Lesson 6 Cool Creation

Scene lead-in

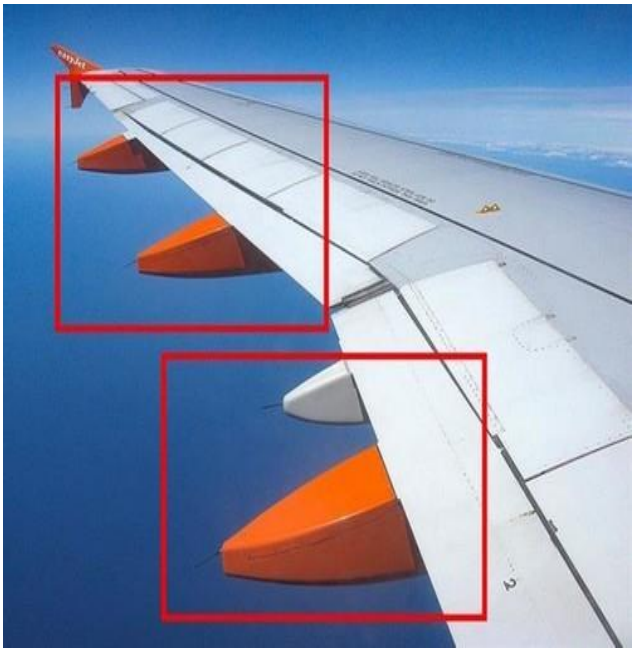
3D printing is widely used in the aerospace field. For the industrial layout of additive manufacturing, the leading companies are GM, Boeing and Airbus of the US. Under the strategic background of "re-industrialization" of America in 2012, GM proposed a concept of "industrial Internet" and performed a series of layouts, wherein, 3D printing is an important constituent part of the intelligent factory. Boeing began to apply 3D printing components in the mid-1990s. At present, Boeing has used more than 20,000 aircraft parts and components (by using the 3D printing) of over 200 kinds to its 16 kinds of commercial and military aircrafts.

Creative design

Project practice: printing of the aircraft model by the robotic arm

Project requirements: Assemble the robotic arm and the 3D printing kit, complete the aircraft model under the guidance of the instructor and print it with the robotic arm.

Project score: Score the aircraft model according to its integrity and aesthetics.



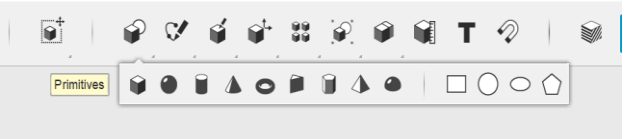
Technology knowledge center
What are the cubes below aircraft wings?
When we are on a plane, we can always find that there are several large cubes behind the aircraft's wings.
The bigger the aircraft is, the more cubes there are, but what are these cubes?
The name of these cubes is flap track fairing, which has the flap transmission device inside.
In other words, the mechanical structure inside is used to control the flap. The machine in the fairing can control the flap to bend downward.

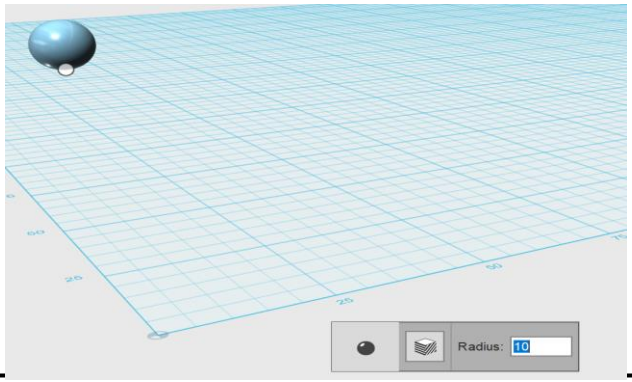
1 123D modeling

The aircraft structure is generally composed of five main parts: wings, body, tail, landing gear and power unit. Let's use the 123D Design to design the aircraft model together.

【STEP 1】

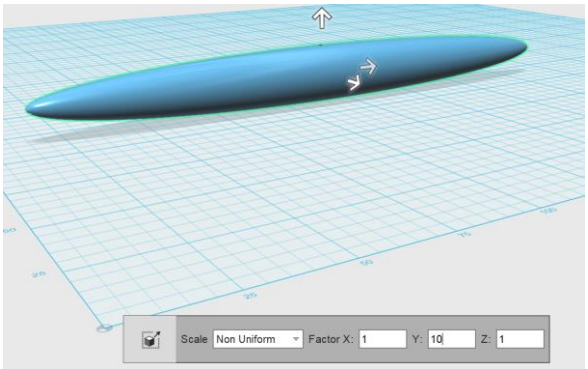
Open the 123D software, click Primitives, then select [Sphere], and input 10 as the [Radius] of the circle.





