SAMS 2018

Mechanisms in Motion

Motor and Crank Units

This lab is adapted from the Hummingbird Robotics Kit web pages
https://www.hummingbirdkit.com/teaching/sketches/laser-cut-mechanisms

In this lab, we will be cutting out and assembling the crank unit that will drive all the mechanisms we make this week. The overall plan is:

1. In RDWorks, personalize your motor and crank units so you know which ones are yours.
2. Download your files to the laser cutter and cut the parts for your motor and crank units.
3. Break: play with linkages, movement, and characters
4. Assemble your motor unit using hot glue and care.
5. Assemble your crank unit using hot glue and care.
6. At the end of this unit, you should have an assembled motor and crank.

1. Motor unit

1.1 Import the motor file

Open RDWorks and **Import** the motor.dxf file you received in email earlier today. You should have the following pieces:
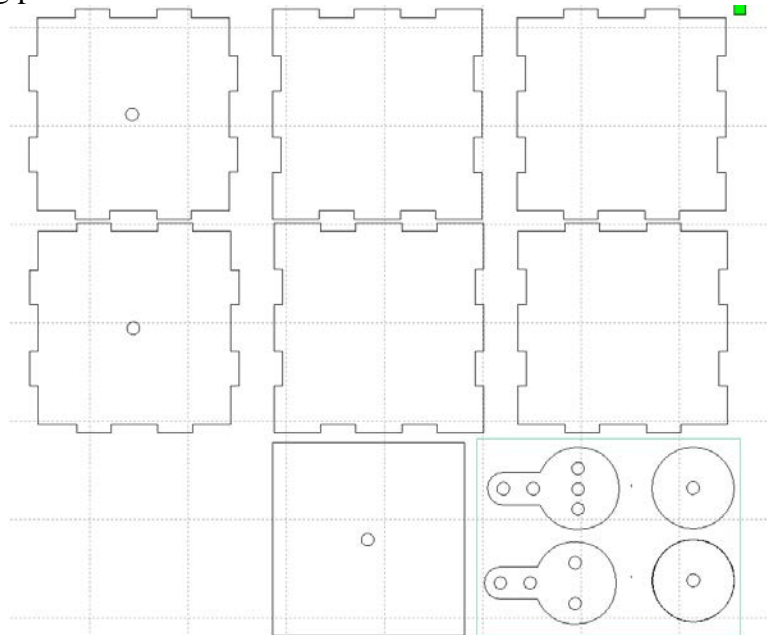

The seven squares go together to create a box with a middle support. The holes are for the axel that goes through the center of the box. The other four parts will connect the axel to the handle and to the other mechanisms that we create this week.

1.2 Personalize your motor unit

In RDWorks, select **Draw** → **Text** or click the Text button (f I) in the left hand column. Position the text cursor on one of the sides that doesn't have an axel hole. Type your name or your initials. Since you need to etch, not cut your name, you need to change the color of the text. While your name is still selected, click on the Blue box in the color bar at the bottom. Your name should now be blue.
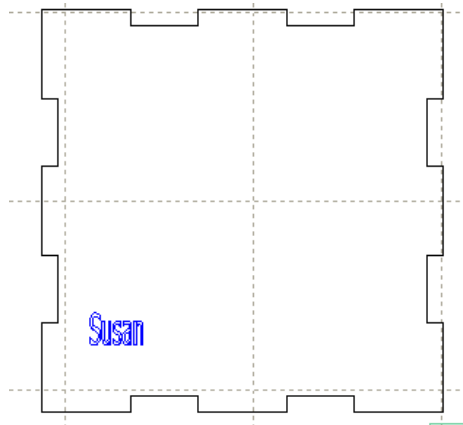
1.3 Set the parameters for the cut and scan layers

