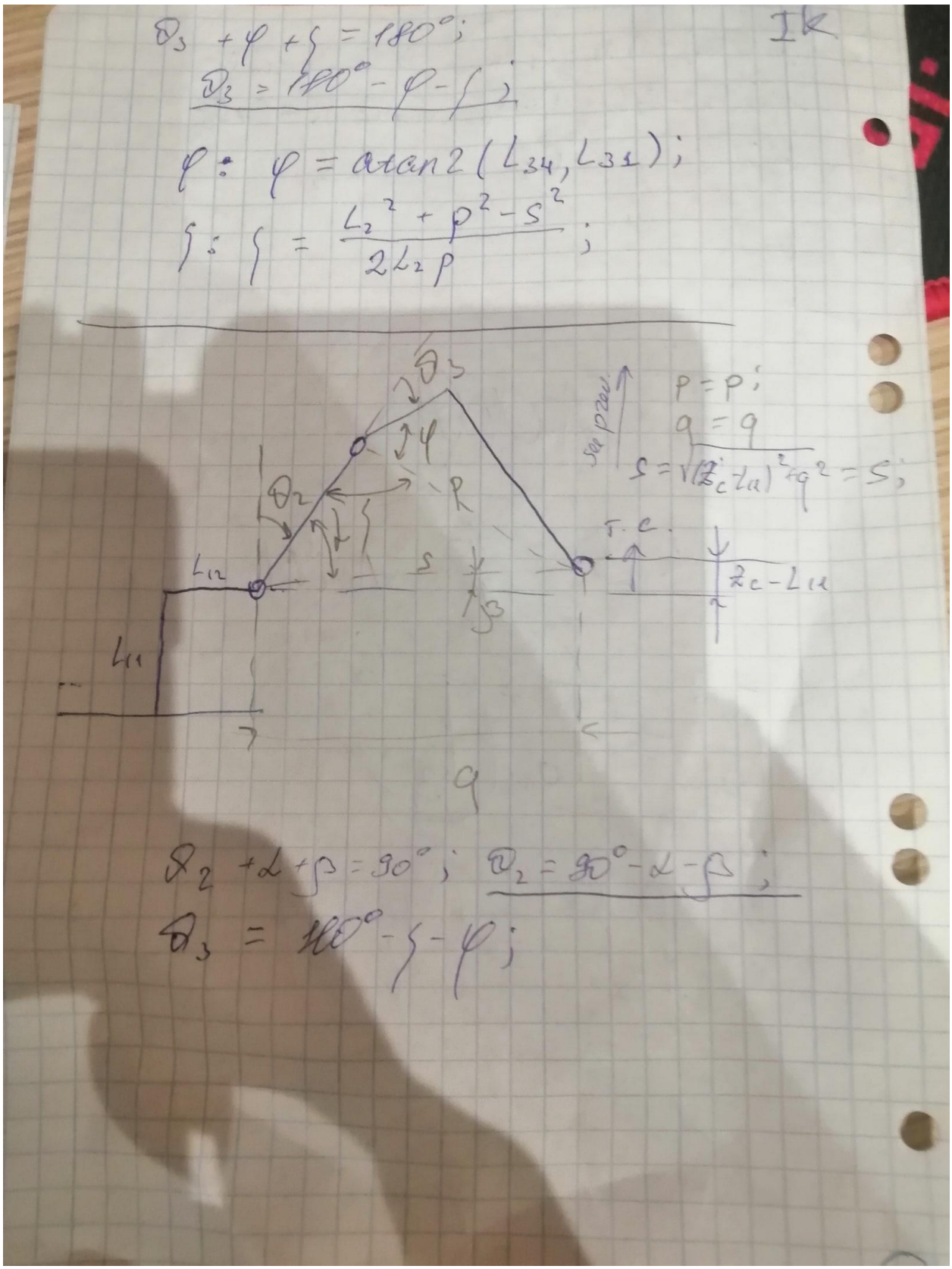
T matrix can be set by yourself or be taken from DK.

Algorithm:

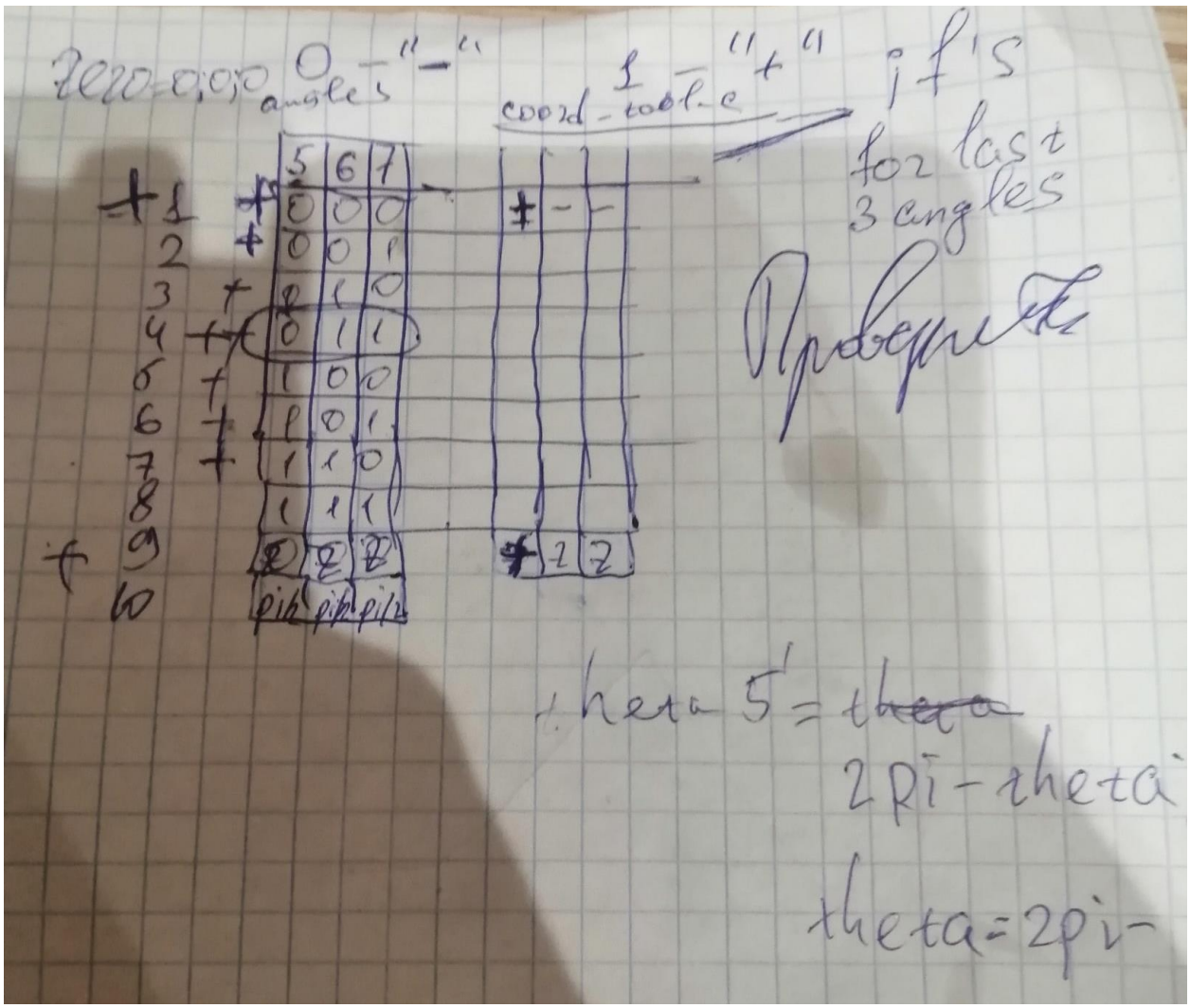
1. Enters Configuration, DH-parameters
2. Calculates the pos of the tool
3. Sets limits of workspace
4. Calculates thetas (angles)
5. Calculates the HM from 0 to 4
6. Calculates the HM from 4 to 6 (to calculate last 3 rotations)
7. Calculates last 3 thetas from formulas (due to the symbolic view of T5_7)
8. Output all angles
9. Plotting



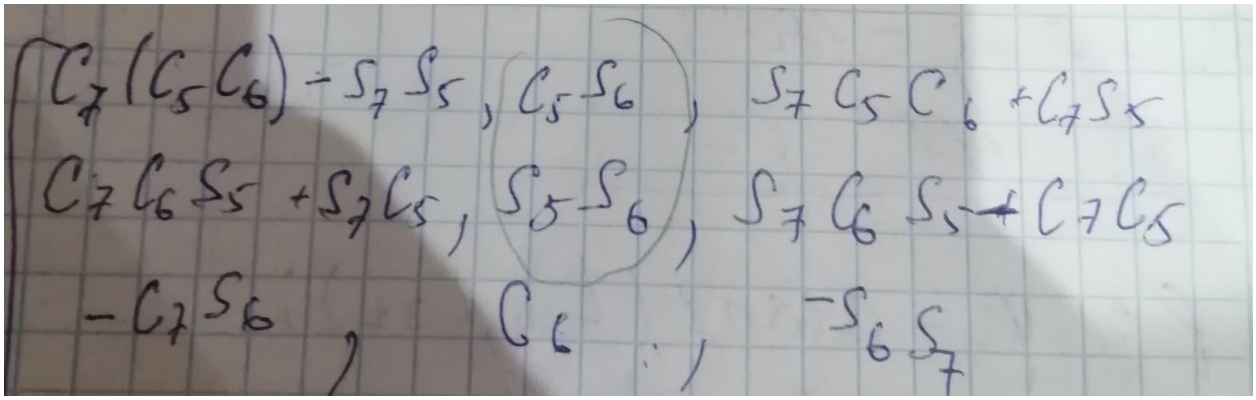
Pic.2 Calculating of theta1 and theta2.