【STEP 2】

Click the sphere by the left mouse button, select the [Scale] instruction and then select the Non Uniform in it. Set the scaling of X, Y, and Z in the Factor as 1:10:1 respectively

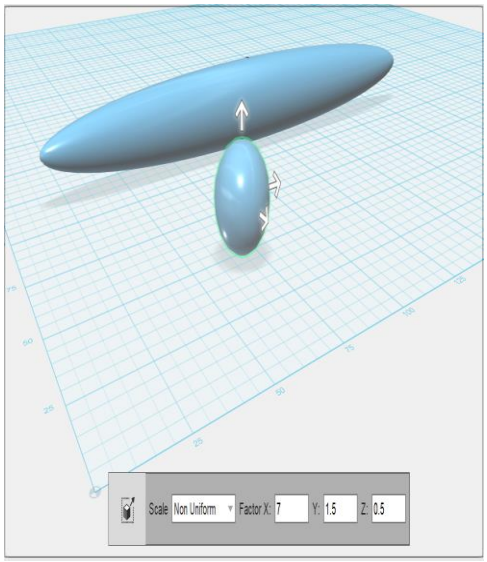


【STEP 3】

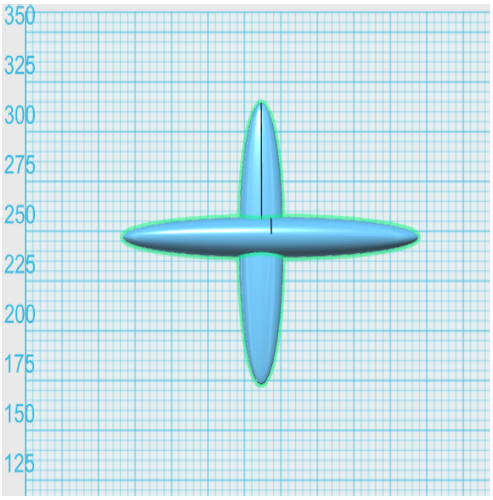
Draw a sphere in the same way mentioned in the first step, and select Scale instruction to adjust the scaling to:

X : Y : Z = 7 : 1.5 : 0.5.

Then click the object with the left mouse button for a long time until it moves to the proper position.

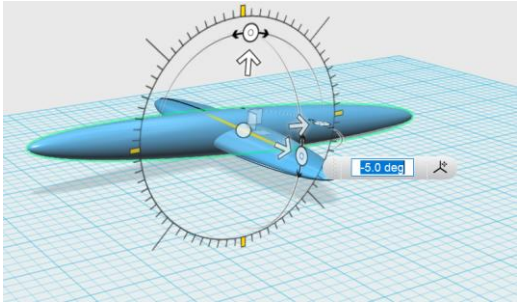


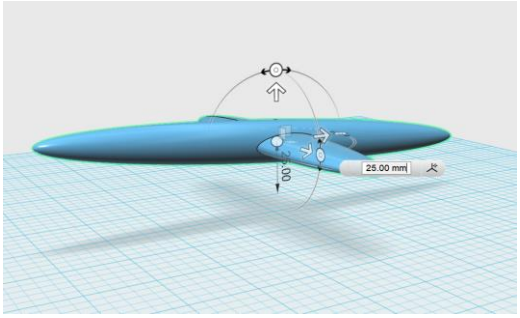
The wings are completed.



【STEP 4】

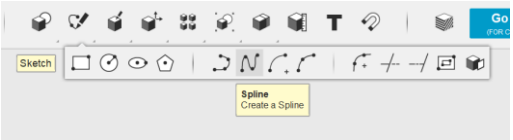
Click Move instruction at first to make the aircraft body have a certain inclination angle, then click Merge instruction in the Combine, select the aircraft body, and then the wings to make them be as a whole. Finally, raise the overall aircraft to 25 mm.

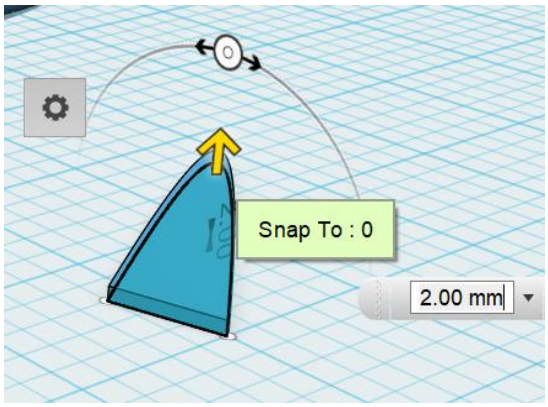




【STEP 5】

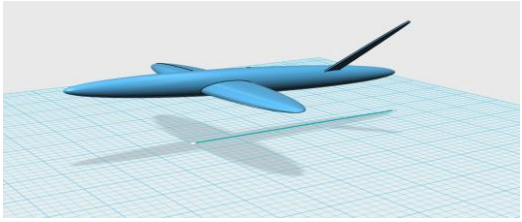
Use the Spline instruction in Sketch to draw a plan of the aircraft tail, and then select the Extrude instruction in Construct to stretch it for 2 mm to make it a part of the three-dimensional tail.

