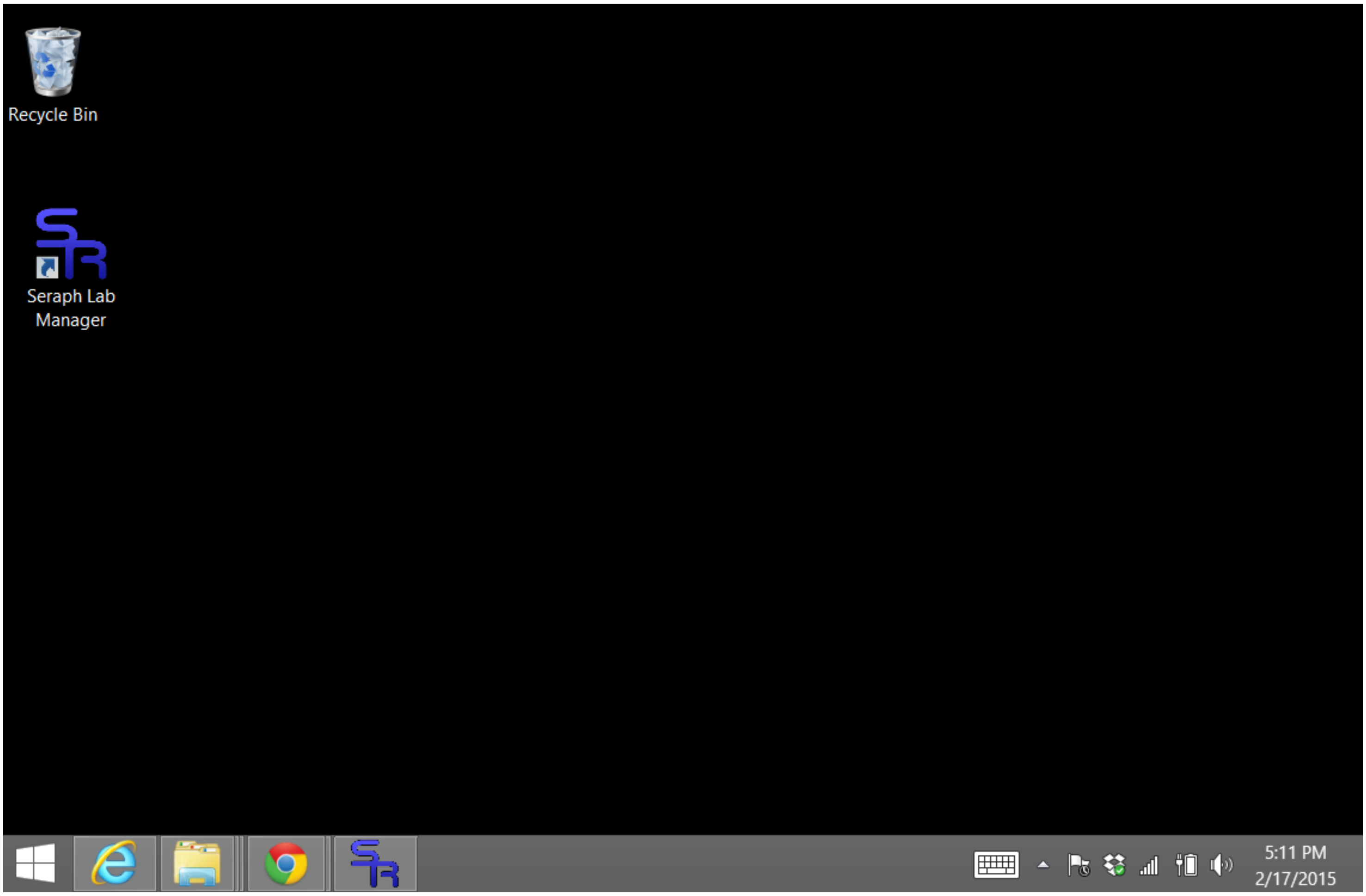
Software Guide

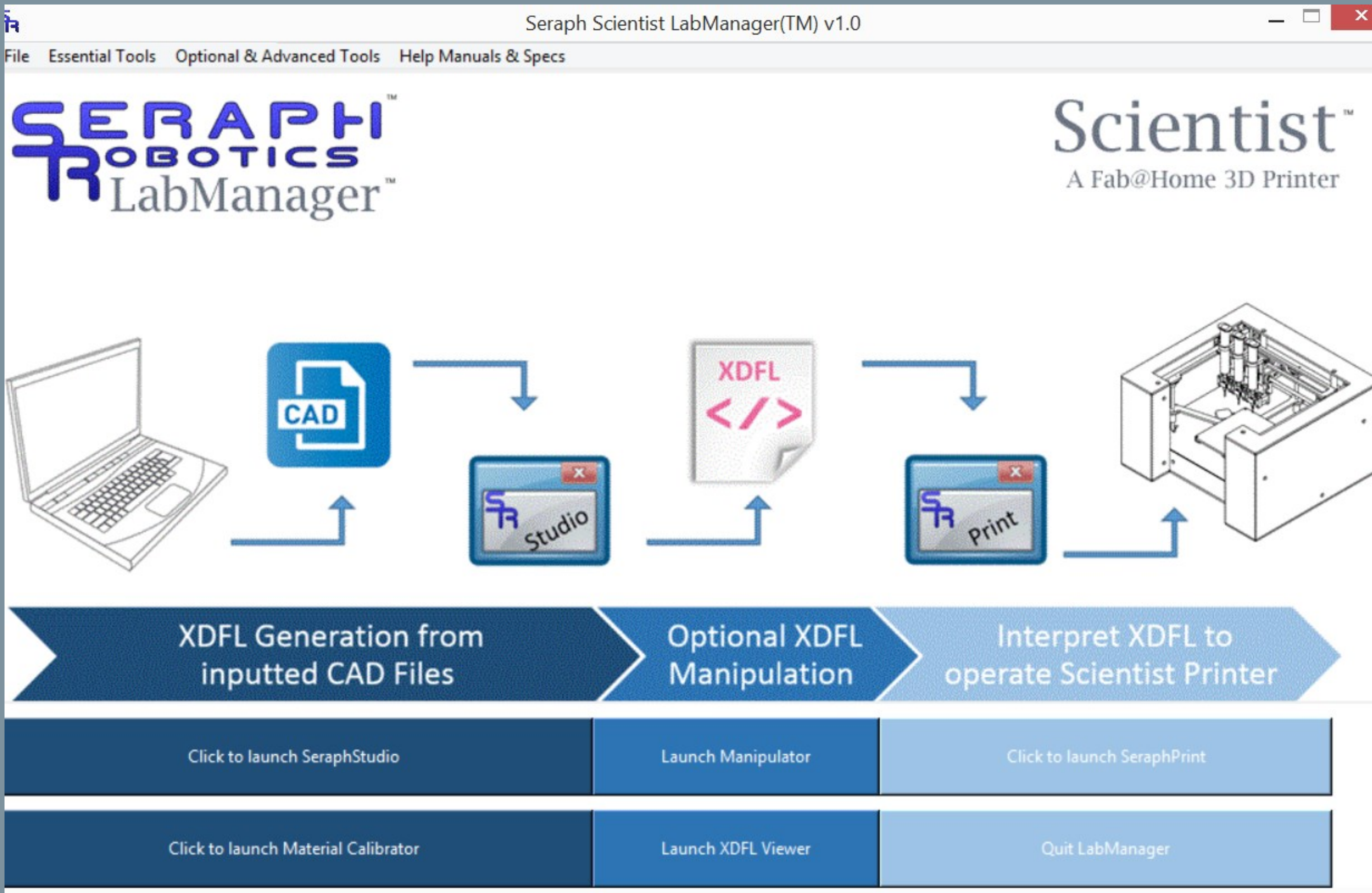
Installation Instructions

Visit the provided web link

Or scan this QR Code to download our software.

Double click the installer and then the SR icon to launch Lab Manager ™





With the Scientist™ , Seraph introduces Lab Manager™ , our centralized 3-D printing control suite. Use the Lab Manager flow chart to guide your 3-D printing experiments from computer concept to printed reality.

Begin by using the Calibrator ™ tool to calibrate your material and generate a "tool script" file unique to that material's settings.

Then, launch SeraphStudio ™ to import STL files for processing.

For most users, the easy-to-use, advanced features of **SeraphStudio**™ will provide all of the tools they need to conduct both simple and complex 3-D printing procedures. However, for more advanced users, Seraph introduces **Manipulator**™ which allows for the batch combination and editing of multiple processed STL files (XDFL files).

If you've created a complex printing job and would like to view a digital representation of the past the printer tool head will follow, launch the **XDFL Viewer** to scroll through the various layers in your print job.

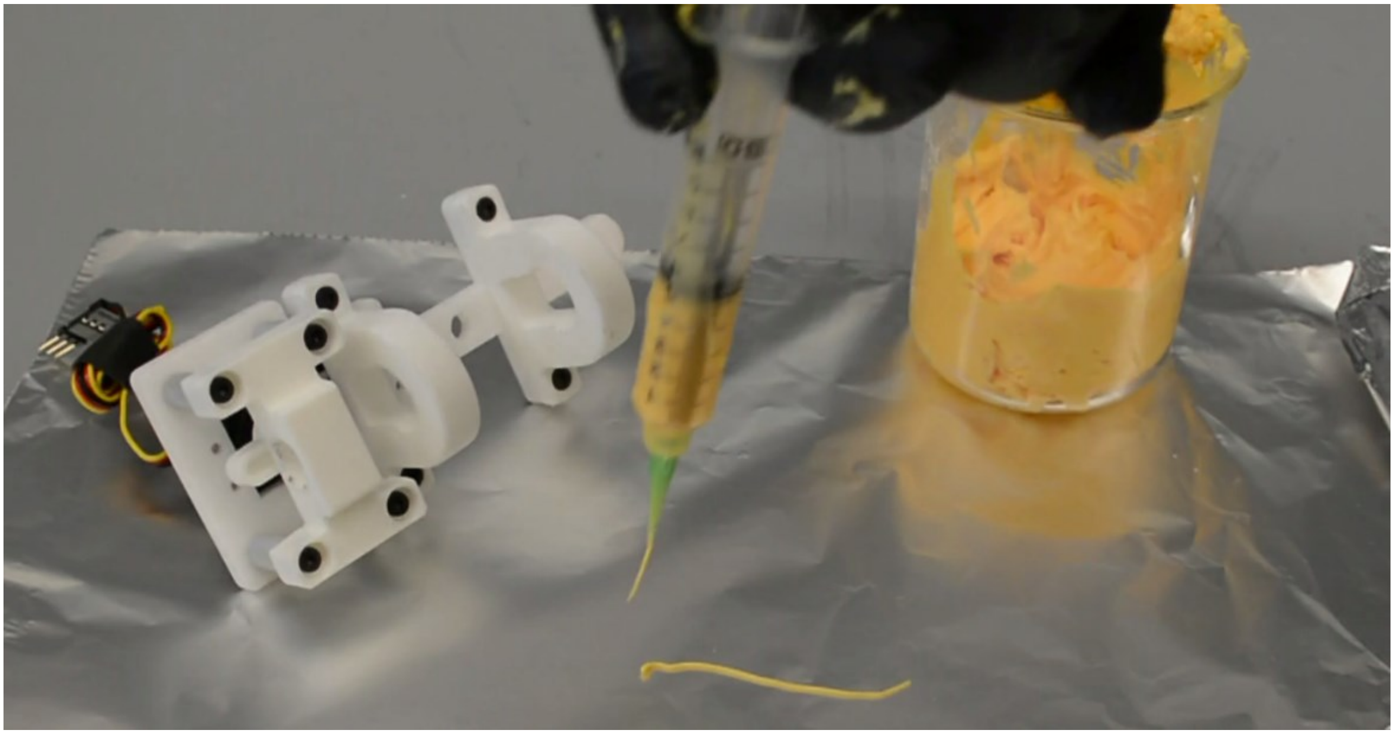
Whether you create the print job file right from SeraphStudio or you further process it with Manipulator, launch **SeraphPrint** ™ to connect to the Scientist and load your print job.