Pic.3 Calculating of theta3



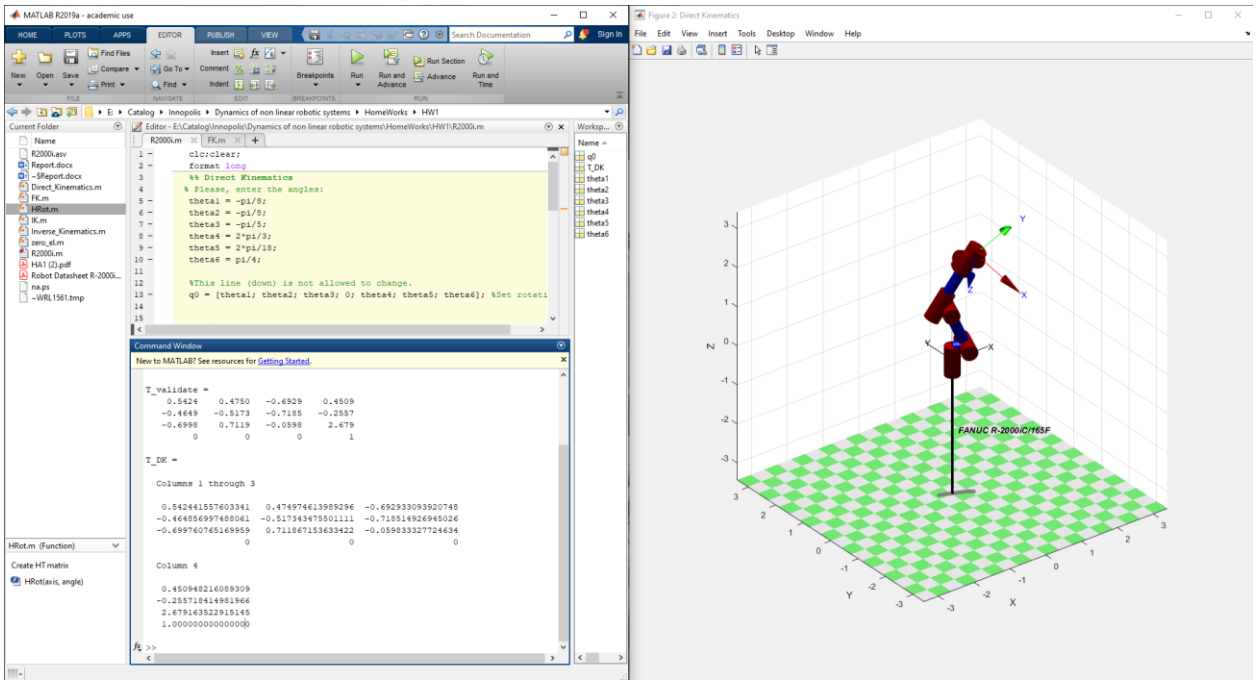
Pic. 4 Numerical method

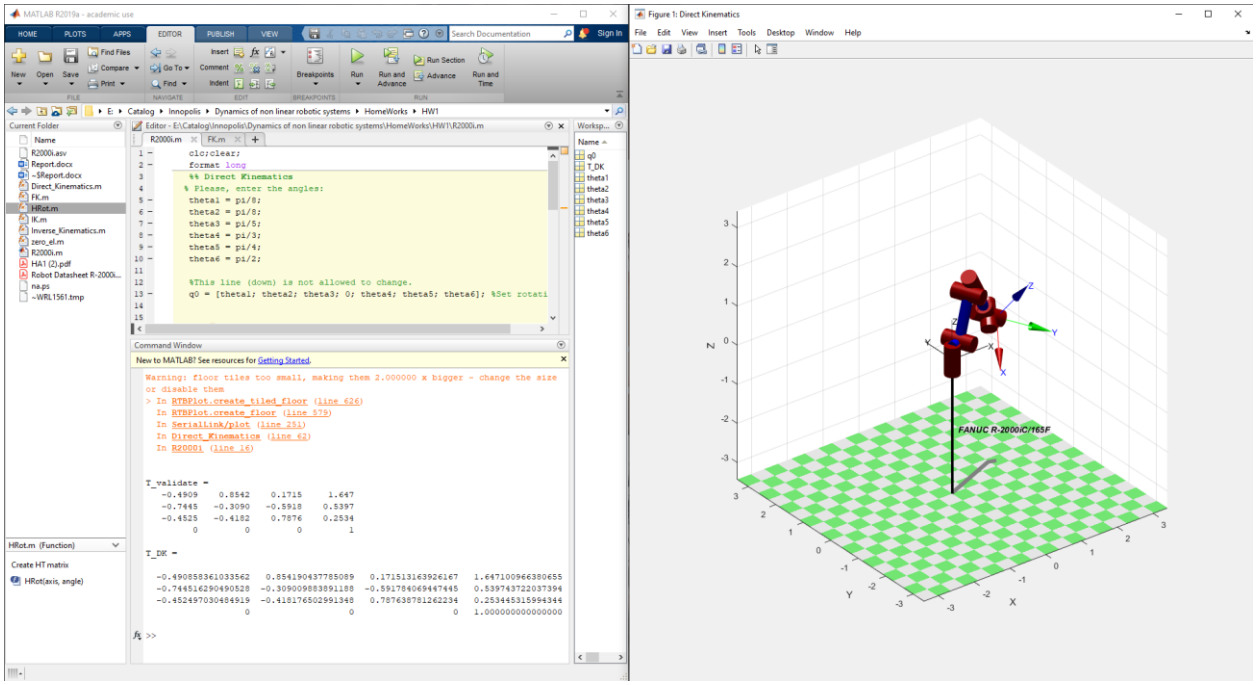


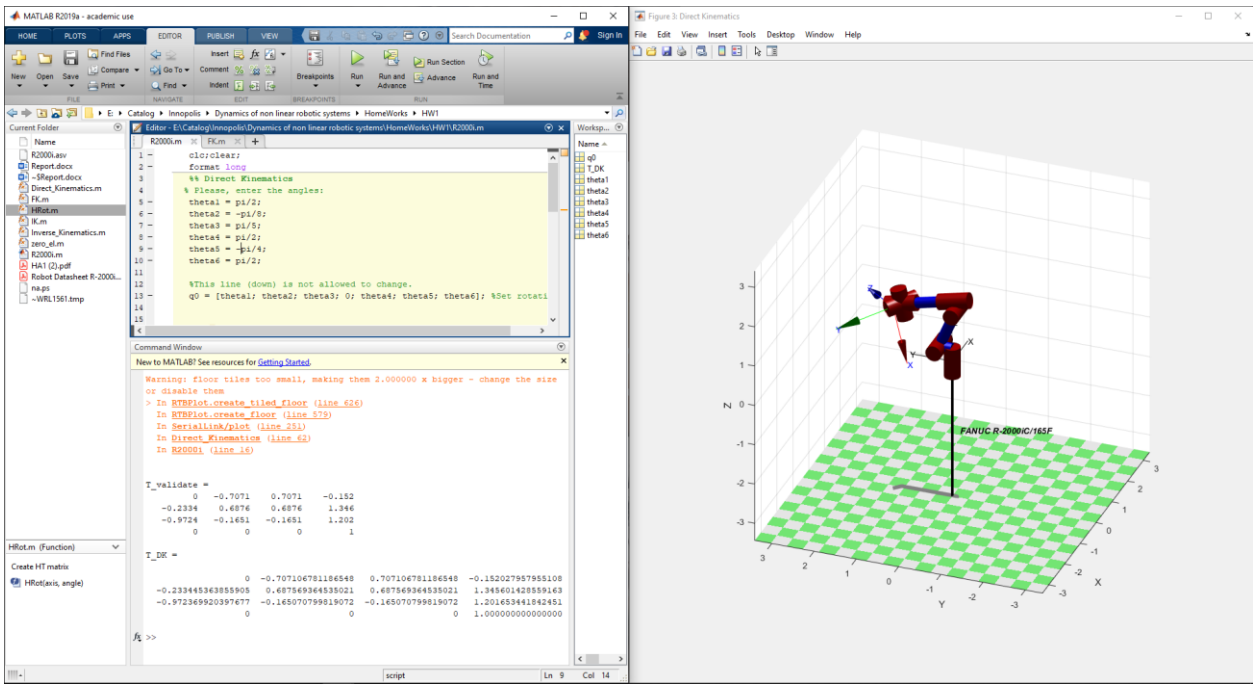
Pic. 5 T5_7 matrix (only R part demonstrated)

