

MCE/EEC 647/747

Homework 1 - Spring 2017

Due 2/2/17 at the beginning of class

1. (10 pt)

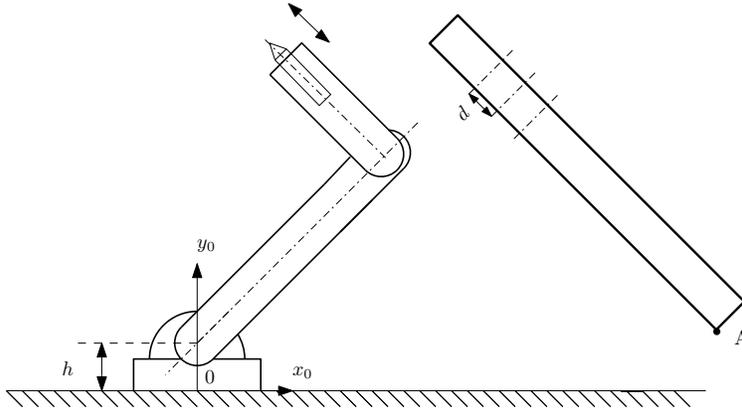
- (0 pt.) Read chapter 1 of SHV and chapter 1 of the Robotics and Automation Handbook (link to material provided in class).
- (10 pt.) Select any field of application that you find interesting (space exploration, medical, industrial, etc.). Then search for an applications-oriented article on robotics from one of the journals available through the CSU Library's Journal Finder, for example:
 - Robotica
 - IEEE Transactions on Robotics
 - International Journal of Robotics Research

The article must be from a technical journal (no magazines or online materials).

Prepare three slides for a 5-minute presentation focusing on the purpose of the robot/system described, the author's objectives, methodology and results.

2. (60 pt) The figure shows a planar two-link manipulator to be used for drilling holes on a workpiece. The holes must be equally-spaced and perpendicular to the length of the workpiece, as shown. The drill bit remains under the flat end of link 2 until the link has been positioned to drill the hole. Then, the bit extends from the flat end as much as necessary to complete the hole. You are asked to find the location and orientation of the workpiece so that the maximum number of holes can be drilled. Work with two cases:

- a. The second link has to be perpendicular to the workpiece and can be as far from it as desired (drill bit is very long).
- b. The second link has to be perpendicular to the workpiece and has to be 2 cm away from it or closer (drill bit is shorter).



Use the following dimensions: $h = 10$ cm, link 1 length (from joint to joint) = 40 cm, link 2 length (from joint to flat face) = 30 cm. Hole spacing = 2 cm. Assume that the workpiece is very long, and don't worry about the location of the first hole relative to the workpiece. Also, assume that the second link can be rotated through 360° and that the links are not allowed to have contact with the floor.

For your answer, give the world position of point A and the slope of the length of the workpiece, along with the number of holes that can be drilled with your solution. Solve the problem by analytical or computer means, but provide a very clear explanation and commented computer code if used. A computer animation will give extra credits and may be presented at the beginning of class.

3. (30 pt) Read chapter 2 of *Linear Algebra and Its Applications* by Strang, de-emphasizing or skipping sections 2.2, 2.4 and 2.5. Then solve the following problems:

- Set 2.1, ex. 3 (p. 82)
- Set 2.3, ex. 2 (p. 110)
- Set 2.3, ex. 13 (p. 111)
- (Doctoral students only) Set 2.3, ex. 28 (p. 113)
- Set 2.6, ex. 6 (p. 149)
- Set 2.6, ex. 36 (p. 152)
- Review set, ex. 1.22 (p. 157)

Only 3 problems will be graded.