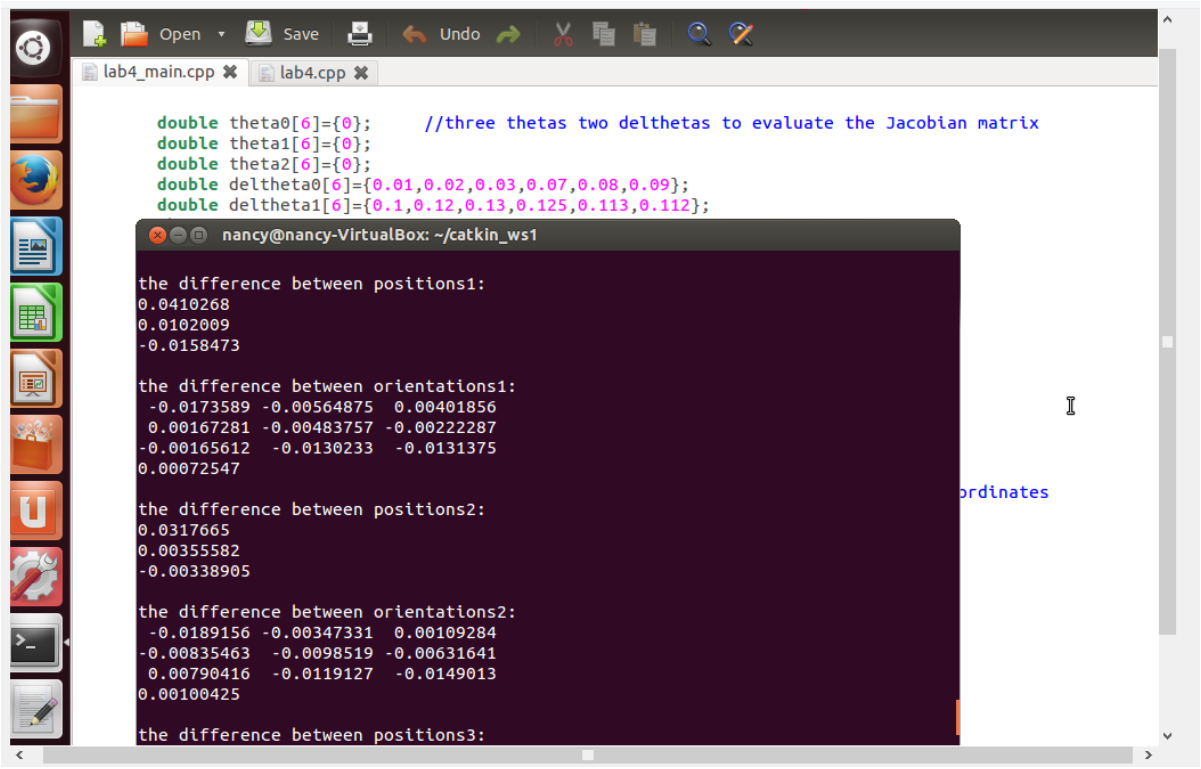
Lab4 Answer

The lab4.cpp contains the implementation of the functions Eigen::Matrix4f J and int inverse as required.

In the lab4_main.cpp, first using the inverse function to get a number of configurations which produce the same end-effector position and orientation as the chosen joint angles (3.3, 3.8, 3.5, 5.1, 6.1, 0.5), along with the number of solutions. In this case the number of solutions is 8, and these solutions and the number of solutions could be printed when simply run the lab4_main.cpp. Some other sets of joint angles have been chosen to test the inverse function, and they all produce the desired solutions. Please change the double qfoward into different values to test the function.

Then 3 different angles and 2 different small joint angles are chosen to test the J function. The cases of the first $\delta\theta$ (0.01, 0.02, 0.03, 0.07, 0.08, 0.09) acting on the 3 different angles are displayed in the code, and the screenshots of the result are listed below.


Open
Save
Undo
lab4_main.cpp
lab4.cpp
double theta0[6]={0}; //three thetas two delthetas to evaluate the Jacobian matrix
double theta1[6]={0};
double theta2[6]={0};
double deltheta0[6]={0.01,0.02,0.03,0.07,0.08,0.09};
double deltheta1[6]={0.1,0.12,0.13,0.125,0.113,0.112};
nancy@nancy-VirtualBox: ~/catkin_ws1
the difference between positions1:
0.0410268
0.0102009
-0.0158473
the difference between orientations1:
-0.0173589 -0.00564875 0.00401856
0.00167281 -0.00483757 -0.00222287
-0.00165612 -0.0130233 -0.0131375
0.00072547
the difference between positions2:
0.0317665
0.00355582
-0.00338905
the difference between orientations2:
-0.0189156 -0.00347331 0.00109284
-0.00835463 -0.0098519 -0.00631641
0.00790416 -0.0119127 -0.0149013
0.00100425
the difference between positions3:


nancy@nancy-VirtualBox: ~/catkin_ws1
0.00072547
the difference between positions2:
0.0317665
0.00355582
-0.00338905
the difference between orientations2:
-0.0189156 -0.00347331 0.00109284
-0.00835463 -0.0098519 -0.00631641
0.00790416 -0.0119127 -0.0149013
0.00100425
the difference between positions3:
0.037182
0.000930275
-0.0214699
the difference between orientations3:
-0.00435035 -0.00137765 0.00117623
0.00157362 -0.00343655 -0.00685424
-0.000798974 0.0104131 -0.000934578
0.000193417

In the screenshot, the difference between positions is the difference between $P_6^0(\theta) - P_6^0(\theta + \delta\theta)$ and $Jv\delta\theta$, and the difference between orientations is the 3*3 matrix A–B, while the last number is the norm of (A-B).

1. Question 4

   The answers to Question 3 show that while the difference of positions is larger, the difference of orientation could be small, and the smaller the original angles, the smaller the difference between the orientations. The accuracy of the implementation of Eigen::Matrix4f J function is not very high, according to the previous question.