Tests

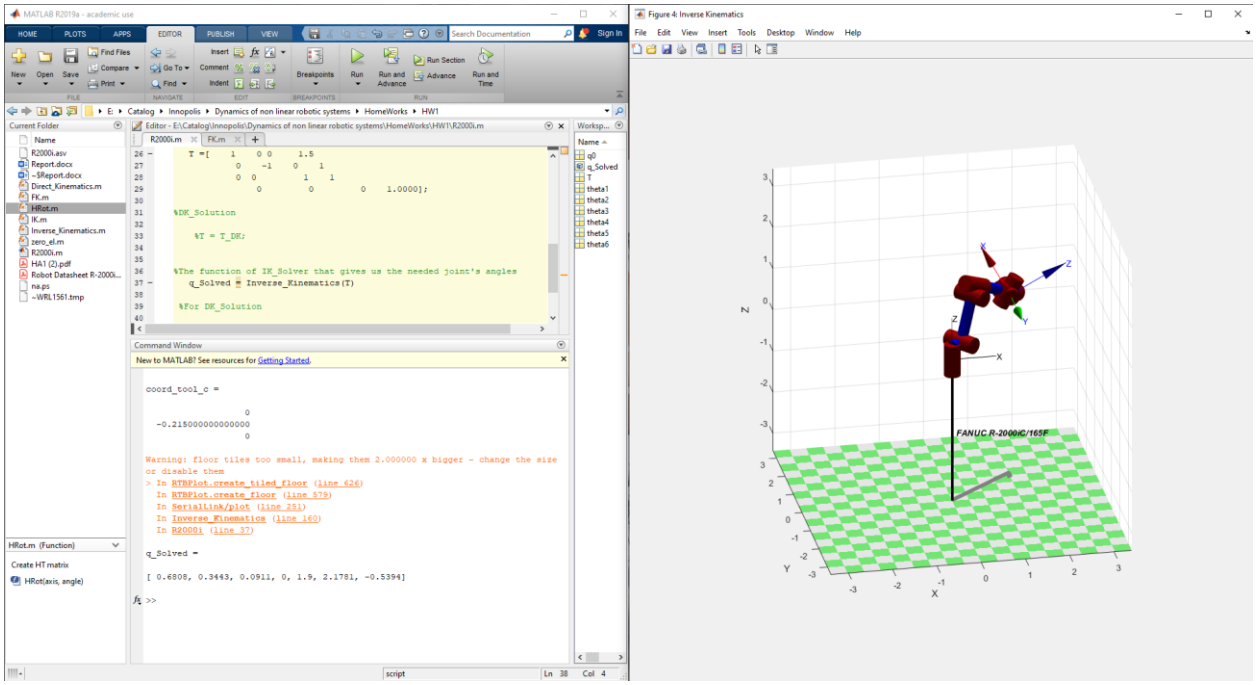
Direct Kinematics solution

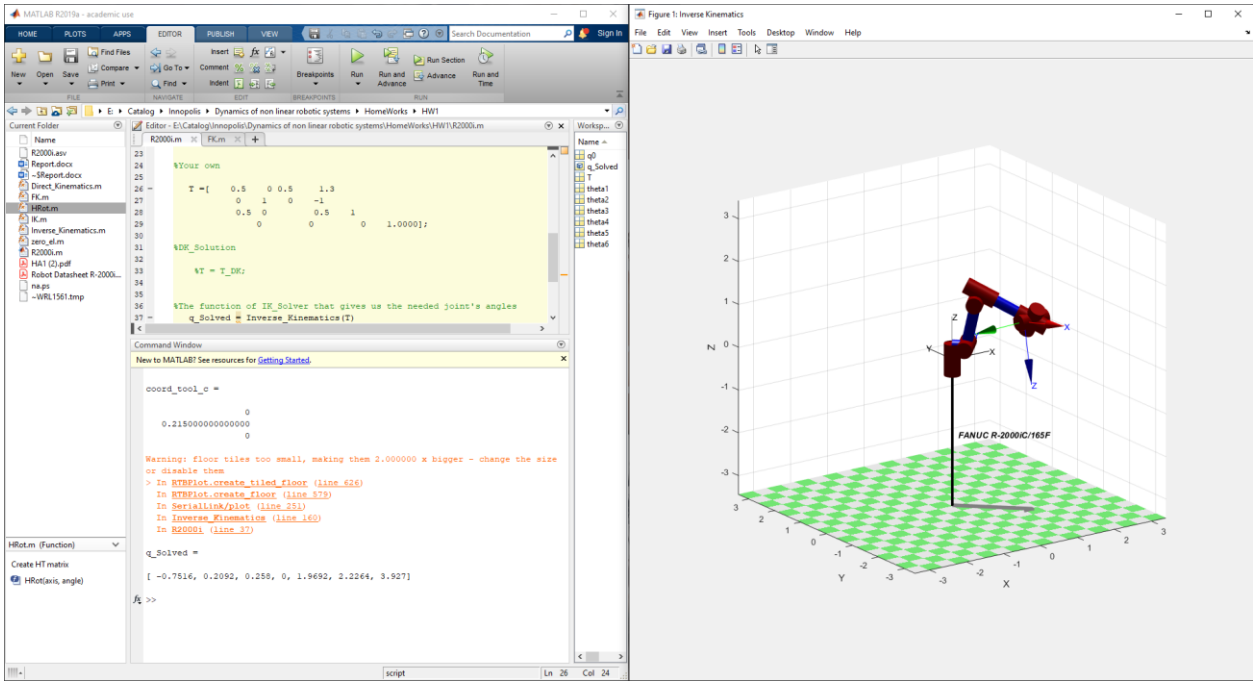




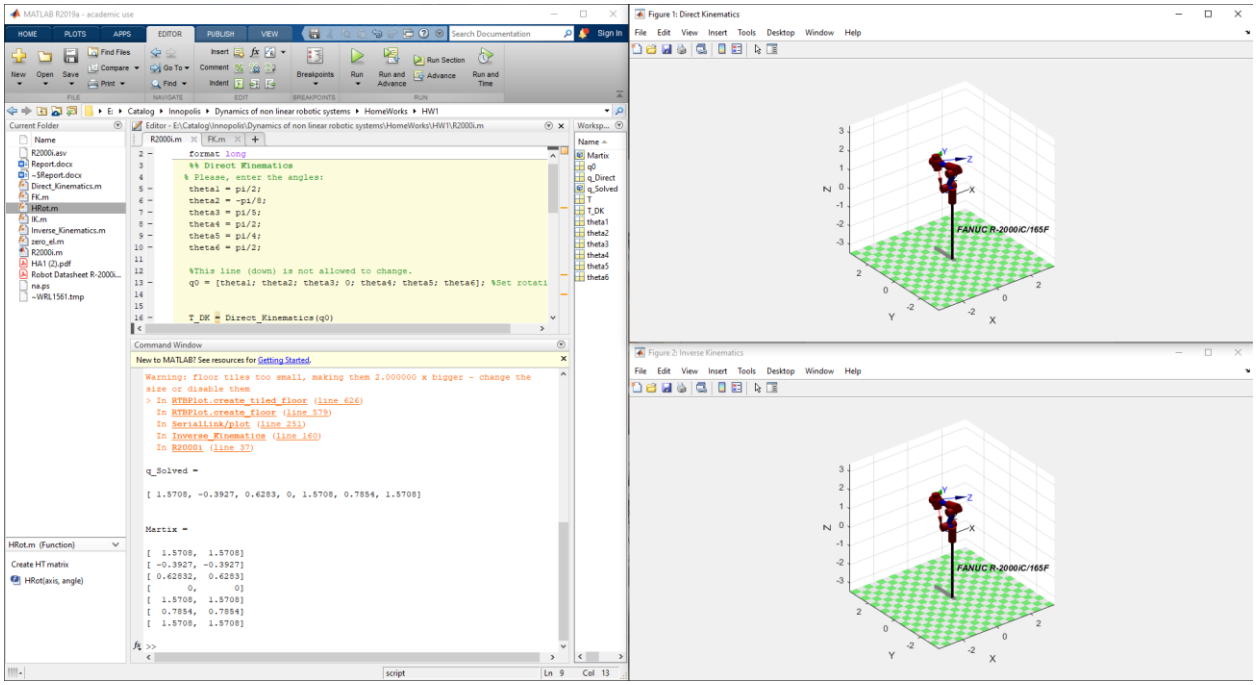


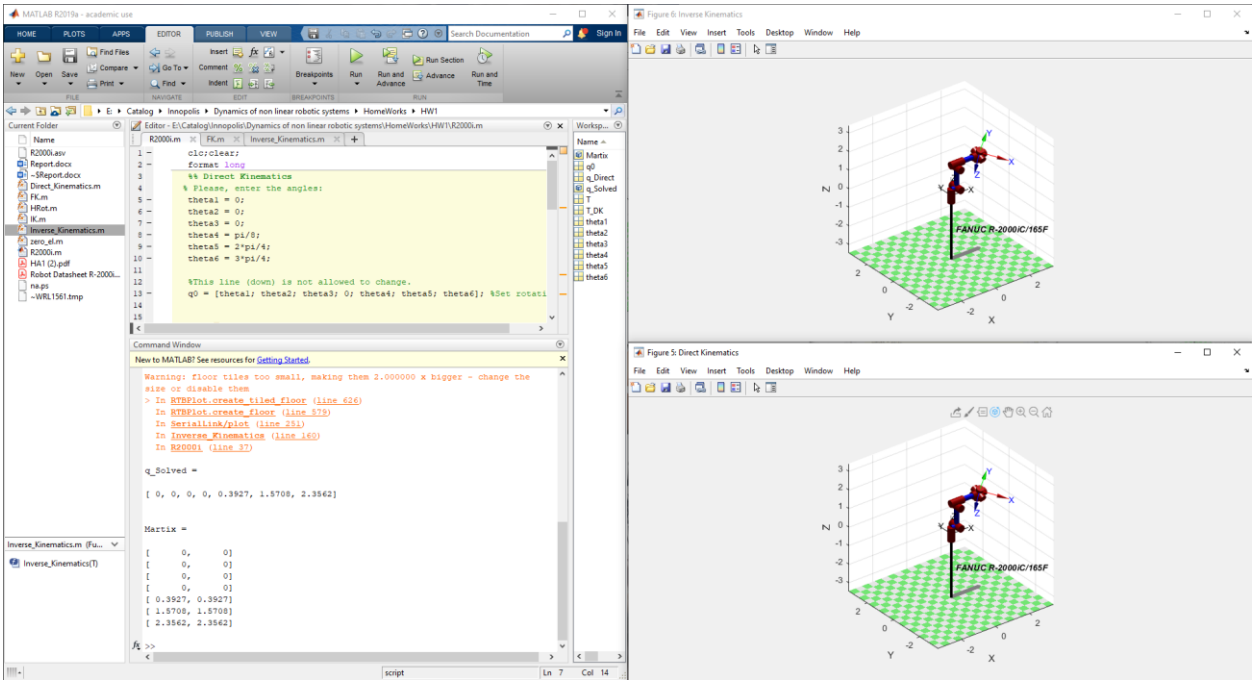
Inverse Kinematics solution





Direct→Inverse Kinematics Solution

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1 clc;clear;
2 format long
3 %% Direct Kinematics
4 % Please, enter the angles:
5 theta1 = 0;
6 theta2 = 0;
7 theta3 = 0;
8 theta4 = pi/8;
9 theta5 = 2*pi/4;
10 theta6 = 3*pi/4;
11
12 %This line (down) is not allowed to change.
13 q0 = [theta1; theta2; theta3; 0; theta4; theta5; theta6]; %Set rotati
14
15
Command Window
New to MATLAB? See resources for Getting Started.
Warning: floor tiles too small, making them 2.000000 x bigger - change the size or disable them
> In RTBPlot.create_tiled_floor (line 626)
In RTBPlot.create_floor (line 578)