Even though we think we've thought of nearly every possible tool you might wish to use to modify the XDFL printer instructions, the unique design of Seraph Print allows you to print any XDFL file, regardless of whether was originally generated in SeraphStudio. With this feature, advanced users can write their own XDFL manually or using custom software. We encourage users choosing this option to contact us to let us know what you've come up with!

Software Overview

Calibration Guide

Will it print?



If you can manually extrude the material, and it passes the test of:

1. Being extruded through the syringe
2. Creating lines that hold their shape and
3. can be stacked,

it is probably going to work. If it doesn't work right away, you may need to chemically or physically modify the material by adding an additive or by using temperature or UV accessories.

Theoretical Basis for Calibration and 3D Printer Operation.

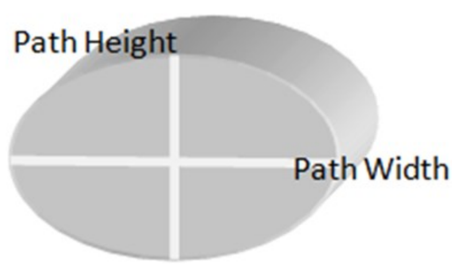
Calibrating a new material

All new materials will need to be calibrated for the size fo the nozzle used, the materials properties, and sometimes different environmental factors. It is important to keep in mind how the printer operates when calibrating a material. The printer lays down a bead that can thought of as having a height (PathHeight Ph) a width (PathWidth Pw) and a length D. This is done in a set time t.

Since $Volume = Width * Height * Distance * constant$ for extruded prisms. We can write an equation $Q = \frac{Vol}{t} = A_c * P_w * P_h * \frac{d}{t} = A_c * P_w * P_h * P_s$ where $P_s$is the path speed. Ideally the tool head would balance out this mass flow equation and deliver the exact amount of material as needed. However printed materials often have non-linear fluid properties and can be compressible. Therefore we need a “Compression Volume” term that can account for the need of the print head to charge up at the beginning of a deposition and decompress at the end. General the path width and height are measured imperially for a material flow rate and nozzle size. Often the dimensions are very close to the nozzle diameter. From there you can calculate the volume per unit length of material and get the Area Constant. Then you fix the path speed to match the flow rate you had established. This may require some iteration to get right. To add the calibration to Seraph Studio you will need the following steps:

$$\frac{Vol}{Sec} = PathWidth * PathHieght * AreaConstant * PathSpeed$$

$$Cross\ Section = AreaConstant * PathWidth * Path\ Height$$



Calibration

Valve Tool Instructions

The steps for calibration using Calibrator™ and the valve tool can be summarized in these steps:

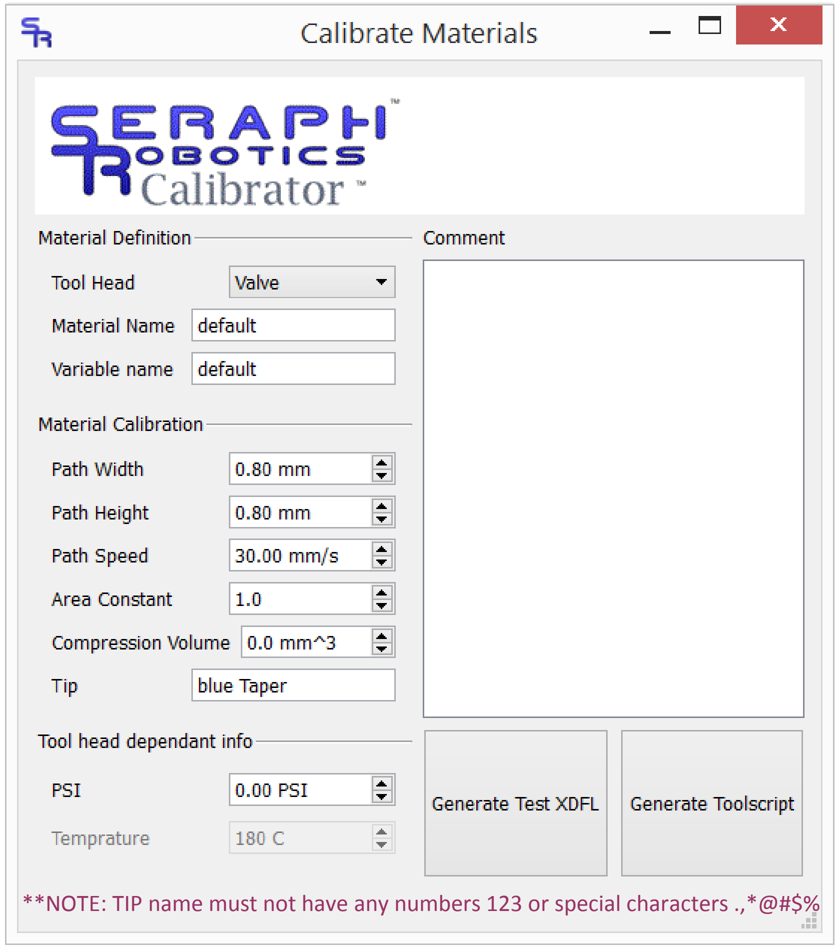
1. After successfully manually testing material, connect the syringe to the pressure source, but don't load into the printer. If you do load it into the printer, be sure to use the controls on SeraphPrint™ to open the valve. Otherwise, hold the syringe barrel and slowly increase pressure. After you've found a "sweet spot" pressure that seems to give a nice material flow out of the tip, record the PSI reading. This is an art, but not a terribly difficult one. Watch some of our demo videos if you want to get an idea of how good flow should look.

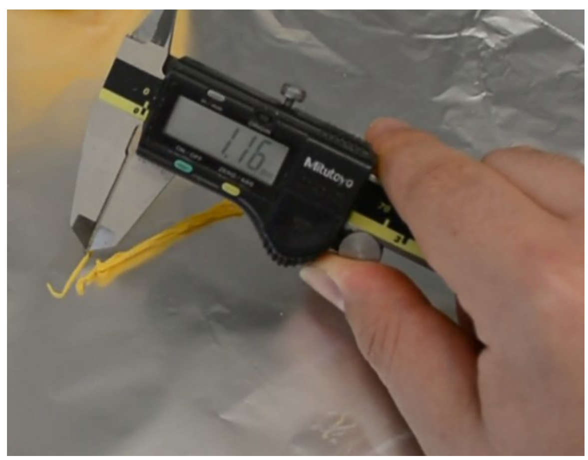
2. Launch LabManager™ and select Calibrator ™. Provide the material name (you can reuse the name in multiple calibrations and a unique "variable name' to identify this calibration.

3. Input your best guess for initial settings. You can manually extrude some lines of material and measure them with calipers to get starting path width/height.

4. The valve tool requires accurate path height and width to calibrate the print file appropriately. Choose a print speed that is appropriate. Start with 30mm/s and move up slowly, as needed. Area constant and compression volume should remain at their default 1.0 and 0.0 mm^3 values.

5. Generate a Test XDFL file and make sure to name it with the "filename**.xdfl**" syntax. Load into Seraph Print and the test file will extrude a line which you can measure again to more accurately configure the material.





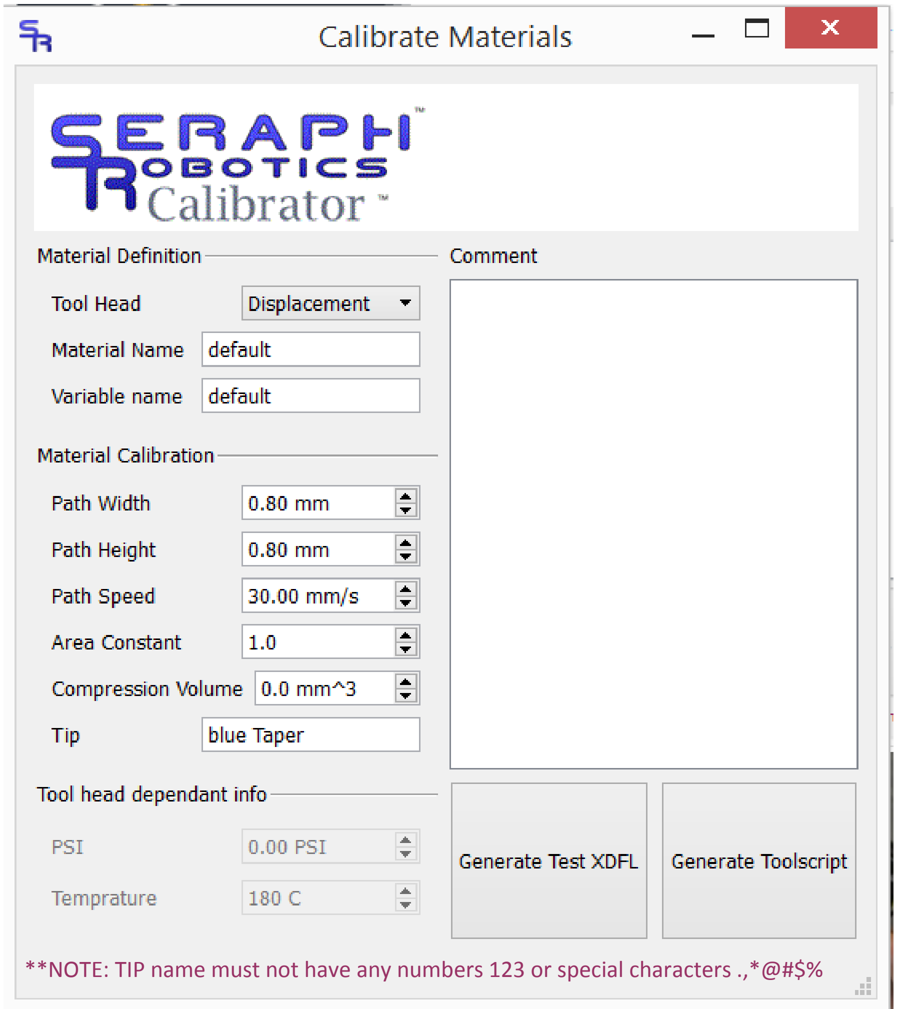
6. When you are happy with the correlation between the input values and printed values, click Generate ToolScript and save the tool script in the Seraph Studio system directory on your computer. Make sure the syntax is "filename**.xml**"

7. Load a Test Cube in SeraphStudio™ using the ToolScript to create the XDFL and send outputted XDFL to SeraphPrint™ to ensure you're happy with your results. (You may try a more complex print first, if you choose, but we don't recommend it. If the first couple layers of the test print go well, you can always cancel it. The idea is to try stacking the material with an easy print of a geometry that is known to print well, a cube being a great shape.)