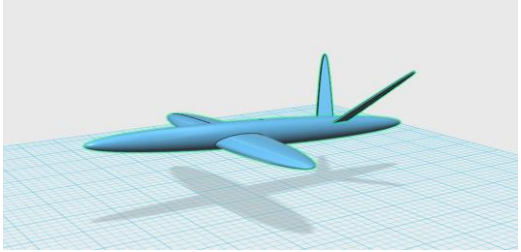




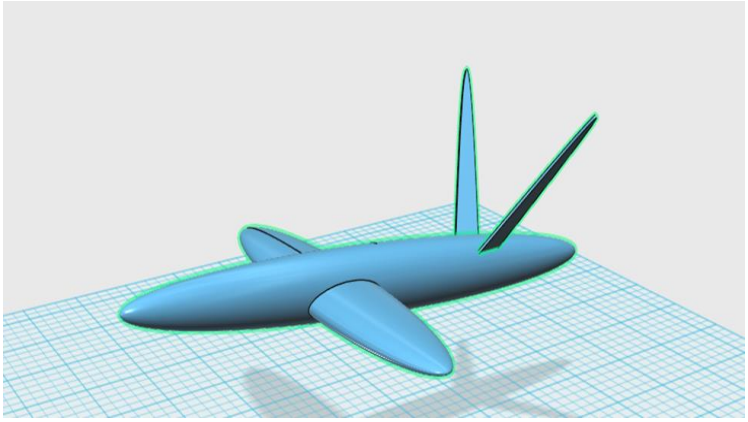
【STEP 6】

Use the mirror tool to draw the other part of the tail. Firstly, draw a straight line right under the aircraft body, and then select the Mirror instruction in the Pattern to draw a perfect tail for the aircraft.





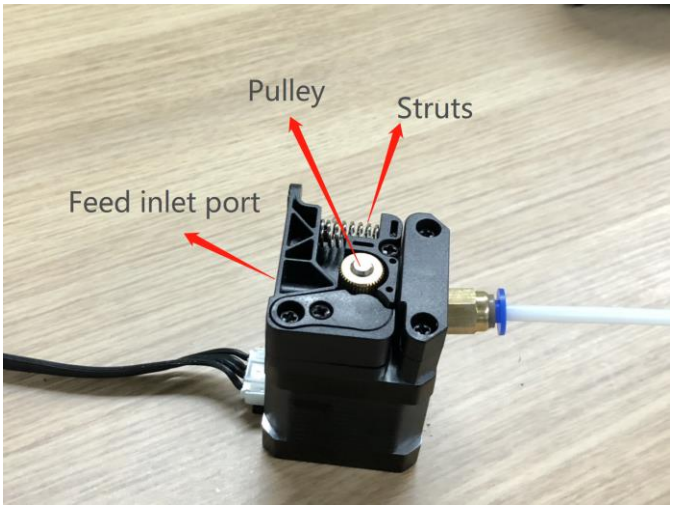
The aircraft model has been completed.



2 3D printing kit installation

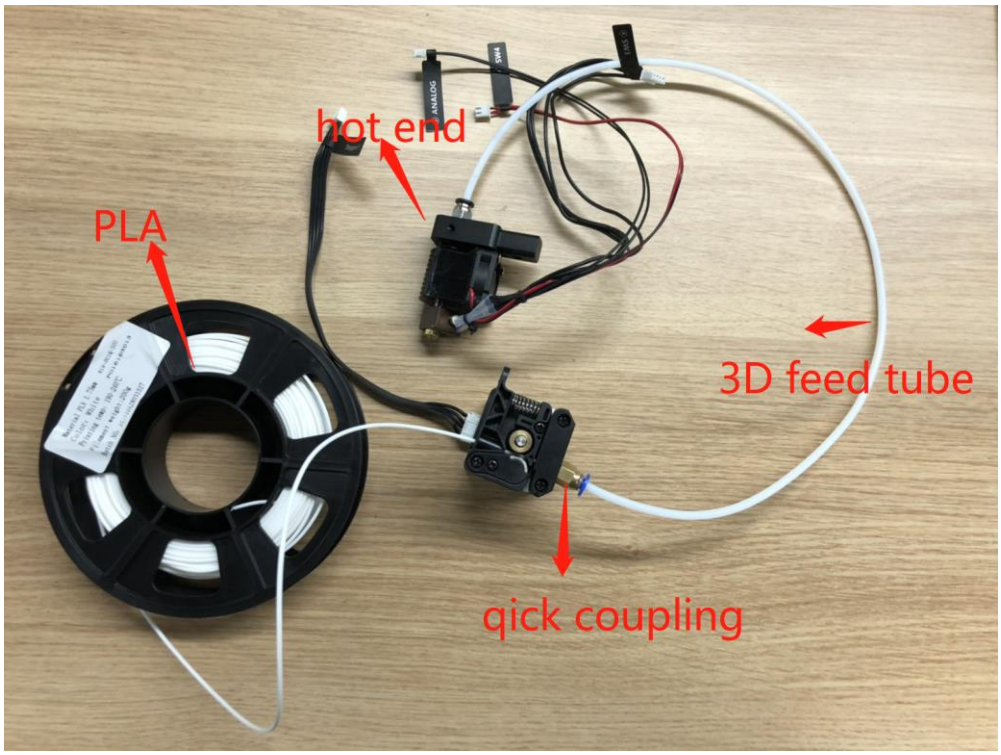
4) Consumables installation

Place the extruder horizontally, press down the pressure bar with your hands, put consumables into the feed inlet and insert it directly by using the pulley until it reaches the bottom of the through-hole. Leave it with the same length as the feeding pipe, as shown in the figure below.