In SerialLink/plot (line 251)
In Inverse_Kinematics (line 160)
In R2000i (line 37)
q_Solved =
[0, 0, 0, 0, 0.3927, 1.5708, 2.3562]
Martix =
[0, 0]
[0, 0]
[0, 0]
[0, 0]
[0.3927, 0.3927]
[1.5708, 1.5708]
[2.3562, 2.3562]
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Col 14
Workspace
Name
Martix
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q_Solved
T
T_DK
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theta2
theta3
theta4
theta5
theta6
Figure 6: Inverse Kinematics
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Figure 5: Direct Kinematics
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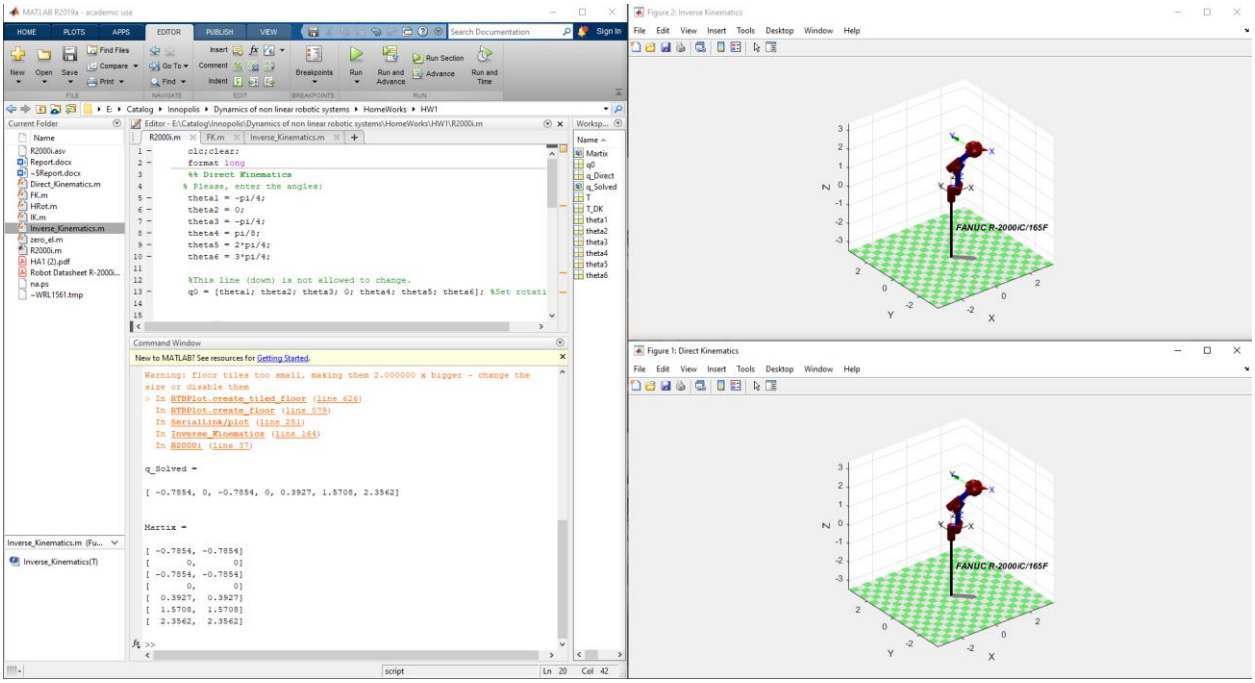
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IK.m
Inverse_Kinematics.m
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R2000i.m
FK.m
Inverse_Kinematics.m
1 clc;clear;
2 format long
3 %% Direct Kinematics
4 % Please, enter the angles:
5 theta1 = -pi/4;
6 theta2 = 0;
7 theta3 = -pi/4;
8 theta4 = pi/8;
9 theta5 = 2*pi/4;
10 theta6 = 3*pi/4;
11
12 %This line (down) is not allowed to change.
13 q0 = [theta1; theta2; theta3; 0; theta4; theta5; theta6]; %Set rotati
14
15
Command Window
New to MATLAB? See resources for Getting Started.
Warning: floor tiles too small, making them 2.000000 x bigger - change the size or disable them
> In RTBPlot.create_tiled_floor (line 626)
In RTBPlot.create_floor (line 578)
In SerialLink/plot (line 251)
In Inverse_Kinematics (line 164)
In R2000i (line 37)
q_Solved =
[-0.7854, 0, -0.7854, 0, 0.3927, 1.5708, 2.3562]
Martix =
[-0.7854, -0.7854]
[0, 0]
[-0.7854, -0.7854]
[0, 0]
[0.3927, 0.3927]
[1.5708, 1.5708]
[2.3562, 2.3562]
fx >>
script
Ln 20
Col 42
Workspace
Name
Martix
q0
q_Direct
q_Solved
T
T_DK
theta1
theta2
theta3
theta4
theta5
theta6
Figure 2: Inverse Kinematics