****Always be aware of safety when working with pressurized items—you are always responsible for your own actions and we make no warranties or representations as to the suitability of 3rd party syringes for use with your materials or our printers.****

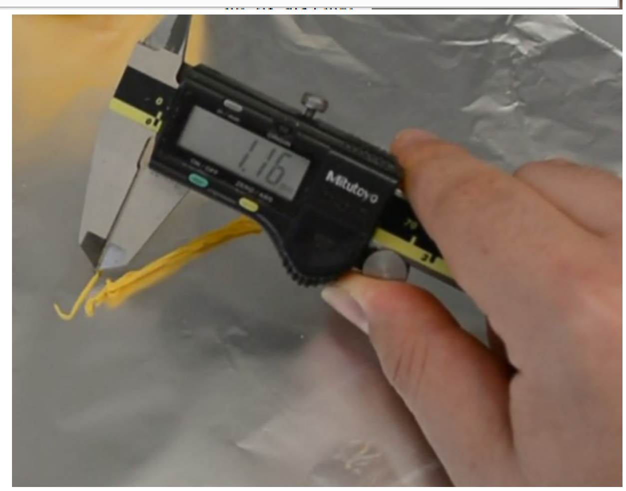
Calibration

Displacement Tool Instructions



The steps for calibration using Calibrator™ and the displacement tool can be summarized in these steps:

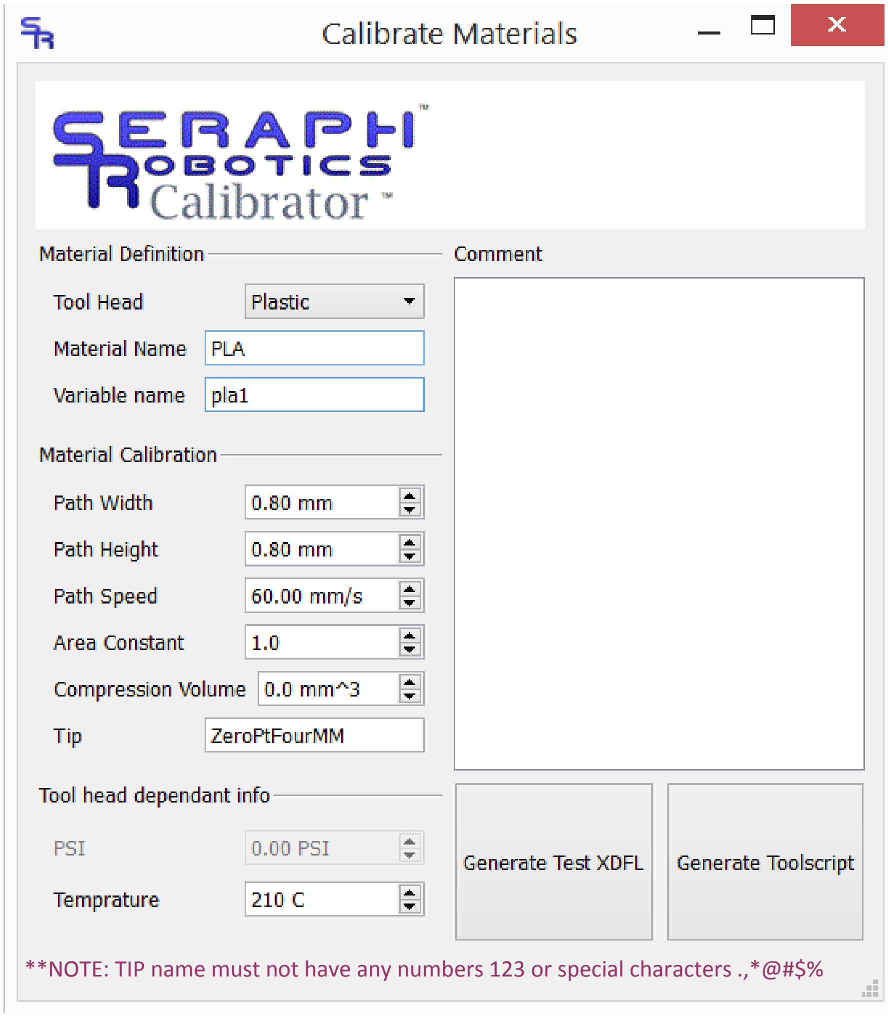
1. After successfully manually testing material, install the syringe the printer. Be sure to use the controls on SeraphPrint™ to prime the tip.
2. Launch LabManager™ and select Calibrator ™. Provide the material name (you can reuse the name in multiple calibrations and a unique "variable name' to identify this calibration.
3. Input your best guess for initial settings. You can manually extrude some lines of material and measure them with calipers to get starting path width/height.
4. The displacement tool requires accurate **path height and width** to calibrate the print file appropriately. Choose a print speed that is appropriate. Start with 30mm/s and move up slowly, as needed. **Area constant** should remain at its default 1.0 , but can be used for quick adjustments to the flow equation, if desired. The and **compression volume** is the amount of "extra push" needed to compress the material to start its flow from standstill. The default value is 0.0 mm^3 , and can be adjusted up for viscous materials.
5. Generate a Test XDFL file and make sure to name it with the "filename**.xdfl**" syntax. Load into Seraph Print and the test file will extrude a line which you can measure again to more accurately configure the material.
6. When you are happy with the correlation between the input values and printed values, click Generate ToolScript and save the tool script in the Seraph Studio system directory on your computer. Make sure the syntax is "filename**.xml**"



7. Load a Test Cube in SeraphStudio™ using the ToolScript to create the XDFL and send outputted XDFL to SeraphPrint™ to ensure you're happy with your results. (You may try a more complex print first, if you choose, but we don't recommend it. If the first couple layers of the test print go well, you can always cancel it. The idea is to try stacking the material with an easy print of a geometry that is known to print well, a cube being a great shape.)

Calibration

Filament Tool Instructions



The steps for calibration using Calibrator™ and the plastic filament tool can be summarized in these steps:

1. Load the filament into the tool according to the instructions in this document. Read those instructions before calibrating any materials with the steps below.

2. Launch LabManager™ and select Calibrator ™. Provide the material name (you can reuse the name in multiple calibrations and a unique “variable name’ to identify this calibration.

3. Input your best guess for initial settings.

4. The filament tool requires accurate path height and width to calibrate the print file appropriately. A guideline is that a 0.4mm tip would have a starting guess of a 0.4mm path width and a 0.2mm path height. Choose a print speed that is appropriate. Start with 60mm/s and move up slowly, as needed. Area constant and compression volume should remain at their default 1.0 and 0.0 mm^3 values. It is critical that you input a **temperature.** Each material is different and you may need to tweak this value. A guide is that PLA usually prints at 180-210C, ABS prints around 230C and Nylon prints around 270C. Please note that temperatures above 280C may damage the tool head or melt it. Always supervise printer and do safety checks!

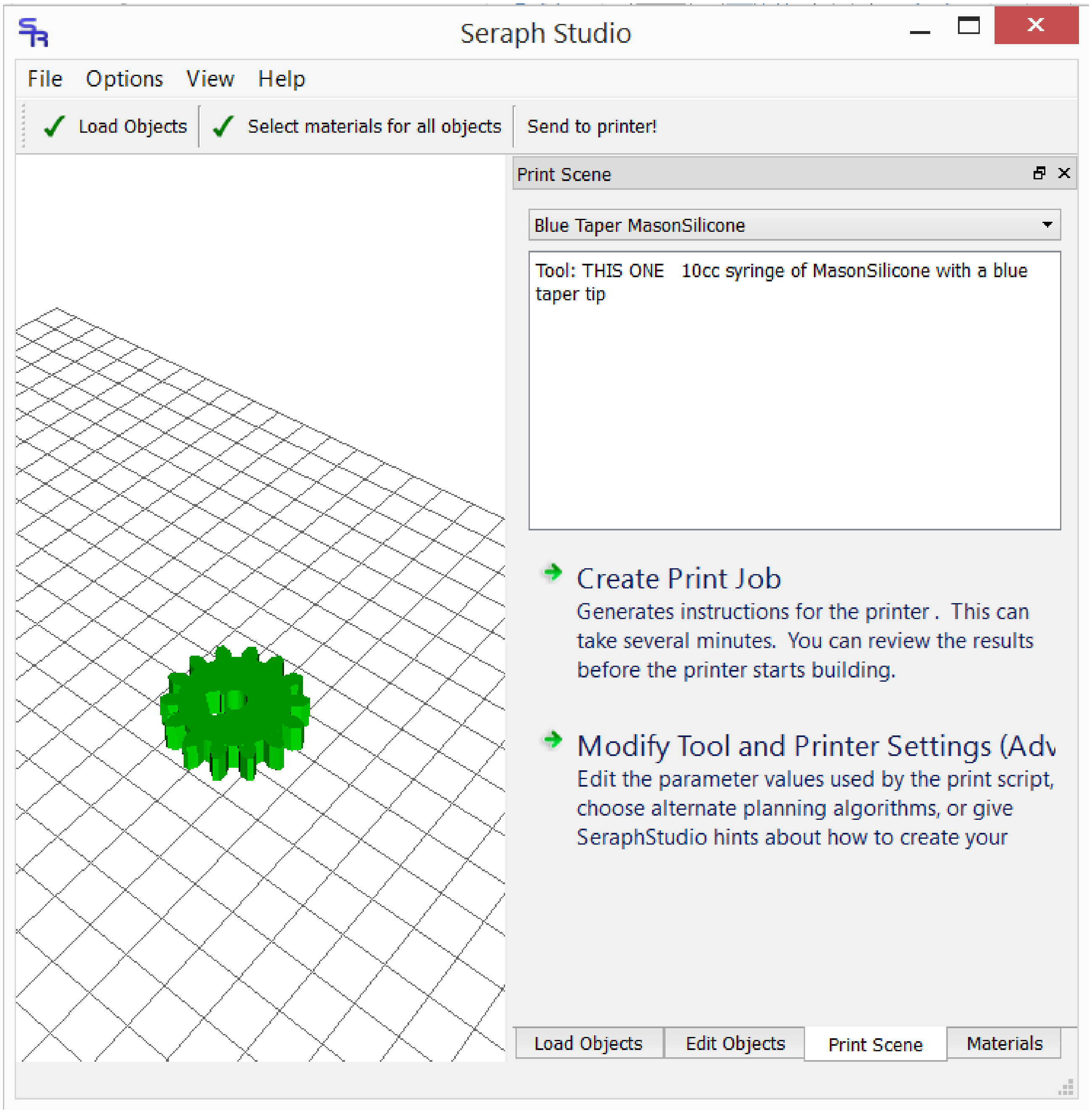
5. Generate a Test XDFL file and make sure to name it with the “filename**.xdfl**” syntax. Load into Seraph Print and the test file will extrude a line which you can measure again to more accurately configure the material.