5) Connection of the extruder and hot end

Insert consumables into the feeding pipe until it reaches the hot end bottom, and then tighten the fast joint of the feeding pipe on the extruder, as shown in the figure below. (Note: At this time, please make sure that the feeding pipe is also inserted to the hot end bottom, otherwise it will lead to an abnormal discharge.)

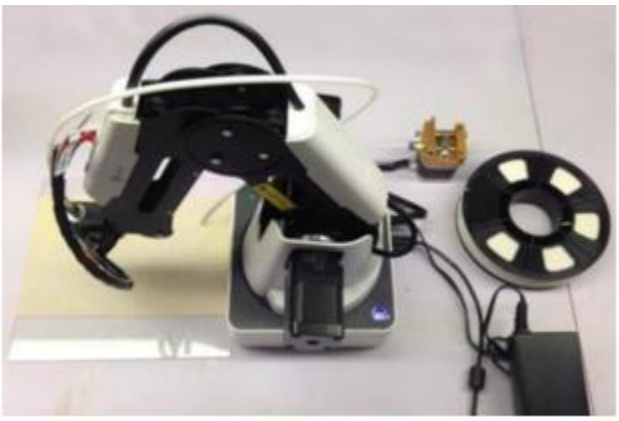


5) Connection of the 3D printing kit and the robotic arm.

Lock the hot end clamp tightly at the end socket; connect the heating rod power supply, the fan power lines, and the thermistor wires to the No.4, No.5 and No.6 interfaces respectively, as shown in the figure below.

Connect the extruder motor wires to the main control box Stepper1, as shown in the figure below.

The installation effect is shown in the figure below.



3 Burning of the 3D slice software Repetier Host

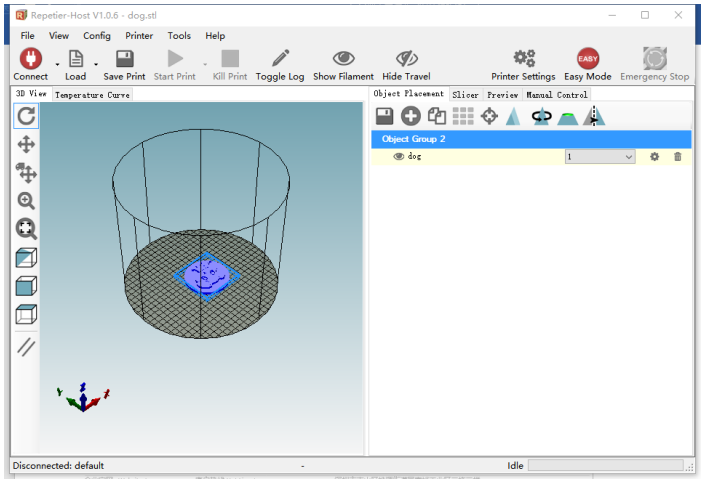
The Repetier Host software is already built into DobotStudio. Connect the robotic arm to the computer, open DobotStudio, and click “3D printing”, as shown in the figure below.

Technology knowledge center

Repetier Host is a free 3D printing comprehensive software developed by the Repetier company, which can be used for slicing, viewing and modification of G-Code, manual control of 3D printer, modification of some firmware parameters and some other small functions, and is suitable for beginners. Particularly, the operation interface, which needs to be controlled manually, makes it easy for the user to control the printer in real time.

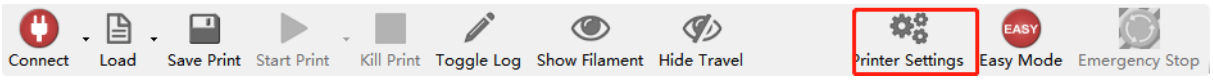
At that time, the 3D Printing Firmware Burning dialog pops up,and then click the Confirm button as shown in the figure below.

After the burning, it will automatically switch to the Repetier Host software as shown in the figure below. (The burning is only performed once at the beginning, and it is unnecessary in the follow-up process.)



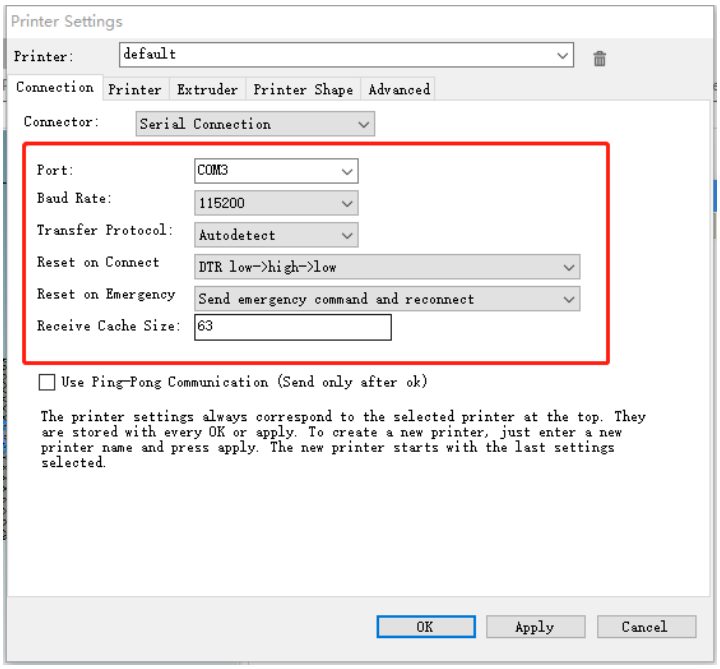
1) Set printer parameters in the Repetier Host software

