01.110: Computational Fabrication Summer 2017

## Lab 4: Computational Linkage Design

Overview

In this lab, you will create physical models of the linkage models you designed in Assignment 3, Exercise 4 (Computational Linkage Design Using SolidWorks), and/or you will create physical models of different types of serial/parallel linkages.

Equipment

- One Acrylic sheet of 3 mm thickness to fabricate the parts of your linkage,
- bolts of 3 mm diameters and nuts to connect the parts of your linkage

### Use SolidWorks to design the linkage

- You will be using SolidWorks to Design the linkage as in assignment 3, exercise 4.
- For a 3 mm bolt diameter, make a 4 mm diameter hole on your part/link. So that the bolt fits snugly into the hole to construct a good revolute joint.
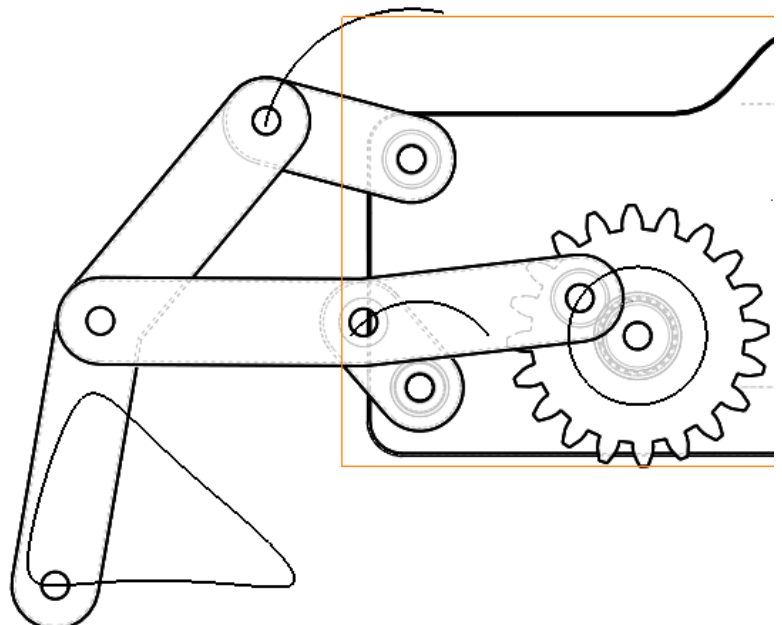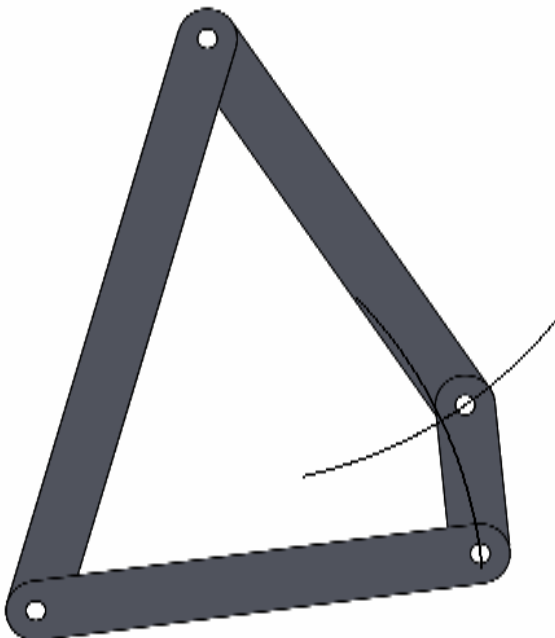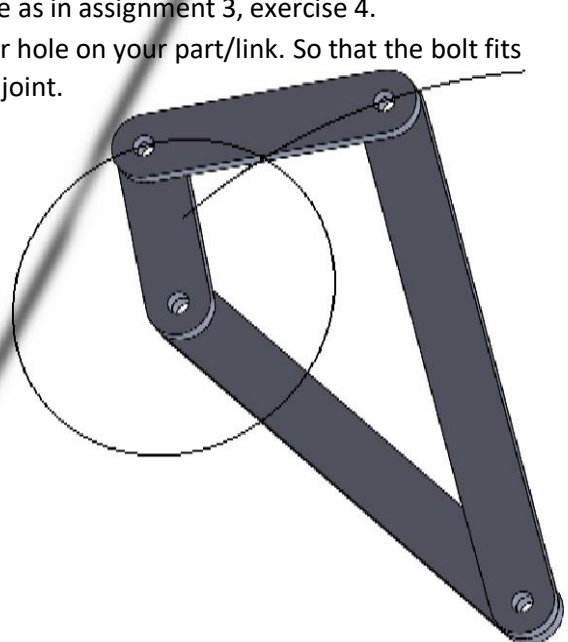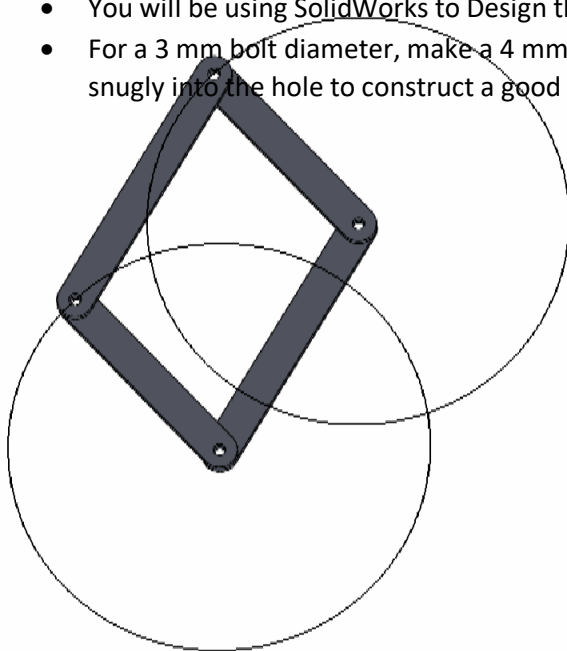
- A collision detection needs to be checked in SolidWorks (manually or preferably using ''Motion Analysis''). You must put the links/parts in different layers so that they do not collide. For example, the following layering order-giving in figure below- works well. You can use spacers if you want some space between two links/parts. Note, however, that the bolt lengths (16mm) are limited to 2, 3, and 4 layers, which are equivalent to 6mm, 9mm, and 12mm.