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Figure 1: Direct Kinematics
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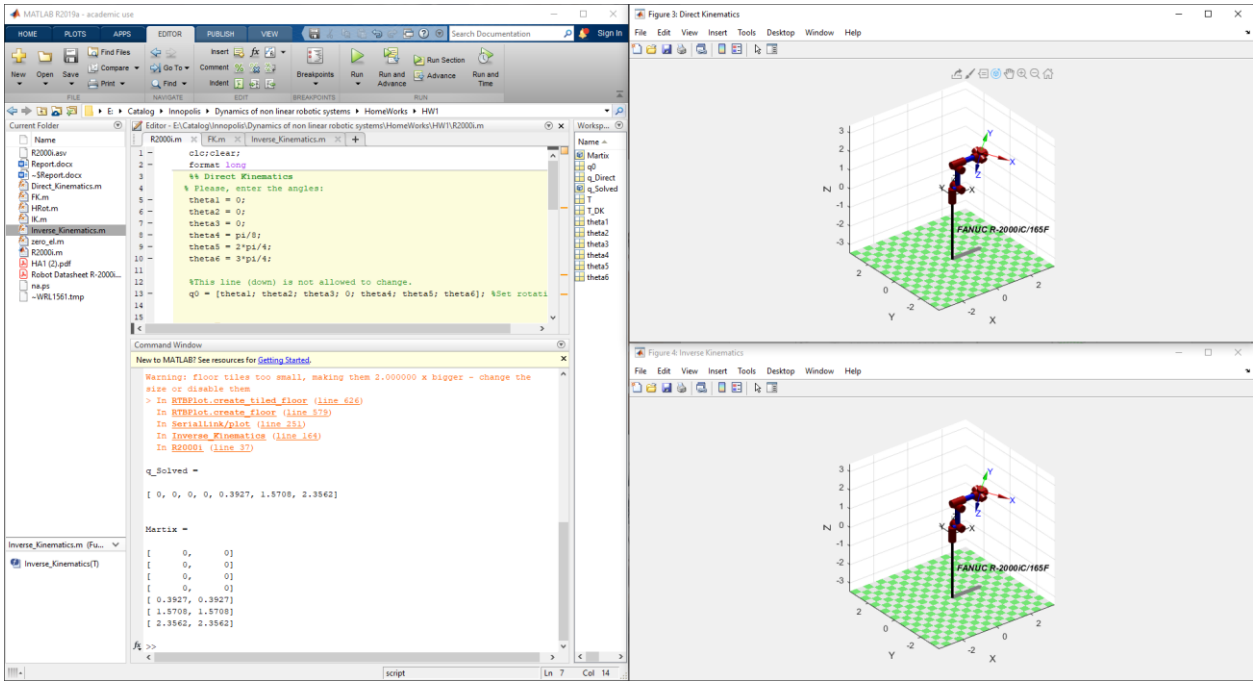
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Figure 3: Direct Kinematics
Figure 4: Inverse Kinematics
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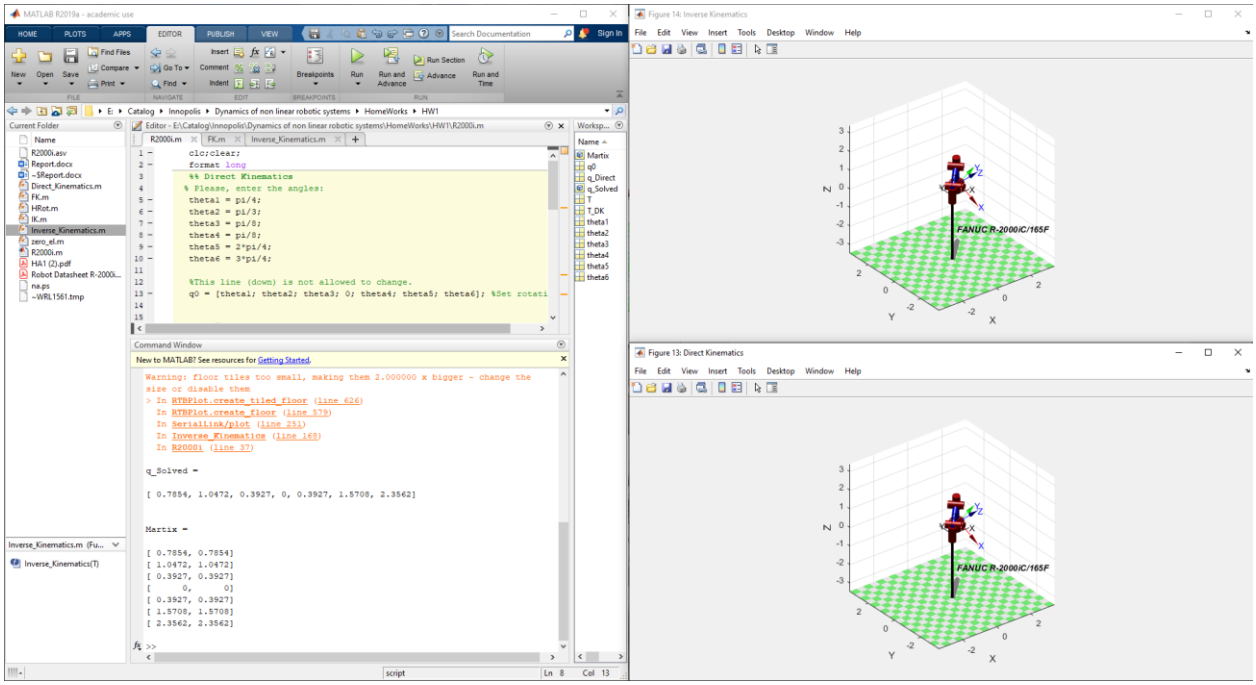
clc;clear;
format long
%% Direct Kinematics
% Please, enter the angles:
theta1 = 0;
theta2 = 0;
theta3 = 0;
theta4 = pi/8;
theta5 = 2*pi/4;
theta6 = 3*pi/4;
%This line (down) is not allowed to change.
q0 = [theta1; theta2; theta3; 0; theta4; theta5; theta6]; %Set rotati
Warning: floor tiles too small, making them 2.000000 x bigger - change the size or disable them
q_Solved =
[0, 0, 0, 0, 0.3927, 1.5708, 2.3562]
Martix =
[0, 0]
[0, 0]
[0, 0]
[0, 0]
[0.3927, 0.3927]
[1.5708, 1.5708]
[2.3562, 2.3562]