During the first printing, we need to set relevant parameters and respectively set and save the "Connection Label", "Printer Label", "Extruder Label" and "Printer Shape". Click the "Printer" icon on the upper right corner of the interface to set relevant parameters in the popped-up dialog box, as shown in the figure below.



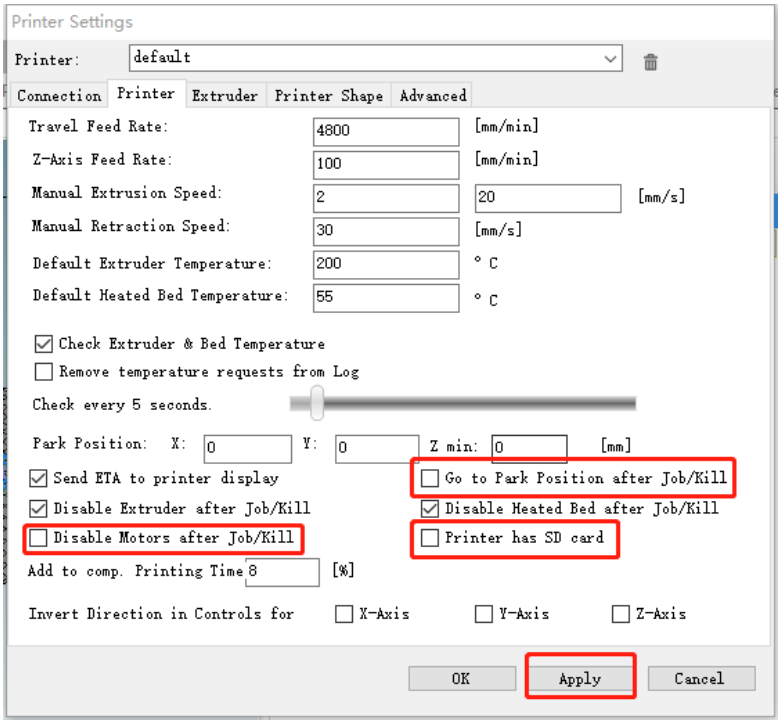
2) Connecting Label setting

Open the printer and set the popped-up window, change the relevant parameter settings as shown in the figure. Click Apply after the settings, as shown in the right figure.

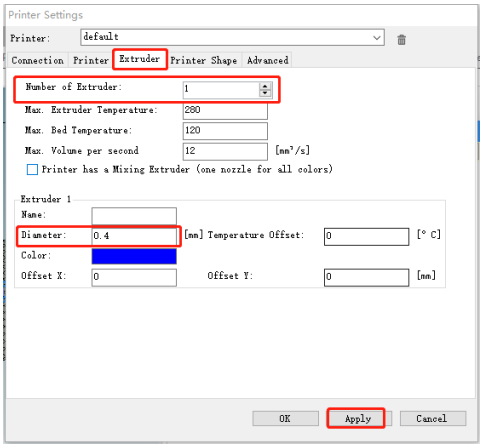


3) Printer Label setting

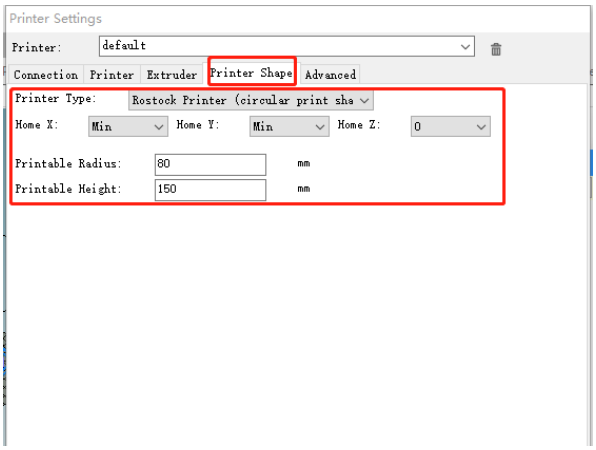
Just check the following three items and leave the others in their default settings.