6. When you are happy with the correlation between the input values and printed values, click Generate ToolScript and save the tool script in the Seraph Studio system directory on your computer. Make sure the syntax is “filename**.xml**”

7. Load a Test Cube in SeraphStudio™ using the ToolScript to create the XDFL and send outputted XDFL to SeraphPrint™ to ensure you’re happy with your results. (You may try a more complex print first, if you choose, but we don’t recommend it. If the first couple layers of the test print go well, you can always cancel it. The idea is to try stacking the material with an easy print of a geometry that is known to print well, a cube being a great shape.)

****Always be aware of safety when working with heated items—you are always responsible for your own actions and for inspecting the printer for safety*****

Calibration Guide

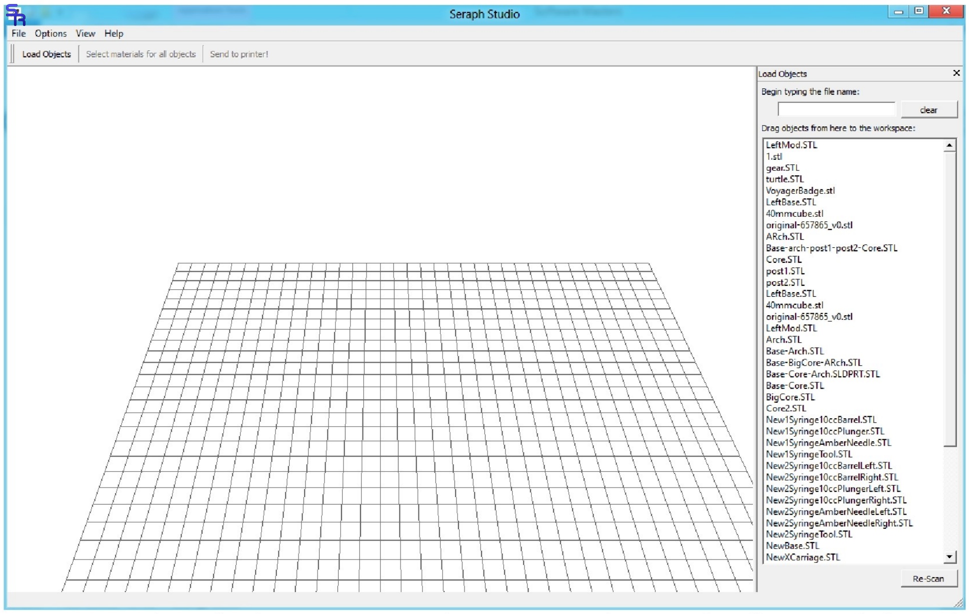


The tip name, comments, and PSI settings you input in calibrator will appear in Seraph Studio when you load the print scene of a calibrated material for which you have generated and used a toolscript.xml file saved in the appropriate directory.

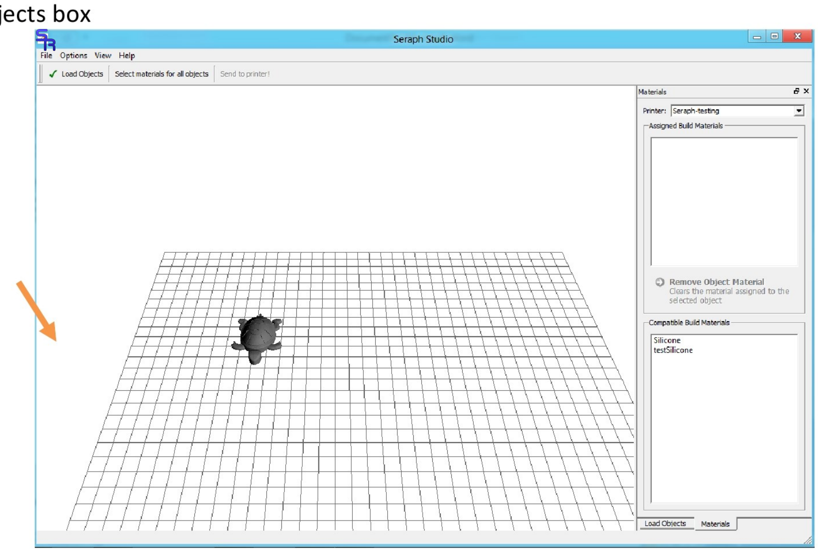
Use Seraph Studio to Process STL files created in your CAD software of choice into XDFL files, specialized files containing instructions for the 3D Printer. (See XDFL Guide to understand how XDFL works and how you can by pass SeraphStudio to write your own XDFL code to control the Scientist, if you wish.)

SeraphStudio

Load Objects

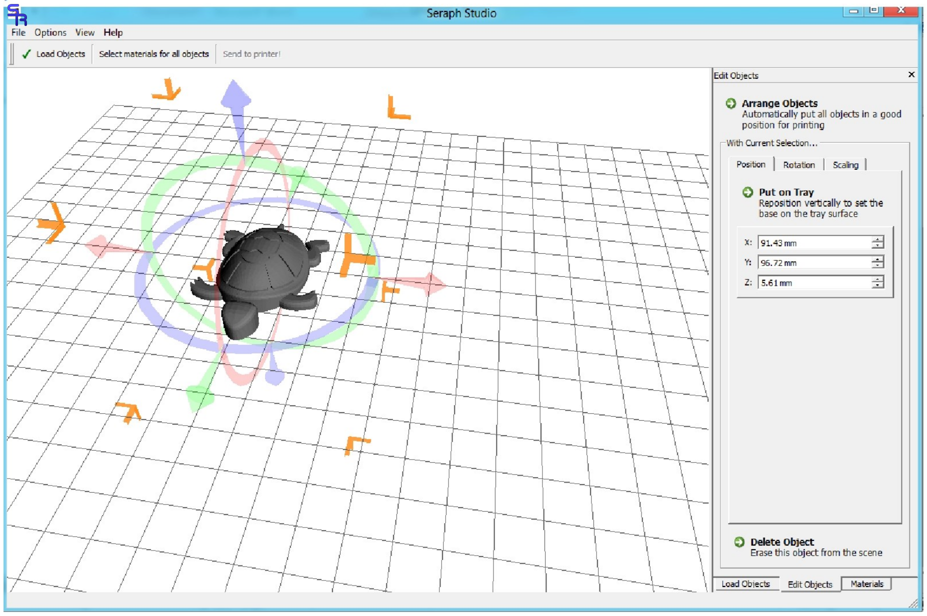


Upon opening Seraph Studio the program searches your User directory for all STLS and places them in the load objects box



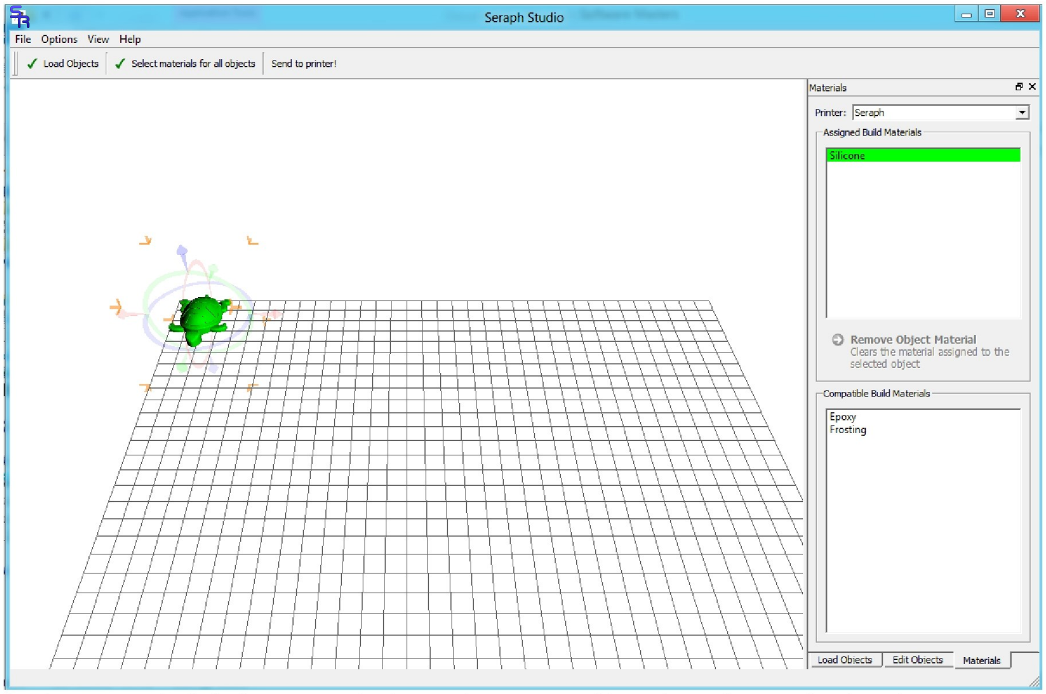
Drag and drop the design into the scene it will appear along with the graphic controls. Dragging and object into the scene will cause the program to switch to the “select material” state, and the materials list will appear. The arrow points to the origin of the scene. You can zoom by holding down the right click button and moving the mouse forward and backward. To rotate views, right click and move the mouse left and right

