

Homework 2

Problem 1

A robot threads a nut onto a bolt with a pitch of 10 threads per inch parallel to the z axis and intersecting the $x - y$ plane at $[1'', 1'', 0]$. Find the twist coordinates ξ that describe the motion of the nut.

Problem 2

Find the twist coordinates ξ and $g_{st}(0)$ for all 4 manipulators in Figure 3.24, page 147, MLS (show your chosen base and tool frames, but please keep them parallel to those used in the book; i.e., z vertical, y to the right, x out of the page). In this problem, we assume there are no offsets between joints in x and z . Please label the offsets in y as l_1, l_2, \dots, l_n accordingly.

Problem 3

Find the matrix exponential $e^{\hat{\xi}\theta}$ for each of the six twists for the Stanford manipulator (Figure 3.24 iii) that you found in problem 2. Please calculate these by hand; **do not use** Mathematica or the equivalent.

Problem 4

Using **Mathematica**, derive the complete transform $g_{st}(\theta)$ via the product of exponential for all four manipulators in problem 2 (Figure 3.24). Copy and paste your code in the homework. The problem will be graded based on the setup of the twists and syntax of commands rather than the final output.

Hint: Read Appendix B in MLS for a brief description of Mathematica. Required package is provided in Canvas.