You should now see a blue layer in the box on the right-hand side of the RDWorks window. Let's change the settings to cut the black outline and etch the blue text. Double click on the blue layer to bring up the layer edit box. Change the blue layer to *scan* (aka etch). Set the speed to 400 and the power to 5.
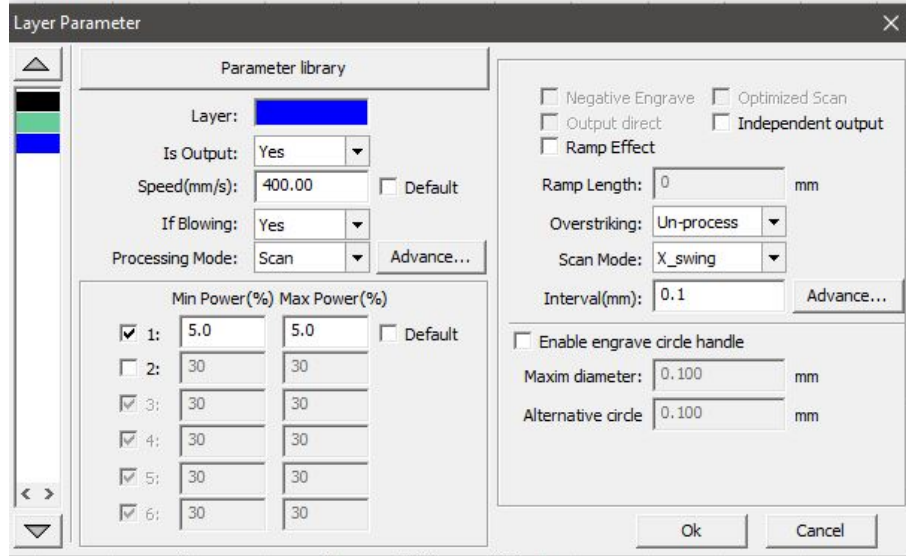
Switch to the black (cut) layer by clicking on the black box in the left-hand panel. Change the speed setting to 30 and the power setting to 30. Click OK.

In the upper right of the main window, you should see that the blue layer is now a scan layer. Since you should always scan before you cut on the laser cutter, use your mouse to drag the blue layer to be the first layer:


1.4 Save your motor file

Finally, save your file on your desktop (or somewhere where you can find it). Include the word "motor" and your first or last name in the file name since we'll be putting the files together on USB sticks. The file type should be **rld**, which is a native file type for the Rabbit laser cutters.
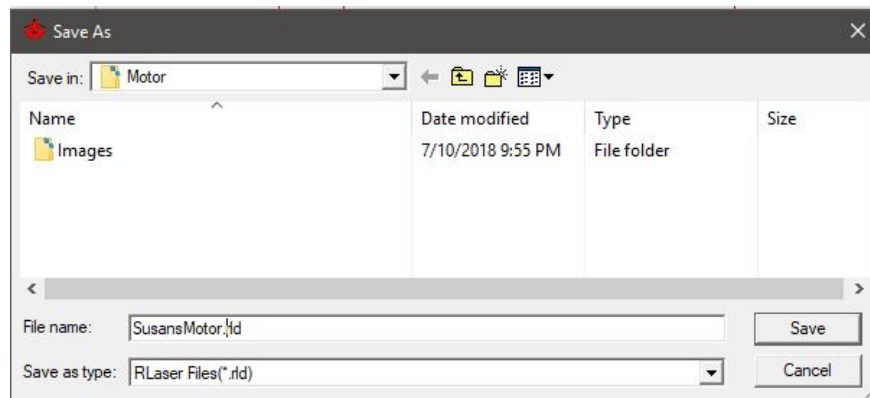
2. Crank unit

2.1 Open the crank file

Next, we will follow the same steps for the crank unit, crank.rld, which you also should have received in email. First, select **File → New** to clear out the motor file. Then select **File → Open** and select crank.rld. The file should look like this:
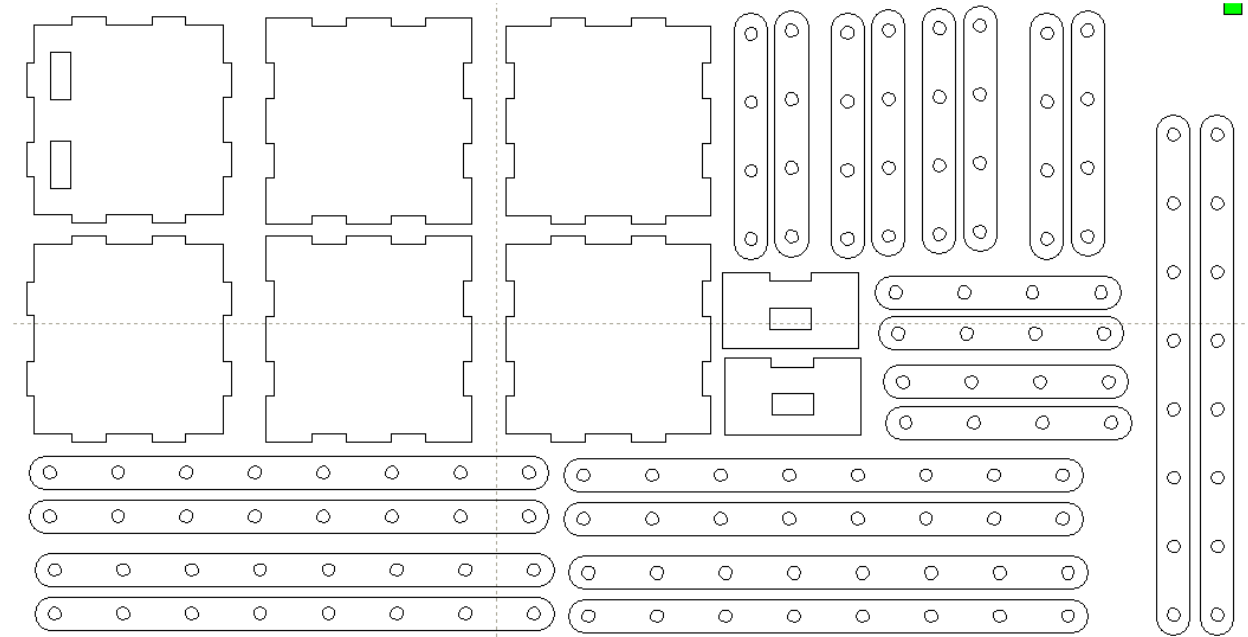
This is another 6 sided box, a guide for a crank, and lots of linkages - one of which will be used as a crank.