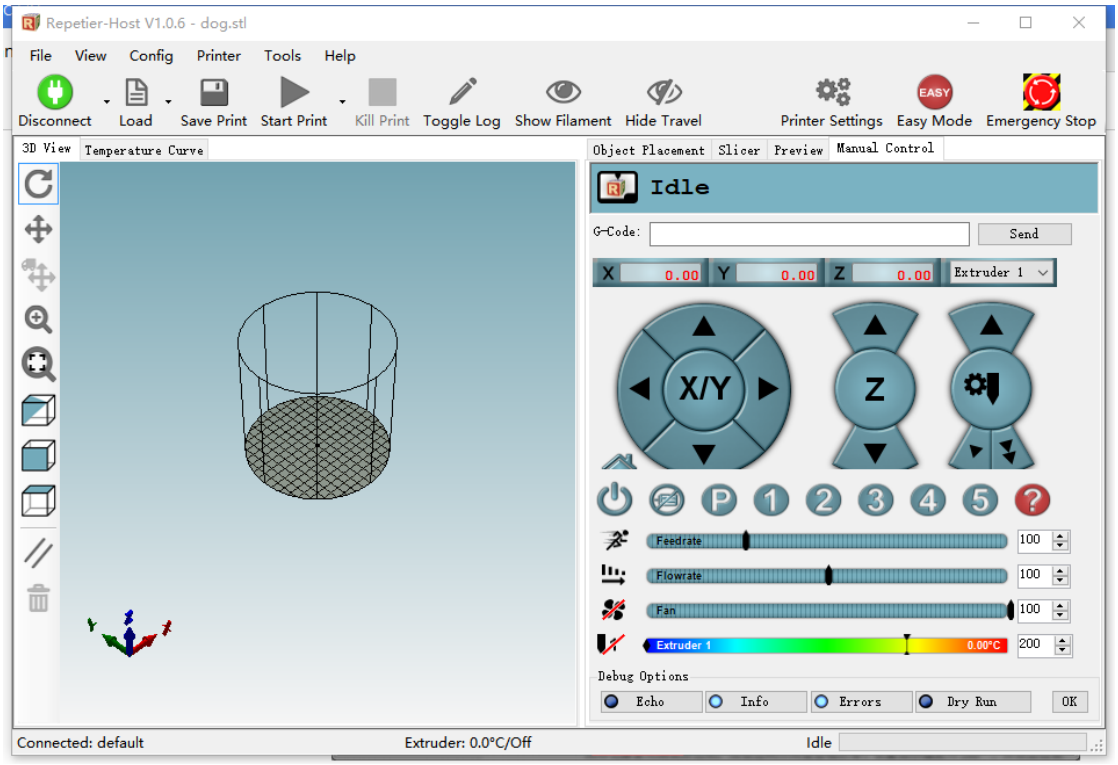
4) Extruder setting



5) Set the printer shape



Go back to the main interface after the settings. Click the "Connection" button at the upper left corner of the main interface to connect to the Dobot. After connection, the button will turn to green, and the temperature will be displayed at the lower part of the interface, as shown in the left figure.



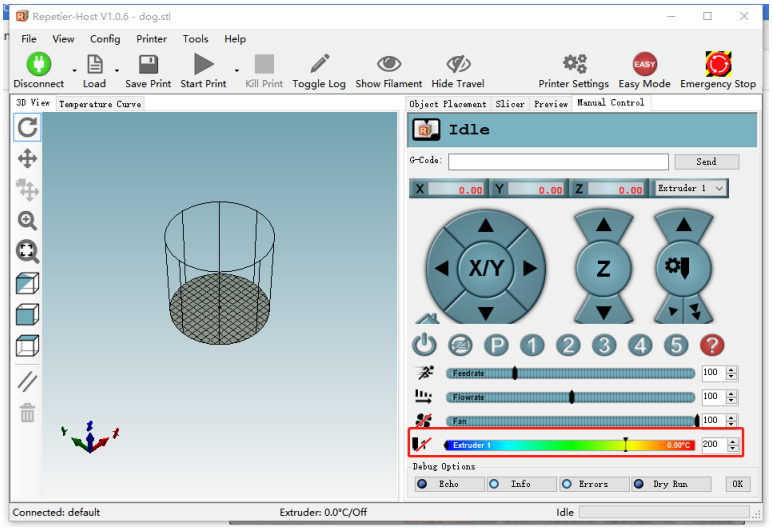
4 Printing preparation

Before printing, we need to do a series of preparations: test the functions of the extruder, adjust the print space,

obtain the print coordinate, import the model and set slice parameters. Now let's begin!