Edit Objects



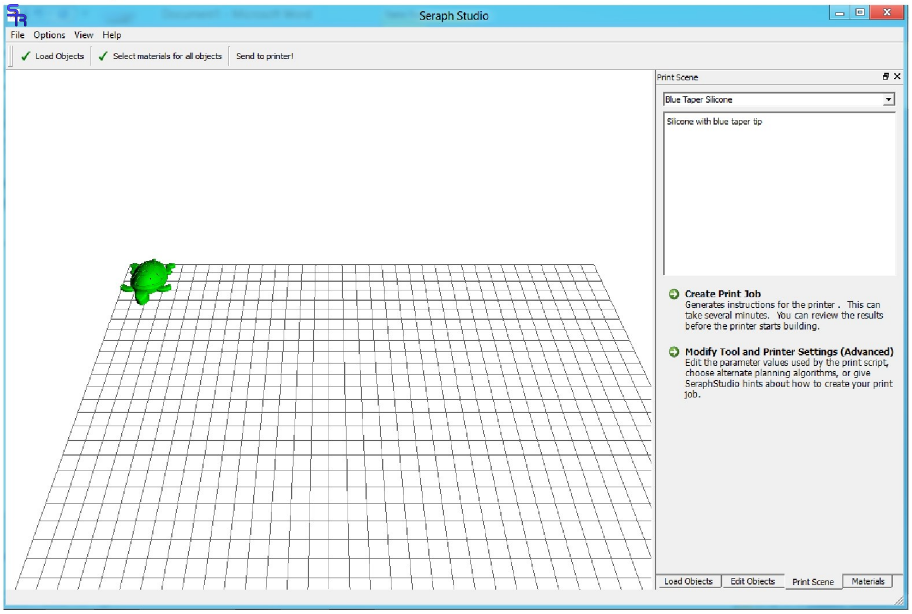
The rings on the visual control allow you to rotate the object by 90 degree increments. The arrows allow you to move the object; the corner markers allow you to scale the object. When you grab the object it will bring the edit objects tab up.

Select Materials

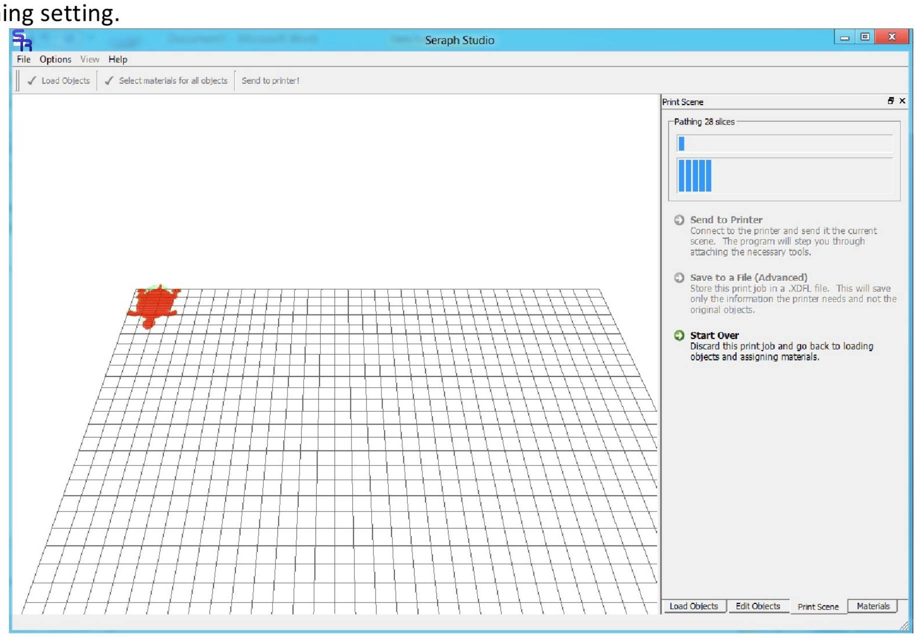


To load a material, click the material tab or Select Material breadcrumb. Use the dropdown to select the type of tool head and printer you're using to filter the material options. Drag and drop the material to the object. This will cause the object to colorize. It will also allow you to see what other materials can be printed with the selected material.

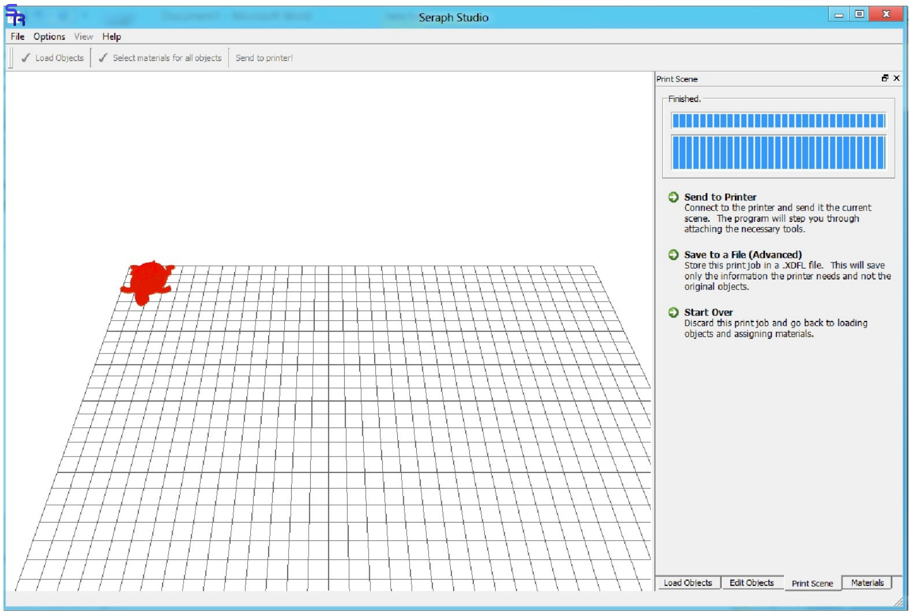
Generate Print Job



Hit Send To printer to bring up the bring screen tab. This will allow you to set the resolution and other settings by selecting the script form the drop down menu. You can then create the print job or modify the pathing setting.

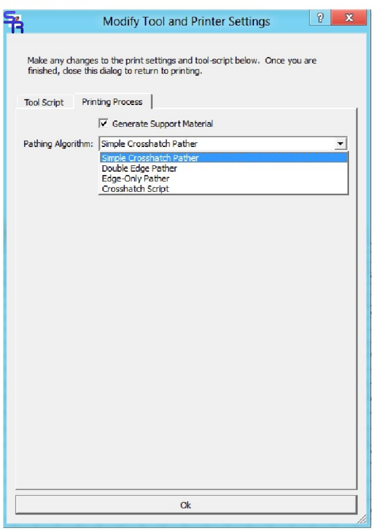


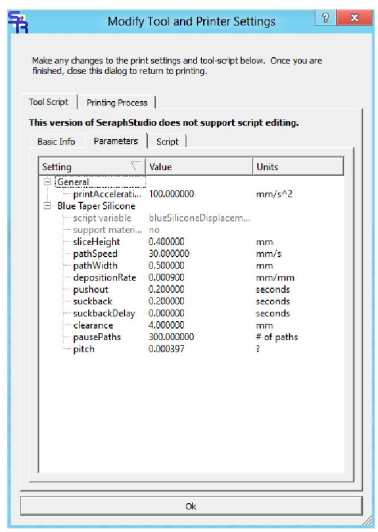
When the hit create print job, the system will slice and path the object. This will cause it to path the object. Paths show up as red lines.



Once pathed, you can either send it to the printer, or save to a file. We recommend saving the print for later. If you don't see the save to file option, please enable advanced features under options Congrats, you have made your first print job.
Once saved you will need to use SeraphPrint to control the printer.

ADV features

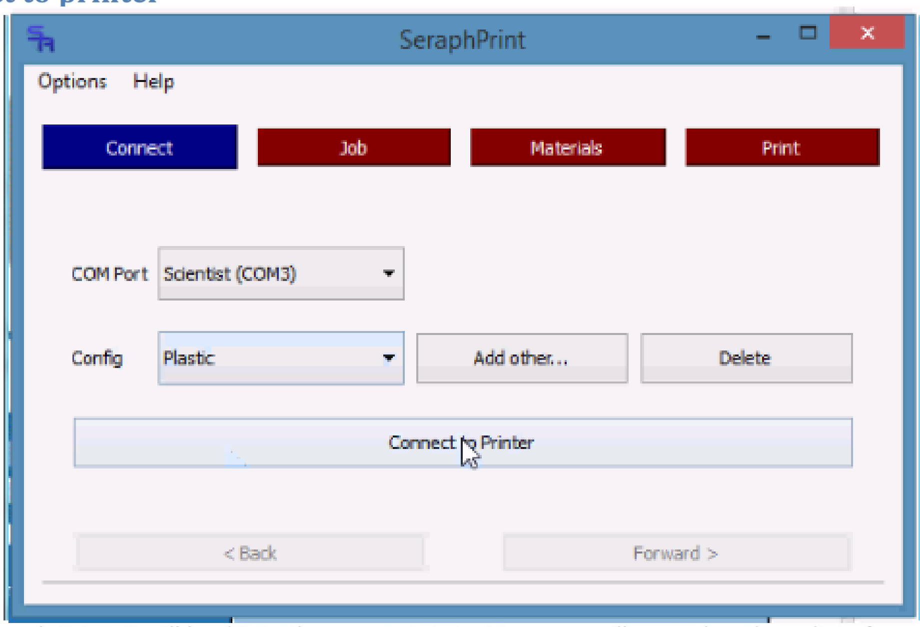




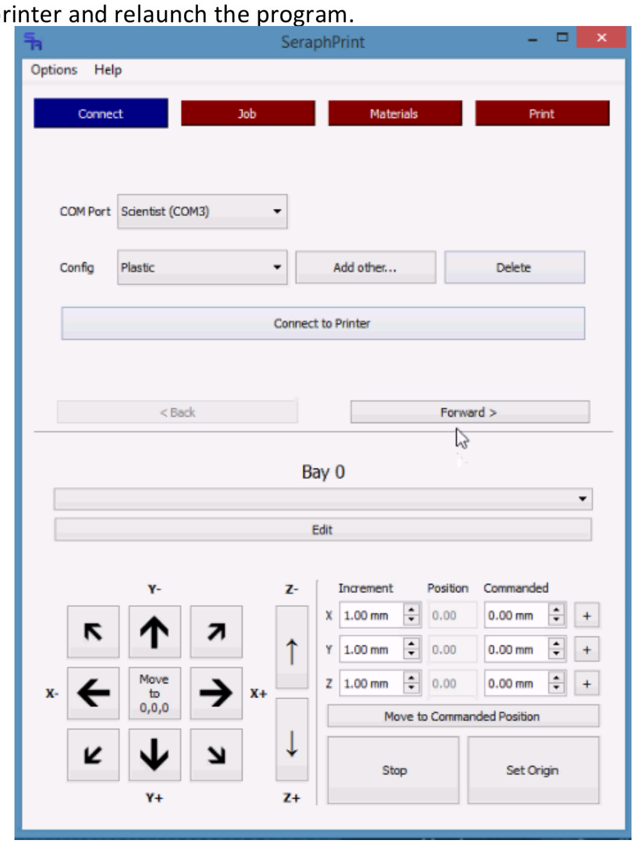
The modify tool and printer settings allows you to select the pather used and if support material is generated. The edge pathers create outlines of the object. Simple Crosshatch script generates an object with double walls and a crosshatch. The crosshatch script only uses a crosshatch to fill the object. You can also review the settings of the toolscript.

