SOP: M100 Microfluidic 3D Printer

Purpose: Print various-sized microfluidic devices

NOTE: These are abbreviated instructions for the M100 Microfluidic 3D Printer. The full manual for additional details and functionalities can be found in the laptop (CADworks3D Training Package folder >> Documentation).

Location: BHE B8 (main area)

PPE: flame-resistant lab coat; nitrile gloves; long pants; closed toe shoes

Protocol for Use:

1. Turn on the 3D printer by pressing the power button on the top of the instrument and wait until the top display indicates “Ready No Network” and the bottom display indicates “Click to Reconnect” (**Figure 1**).

Figure 1: The indicated displays on the 3D printer after system powers on.

2. Press the right-side of the door and open to see the inside of the 3D printer.
3. Ensure that the metal buildplate is properly secured (lever is in the “down” position) and the vat has enough resin (close to the “bottom” step) (**Figure 2**). Close the door when done.
4. Turn on the laptop that is labeled “3D Printer Utility” by pressing the power button on the top-right corner.
5. Connect the ethernet-to-USB adapter to the laptop.
6. Double-click the “Utility” application on the desktop.
7. The main display will have the printer name, layer thickness, grid, and print setting. The teaching assistant will specify the print setting. Afterwards, click “Ok”.
8. The pop-up will disappear and a three-dimensional workspace will be present. Double-check that the top display of the 3D printer now indicates an IP address.
   a. The bottom display might still indicate “Click to Reconnect”, but after some time, it will change to a CADworks3D video.
9. Drag the desired CAD file (.stl format) into the workspace. The design will be displayed on the workspace.

10. Ensure that the design is positioned flat on top of the XY plane. If not, click on the design (color turns from gray to blue-green) and use functions such as “Rotation” and “Put the Object to Ground” on the right-hand side.
    a. An example is given to demonstrate the procedure of rotating and positioning the design flat on top of the XY plane (**Figure 3**).
    b. Unfortunately, the design itself cannot be rotated via mouse. Change the X, Y, and/or Z values by -90/+90 (units are in degrees) to incrementally rotate the CAD.
11. Once the design is properly rotated and positioned, click the “Printer” icon (displayed in Figure 3). A pop-up stating “Enter semi-auto mode?” will show. Select “No”.
12. An “Export Slices” save display will show, and the default “Save as type” will be “SLC (.slc)”. Select the appropriate folder to save the .slc file and click “Save”.
13. Another pop-up stating “Slicing Completed; All layers sliced and slc file saved” will show.

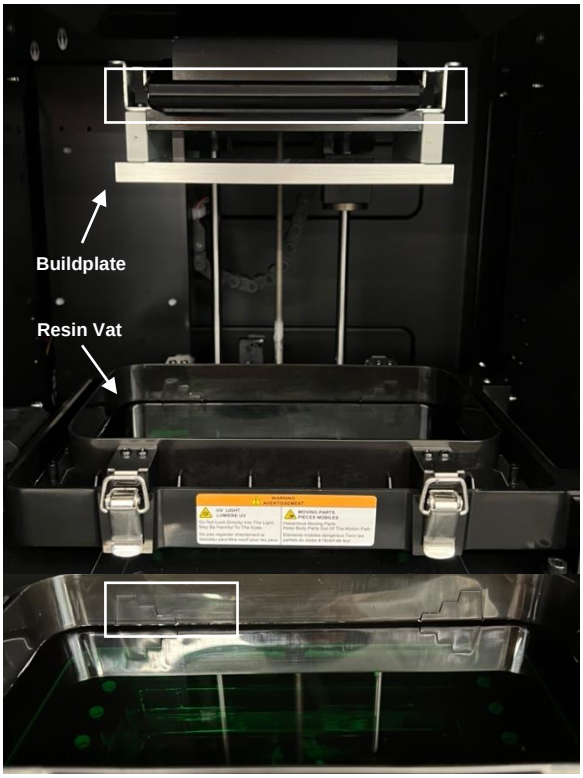

Figure 2: *Top*: Inside of the 3D printer with the buildplate and resin vat. White box indicates the “down” position. *Bottom:* Resin is filled close to the “bottom” step (white box).

14. Then a “Printer” display will show with printer name, input, output, estimated time, layer thickness, and printer setting.
15. Convert the .slc file to a .mii file by clicking “Convert”. Once the green bar reaches 100%, click “Launch to Printing” and a MiiCraft browser will open.
16. Click the finger icon to select the .mii file, which is in the same folder as the .slc file. All the settings are configured for this particular experiment, so click the “Print” button to initiate the process.
17. The top display of the 3D printer will indicate “Platform moving; Downward” as the buildplate is slowly lowered into the resin vat. Once the printing process initiates, both the top display of the 3D printer and the software will display the time required for printing.
18. After the printing reaches completion (“100%” on the software; “Print Finish” on the top display of 3D printer), wait 5 minutes for the residual uncured resin to drip off the microfluidic device.
19. Carefully remove the buildplate by shifting the lever to the “up” position and then pulling out the buildplate. Invert the buildplate (microfluidic device facing up) and place on top of an absorbent mat layered with aluminum foil.
20. Use a razor to carefully lift and loosen the corners of the microfluidic device and then use the metal spatula to detach the device from the buildplate. Place the device into a bath of isopropyl alcohol, as explained in the protocol.