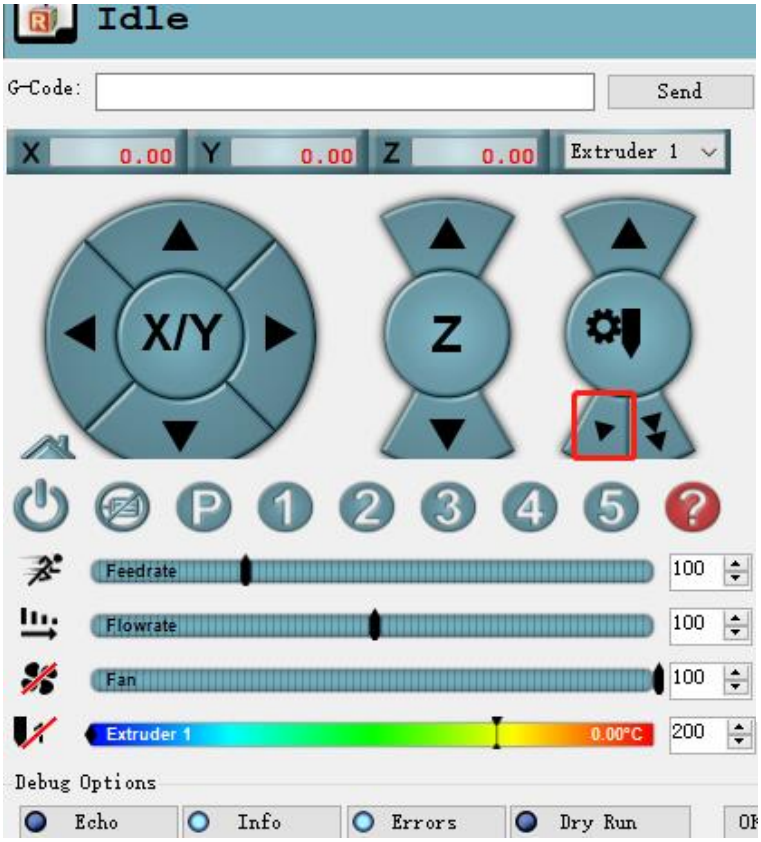
3) Test the extruder

The extruder needs to be tested to ensure that the print head can normally extrude consumables. The extruder must be operated with temperature above 170°, and under conditions of the consumable melting, it is necessary to heat the head of the extruder first. Set the heating temperature as 200°, and click the Heating button on the control panel, as shown in the figure below.



Precautions:
The heating rod can reach temperatures up to 200°, so please be careful! Do not let children play with it; it must be monitored by the staff during the operation, and shut down the equipment in a timely manner after the operation.

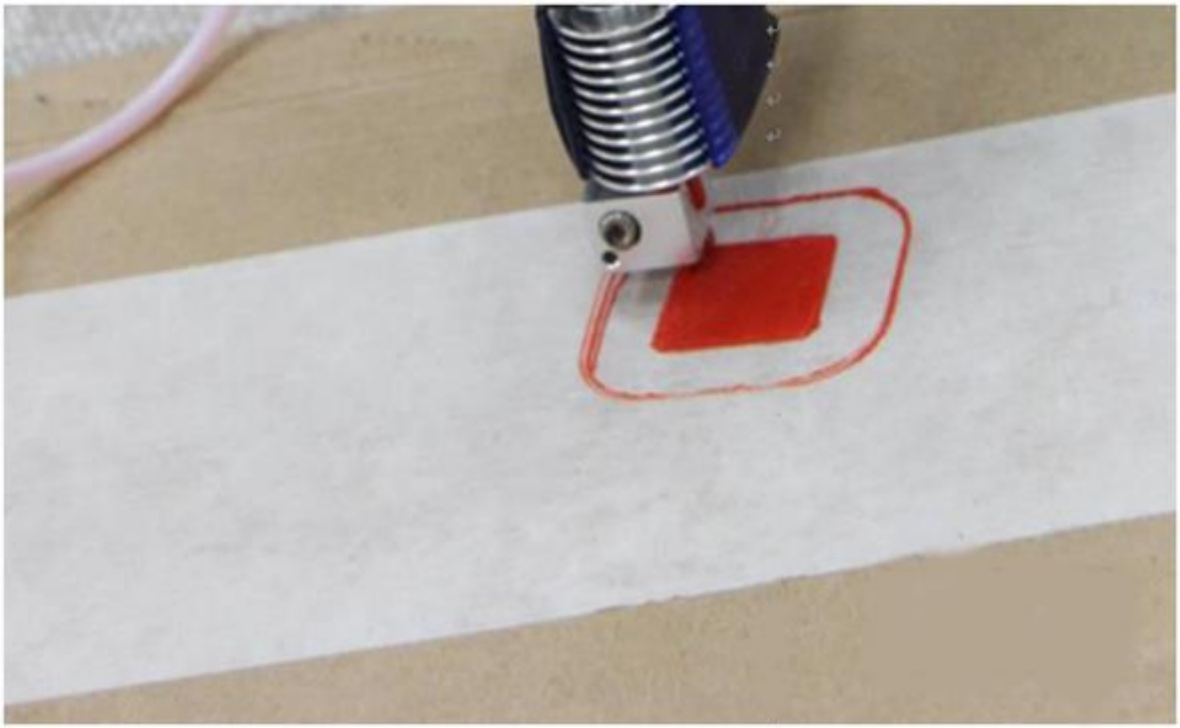
After heating it to 200°C, click the Feed button of the extruder to feed consumables for 10-30 mm, as shown in the figure below.



Extruder is functioning normally if melt consumables can been seen coming from the nozzle, as shown the in the figure below.

4) Adjust the print space to get the print coordinate

During the printing, the distance between the nozzle and the print bed shall not be too far or too narrow, or it will lead to the non-sticking of the first layer or the nozzle blocking. In order to increase the adhesion of the first layer, paste a piece of textured paper on the glass print bed (it is suggested to fix the glass pane with scotch tape to prevent the glass pane from sliding during the printing and causing failure to print).



The space between the print head and the glass pane can be adjusted as follows: Hold the UnlockKey button on the little arm, and drag the print head to place it at a position with the thickness equaling to A4 paper. Then input the M415 instruction in the command row, and press Enter to get the Z coordinate of the current print plane, and the distance is adjusted.

