ME 380: Kinematics and Machine Dynamics
Grashof Criterion

1 How to use this assignment

In this assignment, students will learn various how to classify fourbar mechanisms using Grashof criterion.

- The instructor will provide questions and provide intermittent help.
- This activity provides the opportunity for the students to learn the classification of fourbar mechanisms. It also provides practice for the transmission angle concept.
- Students will spend approximately 30 minutes on this activity.
- This activity will be submitted and graded.

2 Learning objectives

After completing this assignment, students will be able to

- Students will be able to apply to Grashof criterion to four-bar mechanisms.
- Students will be able to identify and compute transmission angle.

3 Assignment completion instructions

1. Planning
    - What will the instructor need before the activity?
    - What will the student need before the activity?
        - Pencil and paper
        - Calculator
2. Source material(s) for the activity
    - Lecture notes
    - Resources placed on Piazza.
3. Introduction and warm-up practice activity for the students
    - Introduction and instructions
        - Think about the triangle inequality.
        - Recall the definitions of drag-link, crank-rocker, double-rocker, change-point mechanisms.

- Warm-up and practice
  - Brainstorm
  - Think, pair, share: Think about the definition of the transmission angle and its meaning.

4. Main activity
   - Students can submit a soft-copy via email or hand-in a hard-copy per group.
   - This activity graded.
5. Wrap-up / reflection
   - Peer review
     - Have a neighboring group review your work.
     - Neighboring group should provide opinion about whether or not the solution and its development are correct.
     - After the peer review is done, the owner group tries to incorporate the suggestions and improve the solution.
   - 3-2-1 Countdown
   - One-minute paper

4 Conclusion and moving forward

This activity is aimed to teach the students the classification of fourbar mechanisms. It also deals with the concept of transmission angle.

5 Grading criteria

- Preparation
- Critical thinking
- Technical expertise
- Adherence to assignment guidelines
- Timeliness

5.1 Peer reviewer notes

1. Check if the mobility of the given mechanism is correct.
2. Check if the transmission angle is identified and correctly computed.

5.2 Preparation and content

Students can prepare for this assignment by reviewing the lecture notes. Specifically, students should review …

5.3 Creativity and communication

Students should be able to explain their thinking process to a fellow student in order to make sure that they have learnt the material.

5.4 Critical thinking

Students should recall how to manipulate inequalities.

5.5 Engagement with topic

Every student should be able to and attempt to explain how they think about the problem to a fellow student.

5.6 Technical expertise

Calculus 1

6 Questions

1. [15 points] For each of the following set of link lengths

   (i) $l_0 = 1$, $l_1 = 3.25$, $l_2 = 1.5$, $l_3 = 3.5$

   (ii) $l_0 = 2.5$, $l_1 = 1$, $l_2 = 2.5$, $l_3 = 2$

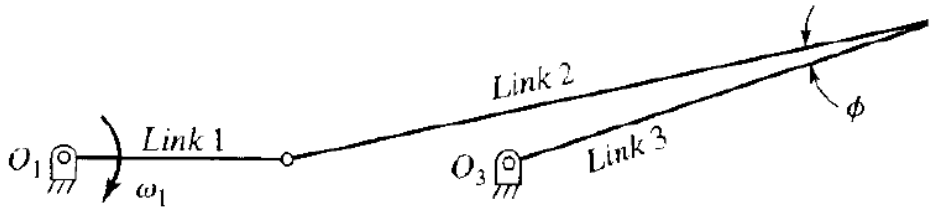

Figure 1 – Four–bar Mechanism

   (a) [5 points] Determine whether the links can actually form a mechanism with the dimensions given.

   (b) [5 points] If a mechanism exists, identify the motion relationships (crank-rocker, drag-link, double-rocker, triple-rocker or change point)

   (c) [5 points] Show the limiting positions if the mechanism is a crank-rocker, double-rocker, or triple-rocker mechanism.

2. [18 points] Find the range of values of the unknown link length, l_3, for $l_0 = 120$, $l_1 = 220$, $l_2 = 80$, if the linkage will theoretically act as

   (a) [3 points] a crank-rocker mechanism (where link 1 rotates through 2π)

   (b) [3 points] a drag-link mechanism

   (c) [3 points] a double-rocker mechanism

   (d) [3 points] a change-point mechanism

   (e) [3 points] a Grashof mechanism

   (f) [3 points] a triple-rocker mechanism

3. [15 points] Let $l_0 = 150$mm, $l_1 = 110$mm, $l_2 = 150$mm, find the length of the link l_3 so that the linkages form a crank-rocker mechanism and the transmission angle falls between $\frac{\pi}{4}$ and $\frac{3\pi}{4}$.