MATLAB R2019a - academic use
Figure 14: Inverse Kinematics
Figure 13: Direct Kinematics
FANUC R-2000iC/165F
clc;clear;
format long
%% Direct Kinematics
% Please, enter the angles:
theta1 = pi/4;
theta2 = pi/3;
theta3 = pi/8;
theta4 = pi/8;
theta5 = 2*pi/4;
theta6 = 3*pi/4;
%This line (down) is not allowed to change.
q0 = [theta1; theta2; theta3; 0; theta4; theta5; theta6]; %Set rotati
Warning: floor tiles too small, making them 2.000000 x bigger - change the size or disable them
q_Solved =
[0.7854, 1.0472, 0.3927, 0, 0.3927, 1.5708, 2.3562]
Martix =
[0.7854, 0.7854]
[1.0472, 1.0472]
[0.3927, 0.3927]
[0, 0]
[0.3927, 0.3927]
[1.5708, 1.5708]
[2.3562, 2.3562]

Problem:

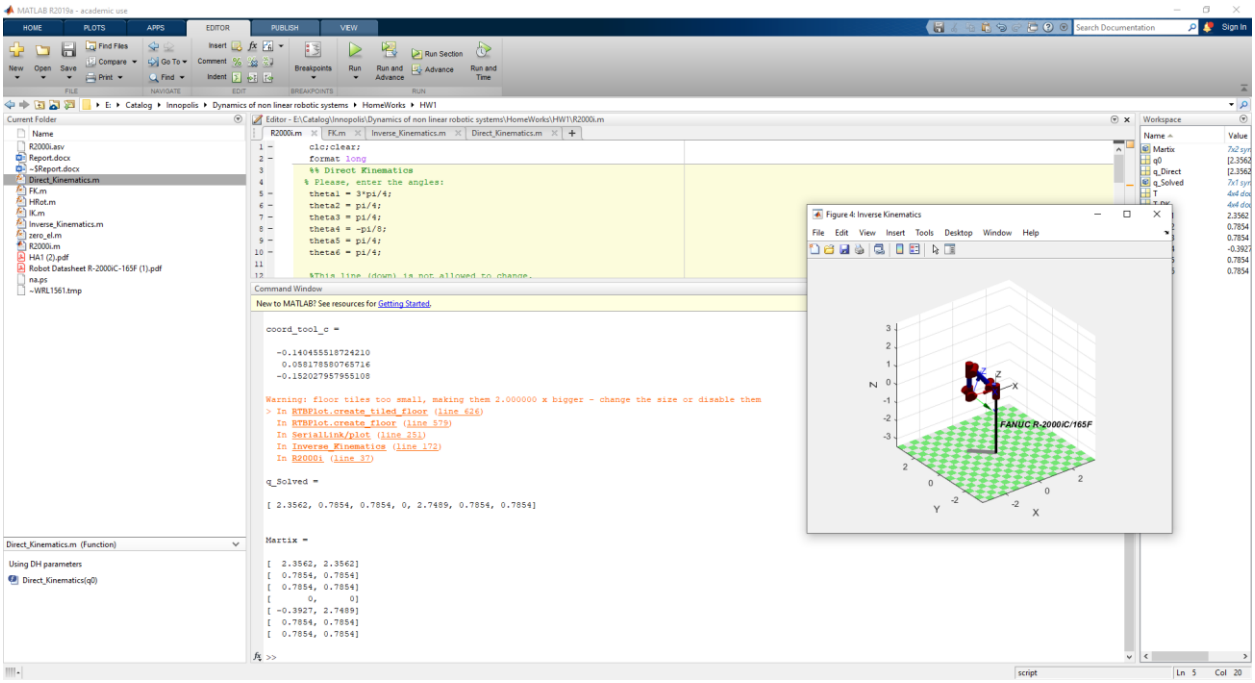


Figure 4: Inverse Kinematics
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