Seraph Print

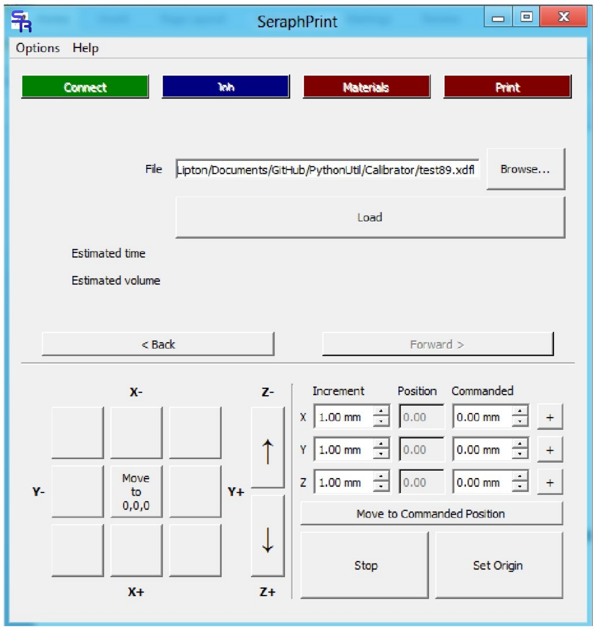
Connect to printer



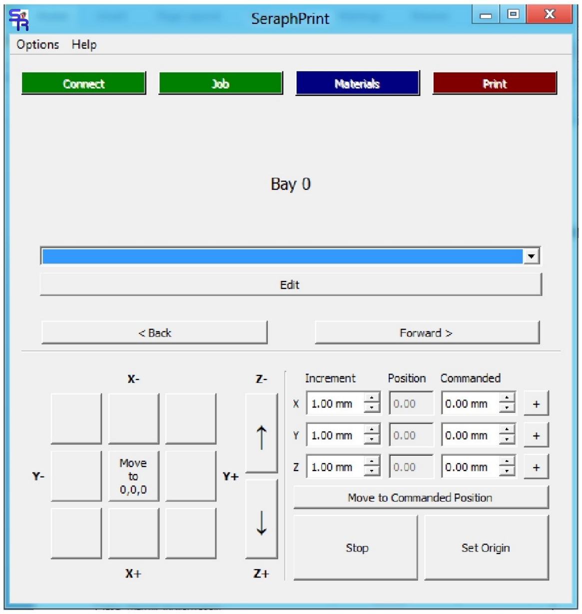
Open Seraph Print. It will load into the connect state, Here you will see a dropdown list of ever available machine. The comport of the machine will be listed. You will need to have the FTDI VCP drivers installed for your operating system. The list of previously added configs will also be available. If you don't see any configs, hit add other to find a printer config file. If you cant see a comport, make sure that the hub is plugged in an turned on, and that the drivers are installed. Once you have selected the machine and config, hit connect to printer. Should it fail to respond after 3 seconds. Cycle the power of the printer and relaunch the program.



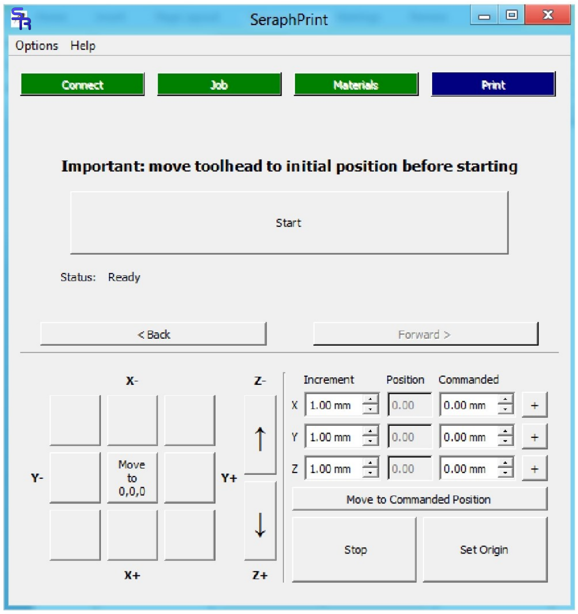
Once connected, the machine interface should appear. You can use the arrows plus up page and down page to jog the head. You can adjust the jog increment, and hit the plus arrow to adjust the speed



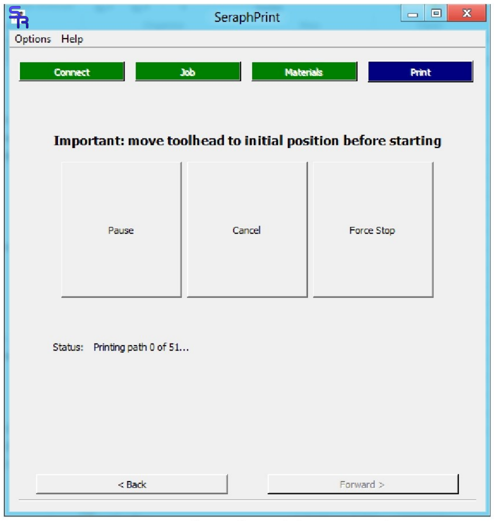
Hit forward and you are brought to the load file stage. You can load the last file by hitting load, or you can browse for the print file. Once loaded you will be given and estimate on how long the print should take. Then hit forward again.



In the materials stagem you can select which print material In the job is in which bay. You can jog the bay motor by hitting edit and using the popup dialog. Once the material is loaded hit forward



Before you start to print, job the print head so that the tip of the bay just touches the build surface. Once there, hit Set Origin. This will set that location as 0,0,0 for the print job. Hit start and the print will begin



Once the print is started you can pause, cancel or forcible stop the print. IF you forcibly stop the print, the program will crash and the machine will freeze. Only use this for emergencies. Pausing will cause the machine to finish the current path and then wait for your instruction to resume. Canceling will finish the path and quit printing, returning you to the load file stage.

XDFL User Guide

eXtensible Digital Fabrication Language

Overview

XDFL is the command language for the Fab@Home system. It is designed to allow for quick modification of calibrations. XDFL is generated from STL files by the SeraphStudio^{TM} program. The SeraphStudio program uses information contained in tool script files to process the geometry into the XDFL. The SeraphPrint^{tm} system converts the XDFL commands into motions the machine will execute. The code that converts the commands into movements in contained in the printer configuration files. Each bay for each tool head contains a JavaScript file that tells the system how to respond to XDFL commands. The XML structure allows the system to be edited by hand and by computer programs. Almost all programming languages have readily accessible libraries for reading and writing XML documents. The SeraphPrint program is case insensitive so it is possible to use any case when developing an XDFL file.

```
<!--?xml version="1.0" encoding="UTF-8" standalone="yes"?-->
<xdfl>
    <palette>
        <material>
            <id> </id>
            <name> </name>
            <pathwidth> </pathwidth>
            <pathheight> </pathheight>
            <pathspeed> </pathspeed>
            <areaconstant> </areaconstant>
            <compression> </compression>
            <pathwidth> </pathwidth>
        </material>
    </palette>
    <commands>
            <path>
                <materialid> </materialid>
                <point> </point>
                    <x> </x>
                    <y> </y>
                    <z> </z>
            </path>
    </commands>
</xdfl>
```

Structure

The first line in an XDFL file is an XML declaration. It sets the XML version and encoding standard for the characters. The seconds line in the root tag of the file. The root tag is always “xdfl”. The xdfl tag has two children, the “pallete” tag and “commands” tag. The pallet contains the calibration information for each material. The commands contain the deposition paths and the non-deposition paths for a print job. The system will execute the commands in order, so positioning of the commands matters for the file.

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<xdfl>
<Palette>
        <material >
                <name>silicone</name>
                <id>1<id>
                <PathWidth>2</PathWidth>
                <PathHeight> 4</PathHeight>
                <PathSpeed > 3</PathSpeed>
                <AreaConstant > 1</AreaConstant>
                <CompressionVolume>10</CompressionVolume>
                <property>
                        <name>conductivity</name>
                        <value units = "siemens">1</value>
                </property>
        </material>
</Palette>
<commands>
        <Path>
                <materialID>1</materialID>
                <Point >
                        <x>1</x>
                        <y>2</y>
                        <z>3</z>
                </Point>
                <Point  >
                        <x>2</x>
                        <y>2</y>
                        <z>3</z>
                </Point>
                …….
        </Path>
        <path>
                ……
        </path>
</commands>
</xdfl>
```

Figure 1: The Layout of a XDFL File.

Pallet

The Pallet contains all of the information needed for each material to ensure the machine can extrude the material. The opening tag is a “palletE” tag. Each material calibration is given its own tag “material” This tag contains and id tag and a name tag. The name lists the materials name for use by human identification. The id tag contains a locally unique ID for the calibration. The paths will reference the id number.

The system operates on the basis of balancing the volumetric flow of material from a tool head. Each path has a height, width and cross sectional area. These paths are traversed at set speeds. This leads to a required volumetric flow rate (Q). The SeraphPrint system extrudes material from the tool head to match the material required for the path. Since no tool head is without the need for priming, and some materials are compressible, the material also need to list a compression volume. This is the volume the system will “extrude” before a path and suckback after a path. The system uses mm for distance, seconds for time, and mm^3 for volumes

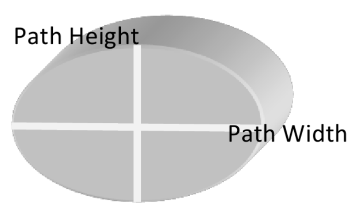
As a result of these requirements, each material must have the following tags:

- name
- id
- PathWidth
- PathHeight
- PathSpeed
- AreaConstant
- CompressionVolume

$$\frac{Vol}{Sec} = PathWidth * PathHieght * AreaConstant * PathSpeed$$

$$Cross\ Section = AreaConstant * PathWidth * Path\ Height$$

(a)



(b)

Figure 2: The equations governing XDFL path flow rates (a), and a diagram of a given path (b)

Commands

The commands section is a list of paths the system will move along and voxels that the system will deposit. Paths are the most common form of deposition and the only form generated by SeraphStudio.

Paths

These paths are executed in the order in which they appear in the file. There are two types of paths, deposition paths, and movement paths. Both paths contain a series of points that define the line segments the machine will move along. Each point contains a tag of x,y and z which defines the location in space of the point. Deposition paths contain a “materialid” tag that has an integer which references the id of a material in the pallet. This reference defines the speed along which the path will be moved and tells the system to extrude material. Movement paths contain a “speed” tag that defines how quickly the system will move along the path. Movement paths are often used to create a movement clearance to prevent the tool head from intersecting the printed object when moving from section to section.

