EN.530.646:
Robot Devices, Kinematics, Dynamic and Control
Lab 2*

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Introduction

The main purpose of this lab is to be able to place and move frames in RVIZ from Matlab. ALL codes are to be implemented in Matlab files named **EXACTLY "lab2.m" and "screwvis.m"** and visualized using RVIZ.

Assignment

A Matlab class "tf_frame" is provided to place and move a frame in RVIZ (in the blackboard, Lab2 folder. Also you can find it in the Lab1 folder, "matlab files"). *Please read it through to understand functions you are asked to use in this lab* (e.g., the meaning of inputs of "tf_frame"). You are required to implement a Matlab script to show some different rigid body transformations.

- Launch "ur_simulation" using the instructions in Installation Instructions and Matlab.
- In your "lab2.m" script, don't forget to start with "`>> ur5=ur5_interface()`" in the beginning.
- Define three transformations in SE(3), `g0a`, `gab` and `gbc`, that are arbitrary and can be changed easily at the top of your lab2.m script to test your code. You can use the functions developed for Lab1 here.
- In lab2.m create one "tf_frame" called Frame_A, using "Frame_A = tf_frame(base_frame, frame_name, g0a)". It is recommended to choose 'base_link' as base frame.
- Create another frame, 'Frame_B' and position it relative to Frame A by `gab`.
- Create a frame called 'Frame_C' coincident with the base link. Then move FrameC by `gbc` relative to FrameB using "Frame_C.move_frame('Frame_B', gbc)". Note here 'Frame_B' is the string that is the name of the frame.

*This document was originally developed by Prof. Noah Cowan.

- Calculate `gac = gab*gbc`.
- Read the new pose of FrameC using "Frame_C.read_frame(ref_frame)". To numerical precision, is `gacreal = gac`? Why or why not? (Give a brief explanation in a pdf described below)
- Print a screenshot of the RVIZ environment that shows all three frames (A, B, & C) and the origin. Make this into a pdf and annotate it with arrows between the frames showing the transformations. You must show all three frames in ONE screenshot and annotate your plots clearly to show conceptual understanding.
- Repeat the previous step with different values for **g0a, gab, gac**. (Your pdf should have two different sets).
- Create a simulation of the screw motion with $\boldsymbol{\xi} = [1\ 0\ \frac{1}{2\pi}\ 0\ 0\ 1]^T$. Place a frame at the origin, and move a frame from the origin, along the trajectory of the screw, from $\theta = 0$ to $\theta = 2\pi$. Draw at least 100 intermediate frames so the animation looks reasonably smooth. You do NOT need to put a visualization of this in your report but the TAs will run you Matlab script. Please call this script "screwvis.m" and put it in the gradescop of Lab 2 (as described below).

Deliverables

- Well-documented Matlab scripts "lab2.m" and "screwvis.m"
- A report in PDF format.

Submission Guidelines

Submit your Matlab scripts "lab2.m" and "screwvis.m" and the pdf to "**Lab2**" on the *gradescope*. Check to verify that the files you hand in run. If your Matlab functions call custom Matlab m-files that you have written (for this course or otherwise) be sure to include *all* necessary files.

Have the two files (lab2.m and screwvis.m) ready to run - the TAs should simply have to hit "run" and everything should work. If not - you will lose points! Start early since problems can be tricky to debug. The TAs will be available during office hours to help. Also, there will be a severe deduction of points if submission guidelines are not followed precisely!

Please note that you have to include all files related to the current submission even though those files were part of the previous lab. Since the submission is done through the gradescope, this will definitely help to grade more efficiently. And it goes without saying if you find errors in your previous labs fix them and include in the submission with explanation!

If you have any questions about this please email the TAs (cc'ing the instructor, also posting on the piazza).