Create an assembly SolidWorks file

Using an assembly SolidWorks file for your links/parts, and mates the links/parts on the same plane within the area of your acrylic sheet with safety margin.

Acrylic sheet area

10 mm
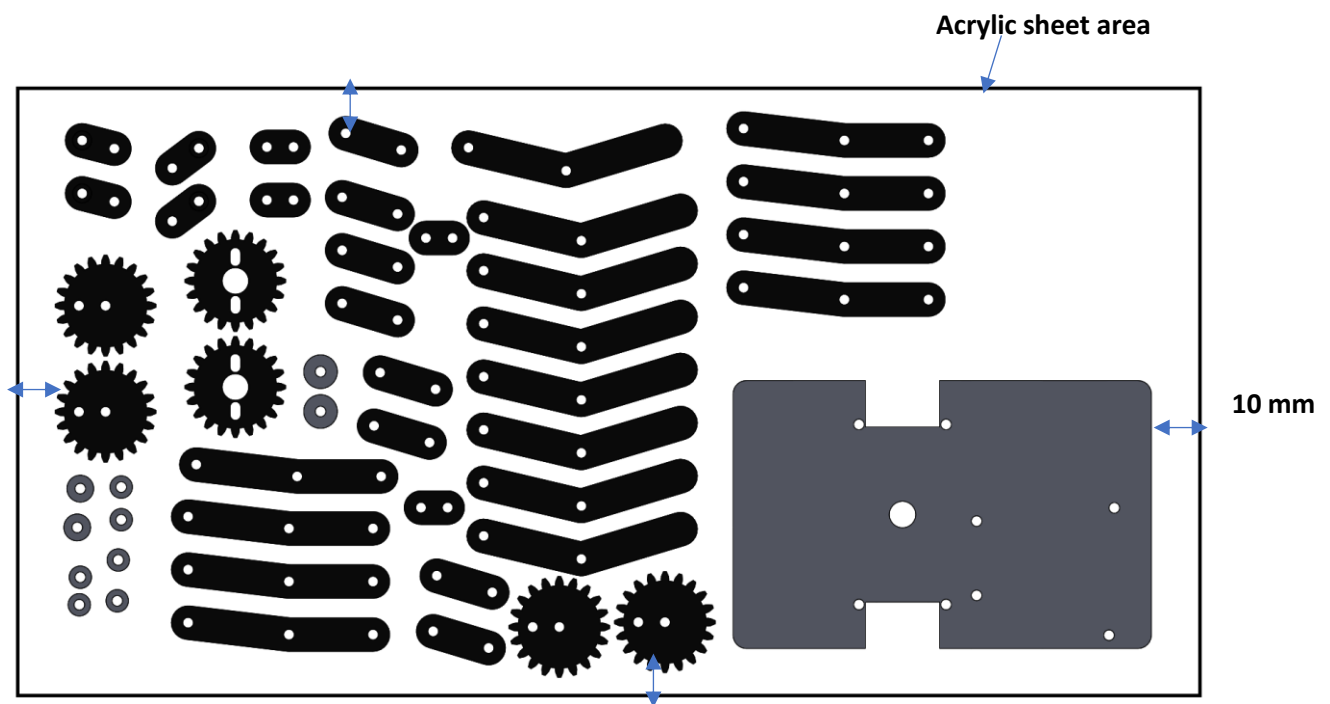
Create a DXF file

Save your SolidWorks assembly file as DXF file.

Load the DXF file into CorelDRAW

- Open CorelDraw, start with a new document, then import your dxf file (file → import)
- The place where you position your file (drawing/links/parts) corresponds to the laser head start position of the laser cutter machine
- Select everything in the scene, go to the right-hand panel in object properties, and change the stroke width to ''Hairline''.
- Choose RGB Red color if cutting, and RGB Black if engraving
- Save this as a CDR file.

Laser head start position

Laser cutter area
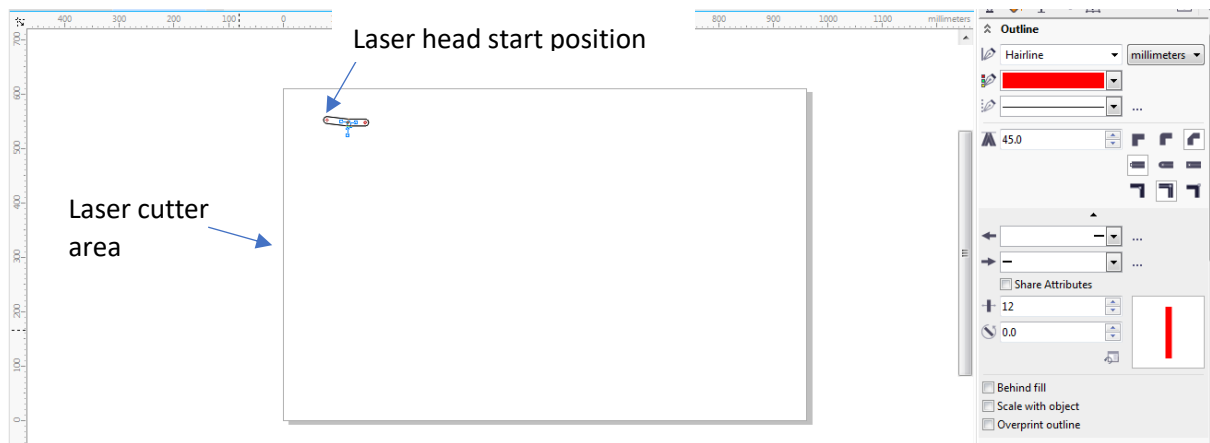
Print the parts/links

- To print (file → print)
- Under general tab, choose between current document or selection
- Under layout tab make sure as in document is selected
- Next select preferences
- In option tab, choose load for cutting and engraving settings or choose from history file (acrylic 3mm)
  - To find settings (desktop → user parameters)
  - Select the appropriate settings for your material (in this case, acrylic 3mm)
- Under pen tab, you can check settings (speed, power, PPI)
- Under advance tab,
  - Position → home
  - Vector function → normal or inside out cutting
- Under paper tab select (X=960, Y=610): the laser cutter area
- OK once finish,
- Preview, apply, then OK to send file to the laser machine
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Laser cutter machine