```xml
<path>
  <speed>30</speed>
  <point>
    <x>0.0</x>
    <y>0.0</y>
    <z>0.0</z>
  </point>
  <point>
    <x>0.0</x>
    <y>0.0</y>
    <z>10.0</z>
  </point>
  <point>
    <x>10.0</x>
    <y>10.0</y>
    <z>10.0</z>
  </point>
  <point>
    <x>10.0</x>
    <y>10.0</y>
    <z>1.0</z>
  </point>
</path>
```

(a)

```xml
<path>
  <materialID>1</materialID>
  <point>
    <x>0.0</x>
    <y>0.0</y>
    <z>1.0</z>
  </point>
  <point>
    <x>0.0</x>
    <y>10.0</y>
    <z>1.0</z>
  </point>
  <point>
    <x>10.0</x>
    <y>10.0</y>
    <z>1.0</z>
  </point>
  <point>
    <x>10.0</x>
    <y>0.0</y>
    <z>1.0</z>
  </point>
  <point>
    <x>0.0</x>
    <y>0.0</y>
    <z>1.0</z>
  </point>
</path>
```

(b)

Figure 3: The paths are the children of the commands tag. There are two types. A movement path (a) and a deposition path (b)

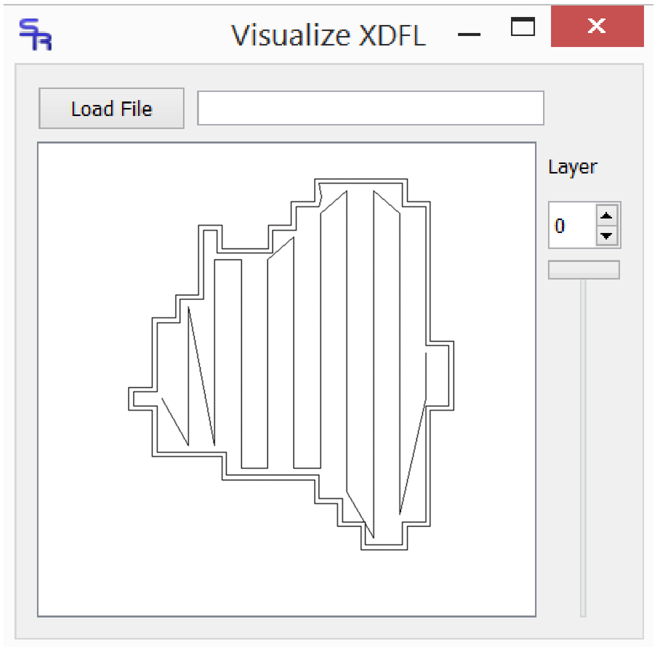
Voxels

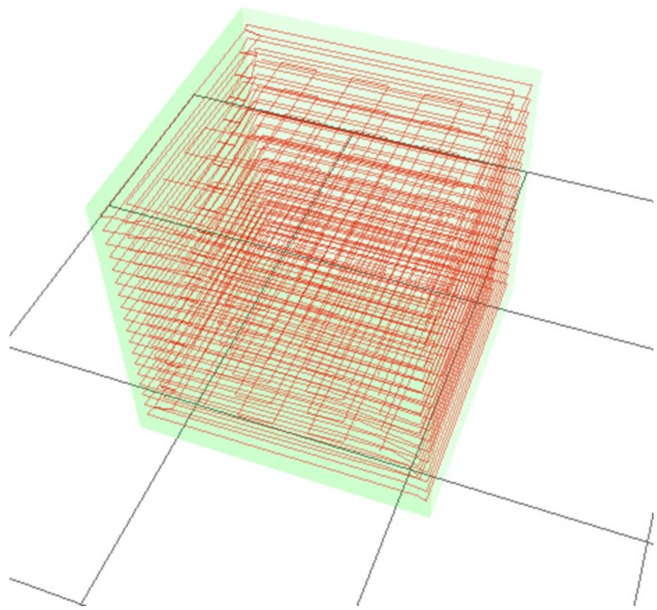
Voxels extrude a single material at a point. They are children of the commands node and list the location, volume and material to be extruded.