21. Clean the metal spatula and buildplate by wetting paper towels or Kimwipes with isopropyl alcohol and wiping away the residual resin. Once cleaned, place the buildplate back inside the 3D printer and move the lever down to secure it.
    a. Pay close attention to the surface of the buildplate and use the metal spatula to scrape away any solid residues.
22. On the software, click “Finish” and then close the software. Unplug the ethernet-to-USB adapter from the laptop and shut off the computer. Finally, turn off the 3D printer by pressing the power button once and then holding the power button for five seconds.

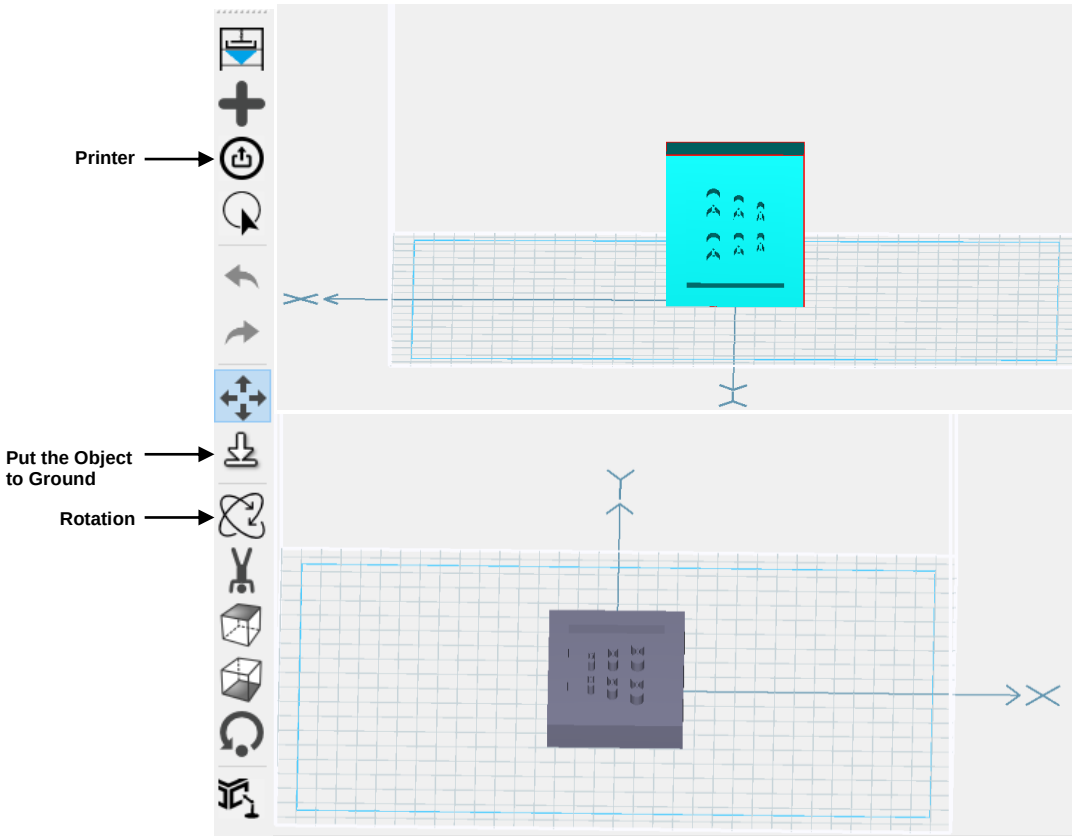

Figure 3: An example CAD file that needs to be rotated and positioned flat on the XY plane. The “Rotation” function rotates the design from a standing position to a flat configuration. The “Put the Object to the Ground” function positions the design directly on the XY plane. The “Printer” function converts the .stl file to a .slc file.

Maintenance Schedule:

With each use: clean the metal spatula and buildplate with isopropyl alcohol and ensure that the lever is at the “down” position.

Contact Information:

Lab Manager: Nathan Cho, BHE B9, (213) 740-2093

Professor: Megan McCain, DRB 140, (213) 821-0791

Vendor Information: CADworks3D, (416) 368-7266, info@cadworks3d.com

Sales Representative: Hemdeep Patel, sales@creativecadworks.ca