- Use manual probe (place it in the laser heat slot) to set the z-height
- Use display panel up/down to raise and lower the laser table
- Ensure the tip of the probe just touches the surface of your material
- To return the laser head to its home position
  - Function – F4
  - Recall – F4
- To scroll through print jobs
  - Previous – F1
  - Next – F2
- Check the settings of your print job against the recommended settings
- When ready to start your print job: start/stop (you can check whether the laser head starts from the correct position by pressing the start button while leaving the protective door of the laser machine open)
- Pausing and resuming during your print job

- To completely stop/restart your print job: start/stop

Assemble the parts

At each pin, pick one link to fix the bolt to. In general this should be the link in the lowest layer. For example, in the four-bar linkage bellow, the bottom two bolts were fixed to the base, the top-left bolt was fixed to the left link, and the top-right pin was fixed to the right link. You may want to reserve space so use can use the bolt as a handle for the driver link (e.g., the top-left bolt in the example figure).
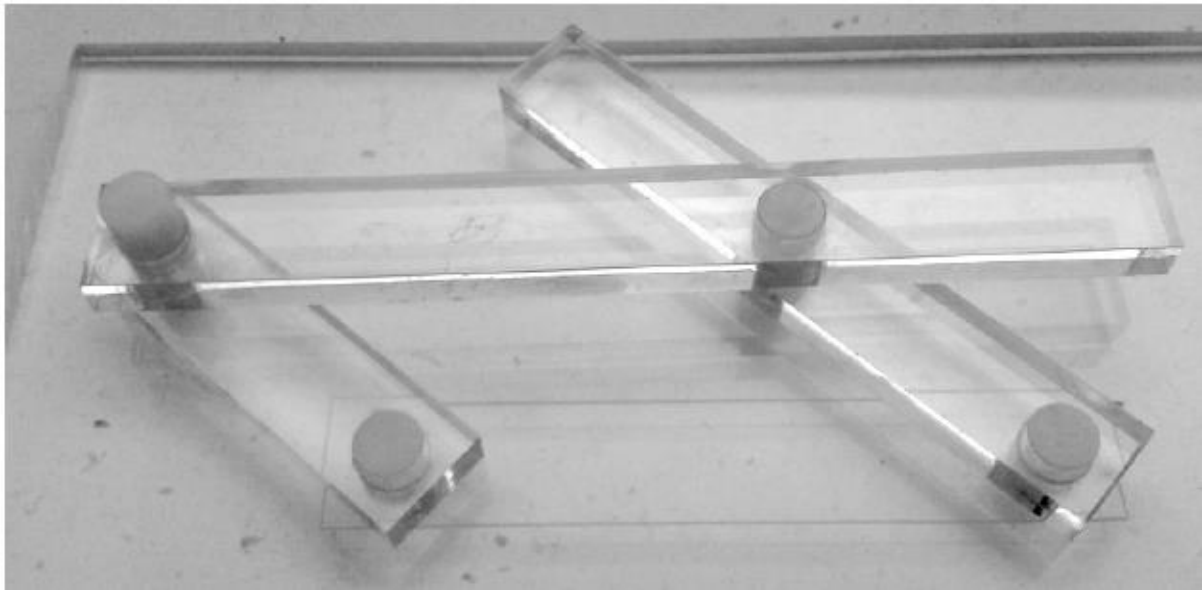
Submission

Submit your assignment on e-dimension. Please submit:

- A write up for your group in either a text file or a pdf file. Describe any difficulties/experiences during the laser cutting and assembly.
- Take short videos of your mechanisms (e.g., with your phone).
- Write down the names of your group members.