After sending the M415 instruction, there will be a short ringing which shows that the current coordinate is saved. If the robotic arm is constantly powered, it is unnecessary to input the instruction for the next print: just click "Run Task".

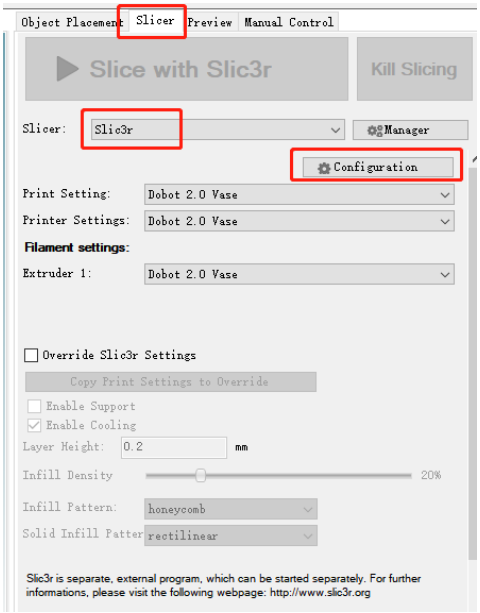
6) Import the model

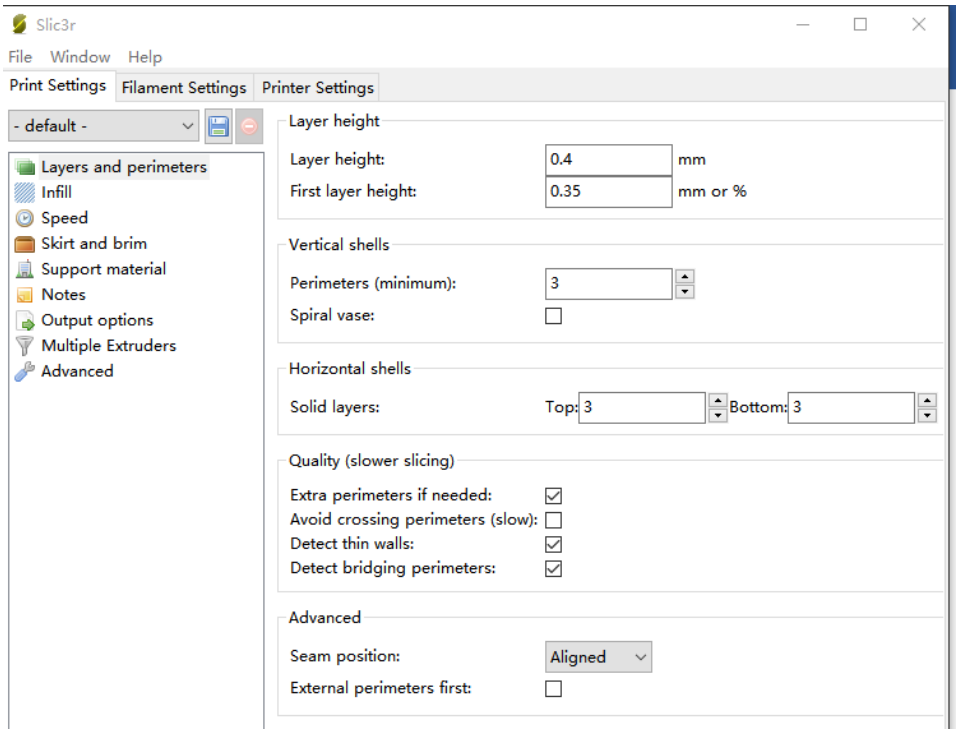
Click the Load button to import the model file. 3D printing applies a general STL file format, the user can design the 3D model themselves and convert it to STL file, or search free model files on the Internet and import it directly.

3) Set slicing parameters and perform the slicing

Slicing parameters should be configured before the first printing. Select the slicing engine Slic3r and click

"Configuration". Open the settings interface of the "Slicing Parameters" as shown in the right figure.





Print a vase using the commissioned robotic arm 3D printing kit. Complete the print steps in the following box.

Step 1:

Step 2:

Step 3:

Consult the relevant data to think about the following questions.

1 How to print a 3D model with more than one color?

2 Can you think of other materials that could be used as the raw materials for 3D printing?

3 What are the characteristics of the 3D printing materials used now?

Knowledge sharing

Practical link	Difficulties encountered	Solution
Installation of 3D printing kit		
Slicing software burn and parameters setting		
Printing preparation		

Comprehensive evaluation

Evaluation method	Evaluation phase	Evaluation contents	Evaluation criteria		
			3 Excellent	2 Good	1 General
Self-evaluation	**Scene creation lead-in**	• Understand the application of 3D printing technology in the aviation industry			
	Creativity	• Be able to design an artistic work.			
	Ability to solve problems	• Be able to create a model by using the 123D Design according to the task requirements.			
	Engagement	• Participate in class discussion and express ideas actively			
	Team collaboration	• Be able to cooperate with others.			

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Et toujours la possibilité d'établir des devis, de commander et de suivre vos commandes/factures en ligne.