```xml
<voxel>
	<materialID>1</materialID>
	<volume units = "mm^3">20</volume>
	<x>0</x>
	<y>0</y>
	<z>1</z>
</voxel>
```

Figure 4: a Voxel tag that extrudes 20 mm^3 of material at 0,0,1

Visualize XDFL Paths

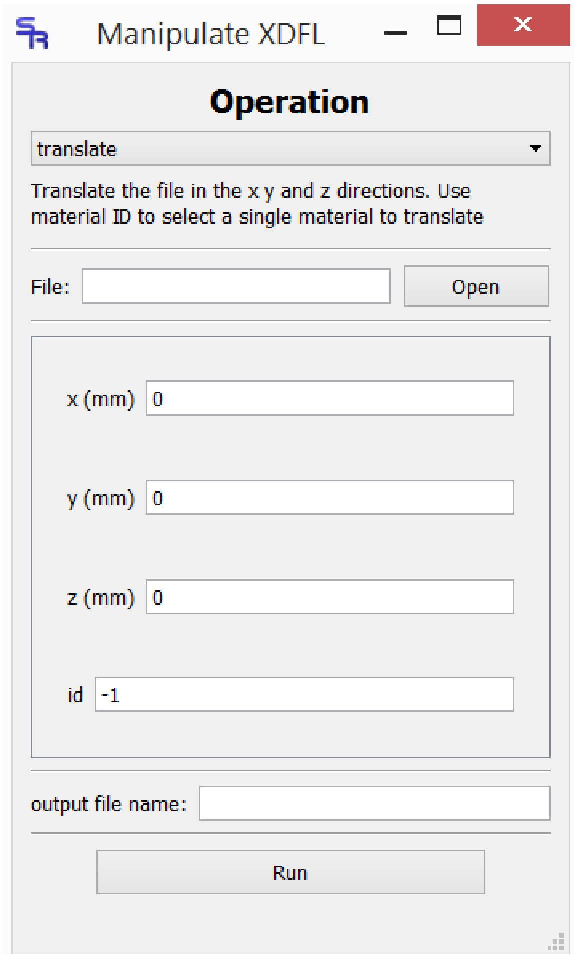


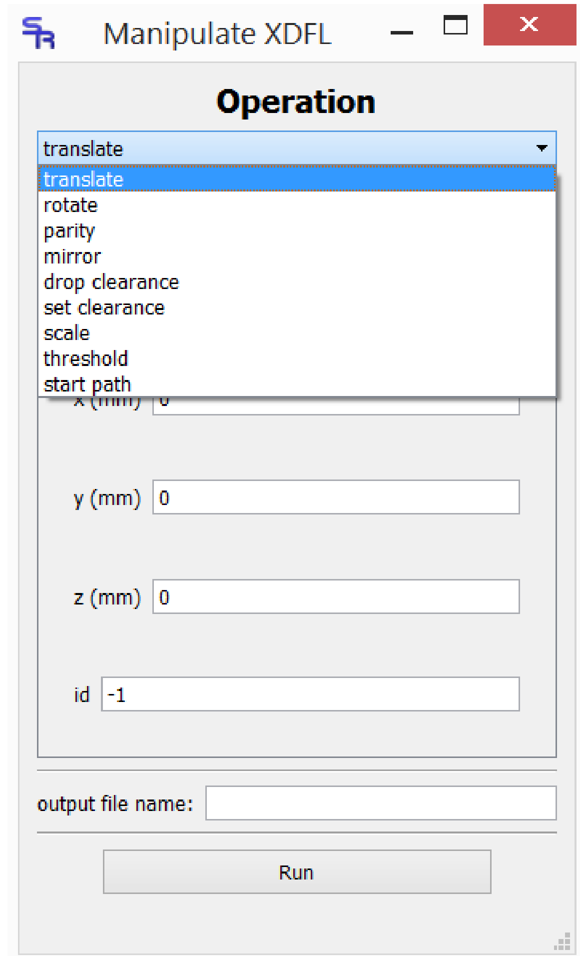


Use the visualizer to load an XDFL file and scroll through its layers. Within each layer, the individual paths the printer will follow are shown. This tool will help you design printing experiments as well as verify the pathing of a processed STL file or custom XDFL file to ensure there are no errors.

526 CAMPUS RD, SUITE 409C, ITHACA, NY 14853 | SALES@SERAPHROBOTICS.COM | 815.301.9504 FAX

Advanced XDFL Manipulation with Manipulator™





Use the Manipulator™ to translate, rotate, parity transform, mirror, drop/set clearance paths, scale, threshold, or reset start path of an XDFL file. Use the dropdown menu to see a brief description of each function. When you select a function, the necessary parameters will appear below it. Fill out the settings, type a name for the output file, and click run to create a new XDFL file in the directory containing the original file.

Translate	Translate the file in the x y and z directions. Use material ID to select a single material to translate
Rotate	Rotate the file about an axis
Parity	Perform a parity transform on the file (x->y, y->x)
mirror	Mirror the file about an axis
Drop clearance	Remove all clearance paths from the file
Set clearance	Set the amount the head will move up between paths and the speed of the movement between paths
scale	Scale the file by a percentage along the x y and z dimensions
Threshold	Remove all paths bellow 0 height
Start path	Remove all paths up until and including the path number specified

Advanced XDFL Manipulation with Manipulator™

Overview

The Manipulation tool for XDFL is designed to let you edit your print jobs and to customize your printing process. The tool has several functions that can change your XDFL print job. The print job is loaded by typing in the file location and name into the line underneath the explaining text or by hitting the open button. Each function has a set of arguments (inputs) that are needed to perform their task. They are loaded into the box beneath the input file name. Each argument is given a default value. You can edit some or all of the arguments. The output of the function is sent to the output file. By default, the input file is overwritten by the function, but you can specify a new file to be written.

The rest of this document will be used to describe the different functions and how to use them. The functions are broken into three groups, geometric, clearance, and edits. Geometric functions change the location and orientation of print jobs. Clearance functions change the behavior of the printer between extrusion paths. Edit functions truncate a print job or merge print jobs together.

Functions

Geometric

Geometric functions change the location and orientation of print jobs. The printer uses X Y and Z coordinates. The XDFL file coordinate will be the coordinates referenced for the entire print job. The Printer bays will moved in order to align the extrusion heads for the correct material to the locations in the print job.

Translate

Function

The Translate tool moves the paths of one or all of the materials in a print to move the object on the build surface. If you use a material ID only that material is shifted, none of the clearance paths and none of the other extrusion paths are shifted to match it. You can used the clearance function to update the clearance paths to match the ends of extrusion paths after shifting one material.

Arguments

Name	Units	Default	Description
X	mm	0	The amount in mm to shift the print job in the X direction
Y	mm	0	The amount in mm to shift the print job in the Y direction
Z	mm	0	The amount in mm to shift the print job in the Z direction
Id		-1	The ID of the material to shift, use -1 to shift all materials and the clearance paths, use 0 to shift the non-extrusion paths

Example

Lets sat you have a multi-material print and you placed one of the STLs in the wrong location, you can use this tool to make a correction. After your first attempt printing, if you measured that you were off by 5mm in the y direction on the STL for material two, you can enter 5 for Y and 2 for ID. Then when you are done use the clearance function to update the clearanc-es.

Rotate

Function

The rotate function turns the entire print job about the X Y or Z axis This function can put parts below the XY plane (the build surface), make sure to shift your prints up to prevent the tool head from crashing into the build plate if you rotate it about the X or Y plane.

Arguments

Name	Units	Default	Description
Angle	Degrees	0	The angle to rotate the print around an axis
Axis		z	The axis to rotate around X Y or Z

Example

Lets say you made a print job that is too long for the X axis but can fit on the printer if your rotated it. Use the tool to rotate the print 90 degrees around the Z axis

Parity

Function

The parity function performs a parity transform. Parity transforms turn right hands into left hands. This is similar to mirror-ing the print through the build tray and rotating up to original position on the build surface.

Arguments

None

Example

Lets say you want to turn and left ear into a right ear, use the parity function to make a new print job.

Mirror

Function

This mirrors the print job through a plane. The planes are defined by the axis that is perpendicular to them. IE the Z axis is perpendicular to the XY plane (build surface). If you mirror about it, it will put the print jobs below the build surface.

Arguments

Name	Units	Default	Description
Axis		z	The axis to rotate around X Y or Z

Example

Let's say you want to print an object upside down. Use the mirror tool to mirror about the Z axis and then use the translate tool to shift the print up back above the build surface.

Scale

Function

This function will scale the print in the X Y and/or Z directions. It will not fill in areas, it will only change the spacing of the points in the paths. 1 is equivalent to 100%. This tool is rarely used, but it can be used to make solid objects into sparse filled scaffolds.

Arguments

Name	Units	Default	Description
X	-	1	The amount to scale the print job in the X direction
Y	-	1	The amount to shift the print job in the Y direction
Z	-	1	The amount to shift the print job in the Z direction

Example

lets say you want to make a sparse scaffold. Take a print with solid infil and scale it in the x and y directions.

Clearance

Clearance paths are the non-extruding movements between extrusion paths. These paths lower the build tray, and then move the head to the XY position of the start of the next path, and then move the tray back up.

Drop clearance

Function

This function removes all of the clearance paths from a print. This will cause the head to move in a straight line between the end of one path and the beginning of the next path. You will want to drop clearance to make a print faster or if you plan on making a series of edits to the XDFL and setting the clearance at the end.

Arguments

There are no arguments for the function other than input and output file name

Name	Units	Default	Description
-	-	-	-

Example

Lets say you a printing with plastic with a single plastic material, removing clearance paths can speed up the print process. You would not want to remove clearance paths when using two materials with different heights which might cause the materials to drag into each other.

Set clearance

Function

This function sets the clearance paths between all paths in the print process. You can set the Z movement amount to ensure either a breaking of the strand from the tip or to avoid dragging the tip into another region of material.

Arguments

Name	Units	Default	Description
clearance	mm	0.1	The amount to drop the tray before moving in XY
speed	Mm/s	10	The speed along the print pass

Example

Let’s say you have a print with a single material that needs a movement to break its connection between the path and the nozzle. Set a 0.1mm clearance and 50mm/s speed to ensure that the head jerks away from the path and breaks the material connection.

Let's say you have a two material print where one material has a 1mm path height and the other has a 2mm path height, setting a 1.1mm clearance will ensure that the nozzles do not crash into printed materials.

Edits

Threshold

Function

This function removes all paths bellow the build surface (XY plane) from the print to prevent the head from crashing to the build surface. This function is needed because there is nothing to stop you from putting an object bellow the build surface using one of the other manipulation functions.

Arguments

There are no arguments for the function other than input and output file name

Name	Units	Default	Description
-	-	-	-

Example

Let's say you have rotated a print using the X axis and it now has the first 5 paths bellow the build surface, but these paths are un needed to print the object, this function can remove those paths.

Start path

Function

This is a debugging function useful for resuming a print from a specific path number if your print fails and you want to recover the print from a specific path. This function removed all paths before this specified number from the print job.

Arguments

Name	Units	Default	Description
Path number	-	1	The number of the path to start the print from

Example

Let's say a 5 hour print fails are path 190 because you ran out of material or the tip clogged. Write down the number of the path it is on in Seraph Print, cancel the print. Move the print to X=0 Y=0 and the current layer height. Then use this tool to make a new print job from that path, and run this new print job.

Merge (for Multi-Material Printing)

Function

This function merges multiple XDFL files together to make a new multi-material XDFL file. All of the materials are kept, even if they are unused in the file. The system assumes that both files are aligned to the same origin. The merged file will be sorted by layer height to make the print order for the layers.

Arguments

There are multiple arguments of the same name, you only need to fill a value for as many files as you are merging together.

Name	Units	Default	Description
File name	-	-	The location of the file to merge

Example

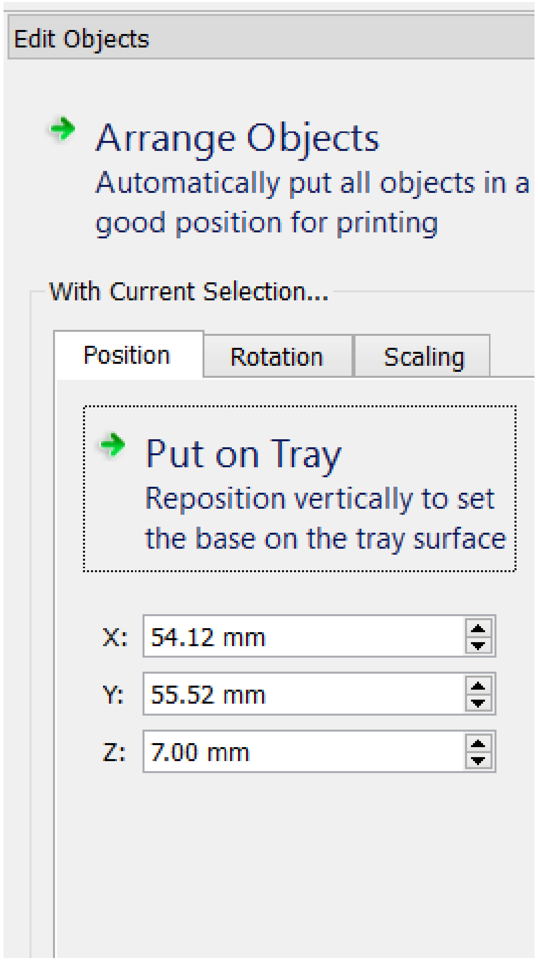
Let's say you want to make a combination of two materials, but don't have a toolscript for the combination. You can align the STLs in seraph studio and record their XYZ positions form the menu on the right. Then remove the STLs for material 2 and path material 1 and save an XDFL file. Then remove the STLs and place the STLs using the corrdinate you recorded before and make a new XDFL file for material 2 and save it. Then merge the two files together into a new file using this tool.

Let's say you have an STL file and a set of paths you generated from code in matlab. You can use the XDFL from the STL file and the XDFL written in matlab code to make a new print job. Use this tool to merge the two sets of paths together.

Multi-Material Printing Guide

Let's say that you want to print a multi-material object. The simplest way to do this using Seraph software is to create two separate XDFL files and merge them.

The first file would contain the geometry of all areas of the print using material number one, and the second file would contain geometry of the print using all areas of material number two. Of course, it is possible to extend this prototypical case and use more than two STL files to accommodate two or more materials in this fashion.



The process begins by selecting the first material's STL file and placing it on the build surface using Seraph Studio. The user should make note of the X, Y, and Z positions of the first STL object and create an XDFL file.

Using this information, the user should then clear the build surface on Seraph Studio and on to an empty virtual build surface, import the second material STL object. Then, place the second STL object in the appropriate position relative to the first, using the "Edit" tab on the program to manually input the correctly offset XYZ position. A second XDFL file should then be created containing only the information regarding the pathing instructions for the second STL file. The user should now have two XDFL files, each containing the respective paths for their object and material.

With the to appropriately positioned XDFL files created, the user must now launch the "Manipulator" from Lab Manager and select the "Merge" tool. This tool will merge the two separate XDFL files into a single XDFL file containing all of the instructions for the printer to simultaneously print both materials. Unlike printing these two XDFL files in succession, using the merge tool will sort their XDFL commands by layer, allowing a successful print comprised of multiple materials per layer.

Please refer to the instructions in the section discussing the Manipulator Tool for more detailed information on the Merge tool. Also note that for your print to be successful the z-heights of the two or more materials should be the same or nearly the same to ensure that one syringe does not interfere with printed material of another. See diagram below, which illustrates how a big z-height (path/layer height) difference is problematic because the tool will crash. To avoid this problem, tell the Merge program a "clearance height" and it will lift the head by that amount between materials to avoid crashing. This will allow you to circumvent the problem described below.