Robotics Assignment 2

Due: Friday 23-2 2024

Visit http://modernrobotics.org and obtain the pdf of the free preprint version of the text-book "Modern Robotics: Mechanics, Planning, and Control," Kevin M. Lynch and Frank C. Park, Cambridge University Press, 2017, ISBN 9781107156302.

NB Clearly explain your answers and always state the formulas and respective values for the variables you used to obtain your answer!

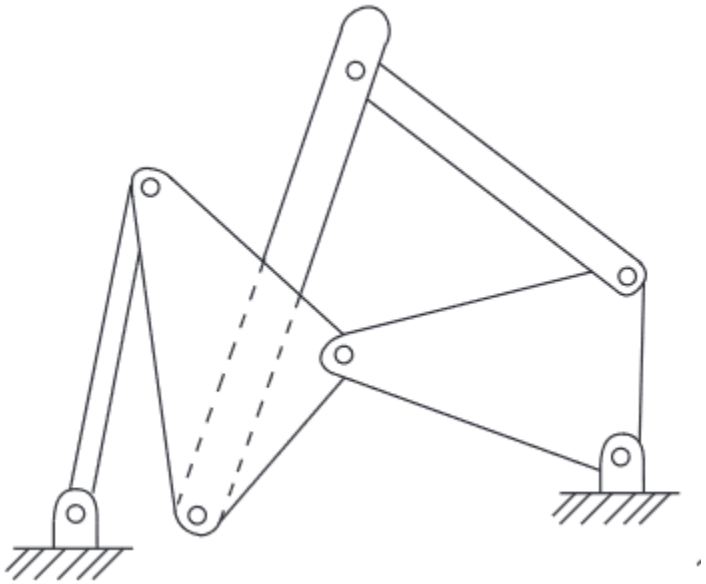
Submit your answers in a **pdf (no .txt or .doc file)** on **Brightspace**, state your name and student number.

Assignments

Read Chapters 1 and 2 of the text-book and answer the following exercises:

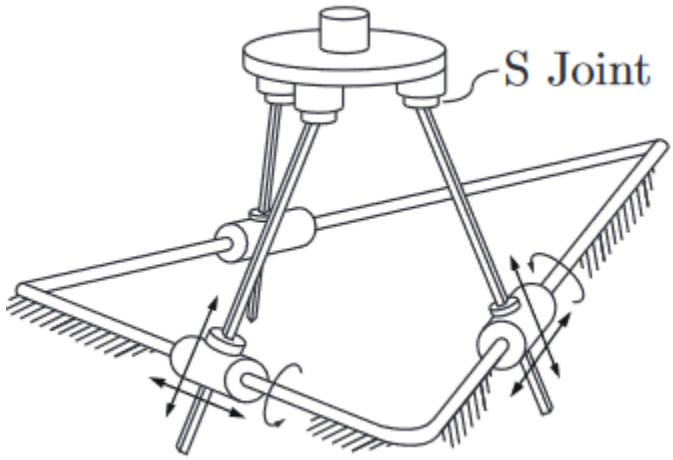
1. Derive a formula, in terms of *n*, for the number of degrees of freedom of a rigid body in *n*-dimensional space. Indicate how many of these dof are translational and how many are rotational. Describe the topology of the C-space (e.g., for n=2, the topology is R^2 x S^1, etc.). Note: consult Section 2.1 for methods to derive the formula.

2. Determine the degrees of freedom of the following planar mechanism:

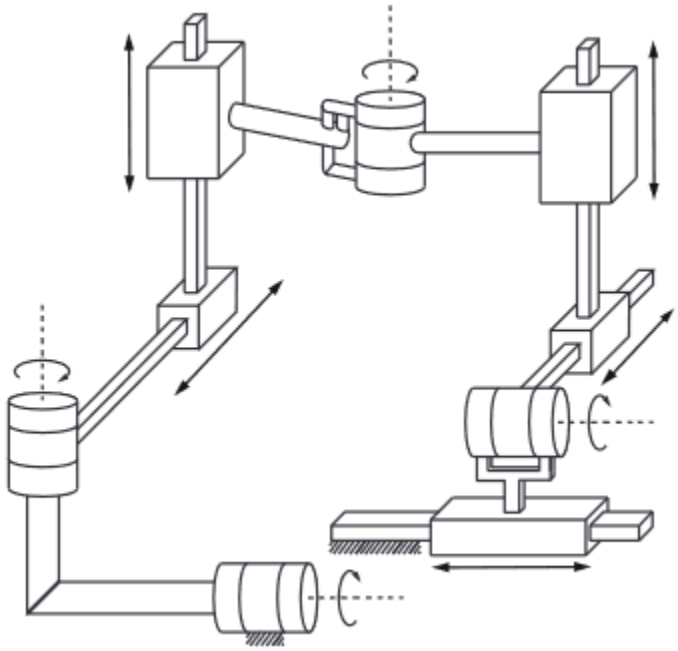


Do your results agree with your intuition about the possible motions of the above mechanism?

3. Determine the degrees of freedom of the following spatial mechanism:



4. Determine the degrees of freedom of the following spatial mechanism:



5. Design and draw a spatial mechanism that has at least 3 universal joints and has a degree of freedom equal to 3. Give the configuration space of your mechanism.

6. (Optional and Exploratory) There exist several tools to design, program and simulate basic electronic circuits using a controller board such as an Arduino or Esp32, connected to inputs (switches, potentiometers, sensors, etc.), and outputs (such as servo's, motors, and displays): https://www.tinkercad.com/learn/circuits , https://wokwi.com/ .
   Explore the Quick-Start Template by S. Fitzgerald (2013) for controlling a servo motor with an Arduino Uno and add 4 servos in a row that move their arms in a snake-like manner when turning the potentiometer. Add screen-shots of your program, circuit and diagram.json to your pdf.

Note:

Modern Robotics is accompanied with high quality video materials. You may also want to review:

Chapter 1:

- https://www.youtube.com/playlist?list=PLggLP4f-rq02hvwNGpSWJMqjZhLpuDM-Y

Chapter 2:

- https://www.youtube.com/playlist?list=PLggLP4f-rq01z8VLqhDC94W2nWpWpZoMj