2.2 Personalize your crank box

Add your name to any of the sides except for the one with slots in it. Make the text blue again.

2.3 Set the parameters for the cut and scan layers

Make the blue layer a scan layer with speed 400 and power 5. Set the black layer to cut with speed 30 and power 30. Move the scan layer to be the first layer.

2.4 Save your crank file

Save your file on your desktop (or somewhere where you can find it). Include the word "crank" and your name in the file name.

3. Laser cut your parts

Put your rld files and your partner's rld files on a USB stick. We'll head into the laser cutter room to cut all the files. Be sure you take your bin with you so the parts don't get mixed up.

4. Assemble the motor unit

To assemble your motor unit, you will need:
- The parts from the motor.dxf file
- An axel, a handle, and a connector
- A partner
- A shared hot glue gun

First, put the parts together by hand so you can see how the box is formed. Note that the sides with notches are not all the same - some are innies and some are outies. We will use the B units for the top and bottom and the A and C units for the sides.
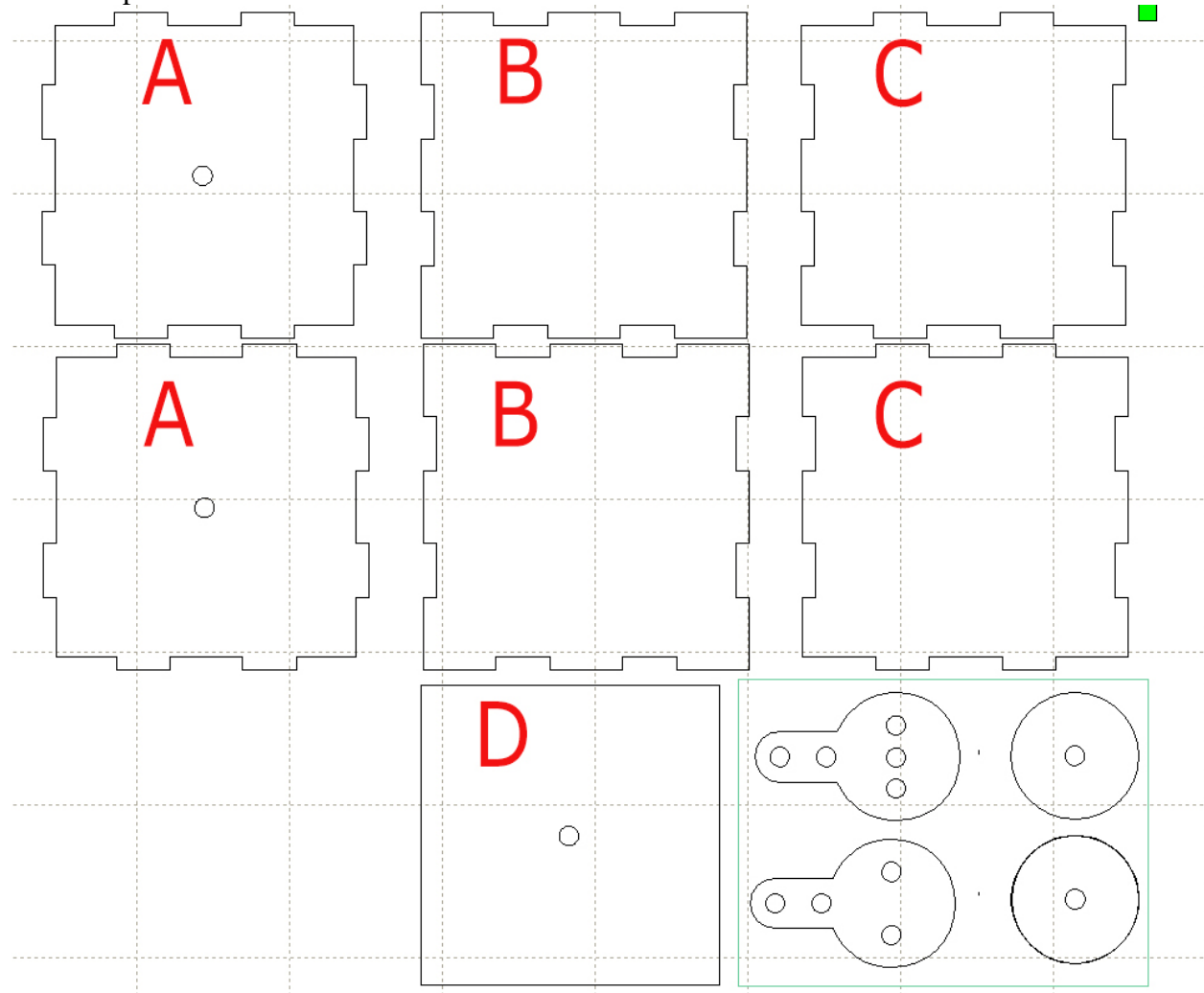
Note: You will not glue all of the sides because we want to be able to change some of the innards. We will leave one of the sides with hole unglued and we will leave the top unglued.

Take one each of the A, B, and C pieces and assemble them using the hot glue gun. Check the picture below to be sure you get them in the right orientation.

Add the other C piece opposite the first one. In the picture above, it would be the right-hand side of the box.

Press fit (**do not glue**) the second A piece so you have a box with an open top.

Now glue the D piece into the middle of the box being sure that the holes align.

Next take the pieces for the driver (That's the banjo shaped piece)

We are going to double up the cardboard to be sure it is stiff enough. Glue the two circles together: ((I'm not sure why one of the circles below doesn't have a hole. Both your circles should have holes.)

Next glue the banjo shaped pieces together to make the driver.

Glue the circles to the driver. The final assembly is 4 layers thick. Note that the hole in the circles does not line up with any of the holes in the driver.

Repeat this process for the second driver.

Finally, insert a dowel through the holes in your box and press fit a driver on each end.
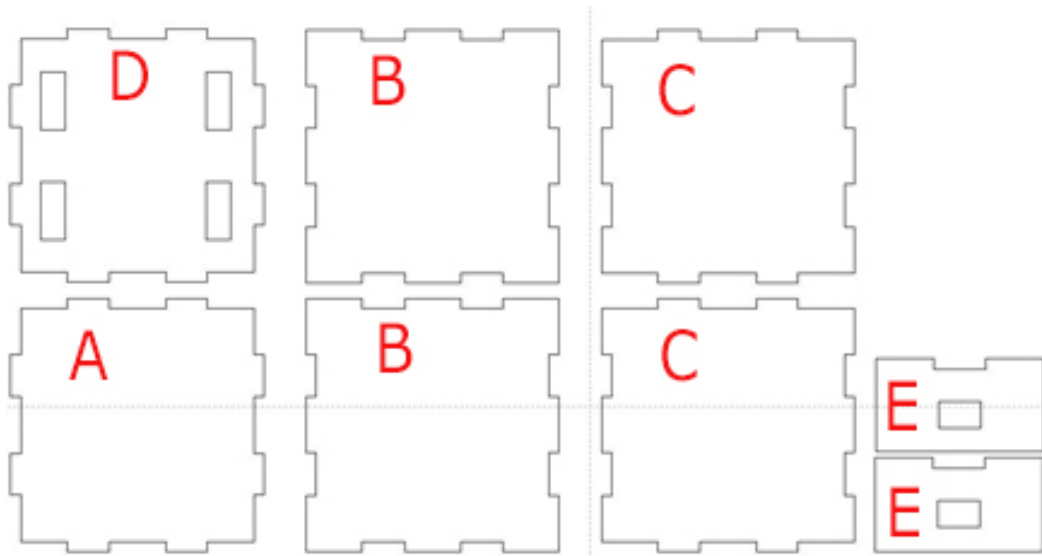
5. Assemble the crank unit

To assemble your motor unit, you will need:
- The parts from the crank.rld file
- Some connectors
- A partner
- A shared hot glue gun

First, put the parts together by hand so you can see how the box is formed. We will use the B units for the top and bottom and use the A, C and D units for the sides. The E units form the guide for the crank.

Assemble and glue this box the same way you did for the motor unit. The differences are that the special side has slots instead of a hole and you can glue everything because we won't need to get inside this box.

To make the guide for the crank, glue two E pieces together.

To make a linkage, glue two of the long pieces together. Be sure the holes line up. Make 2 or 3 linkages of each length.

Insert the tabs of the guide (E) into the slots in piece D.

Finally, attach one of the longer linkages to the horn on the motor unit using a connector pin. Place the crank unit on top of the motor unit and put the linkage through the guide. You now have a crank!