

# Study on optimization of 3D printing parameters

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**Abstract:** With the development of 3D printing technology, the application of 3D printing has become more and more widespread, and the 3D printing efficiency problem that ensued has caused more and more researches. This paper will use the melt deposition type (FDM) forming printer. The printing consumables PLA and cylinder model were used as objects to study the effect of slice height on printing time, consumables, and dimensional accuracy and related parameters were optimized. The results showed that when the layer height was 0.14mm, the shortest printing time can be obtained on the premise of ensuring the quality of printing.

## 1. Introduction

The 3D printer is based on a digital model file and uses powdered metal or plastic bonded materials to add three-dimensional solids by adding layers of material through successive layers of physical layers. This is different from conventional removal materials. Therefore, it is also known as Additive Manufacturing or Additive Manufacturing (AM) technology. Because 3D printing can transform complex 3D manufacturing into a series of 2D manufacturing overlays, it can be generated without the use of molds and tools. Almost arbitrarily complicated parts greatly improve the production efficiency and manufacturing flexibility. Therefore, the development of the 3D printing industry has attracted more and more attention at home and abroad, and will also lead the direction of future manufacturing.

This article will study the parameters of the FDM printer affecting the printing efficiency. The FDM principle melts the low-melting filamentary material (such as PLA, ABS, PC, PPS) into liquid through the extrusion head of the heater. The molten thermoplastic filaments are extruded through the spray head. The extrusion head moves accurately along the profile of each section of the part. Extrusion of the semi-fluid thermoplastic material solidifies to an exact thin layer of the actual part, covering the already constructed part. Above the parts, and quickly solidify within 1/10s. After each layer is formed, the worktable is lowered by a layer of height. The spray head then scans and spins the next layer of cross-section, so it is deposited layer by layer until the last layer. This piles up from bottom to top into a solid model or part. Due to the advantages of the FDM rapid prototyping process, it is now widely used in various desktop printers. In this paper, the influence of the parameters on the printing efficiency is derived from the analysis of the printing parameters of the fused deposition modeling (FDM) printer using PLA as material.

## 2. The study of the relevant parameters of the law

The experimental 3D printer in this article is model Raise3D N2plus as shown in Figure 1-1, nozzle temperature is set to 210°, material is PLA, fill rate is 10%, print layer thickness is 2mm, the model is shown in Figure 1-2. The diameter is 10mm and the height is 15mm.



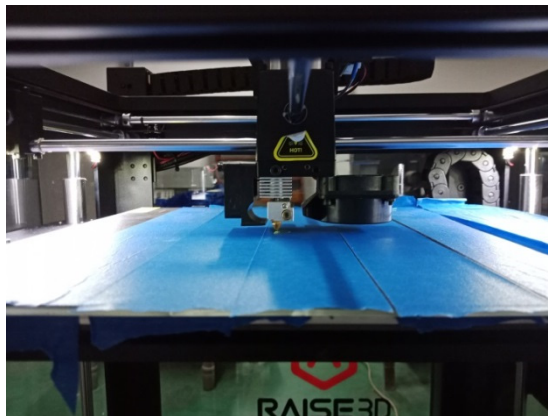


Figure 1-1 Printing equipment



Figure 1-2 Testing model

### 2.1. Layer height and print time test

According to the printing time required for setting up different floor height tests, according to setting the printing time of the products printed by different floor height tests, using the stopwatch measurement, recording the printing time of each experimental sample, and recording the measurement results in the table. The measured height parameters and printing time of each sample are shown in Table 2-1.

Table 2-1 Print Layer Height and Print Time Experiment Data

Layer height (mm)	0.02	0.04	0.06	0.08	0.1	0.14	0.2	0.26	0.32	0.4
Printing time(h)	1.18	0.62	0.43	0.33	0.27	0.22	0.17	0.13	0.12	0.1

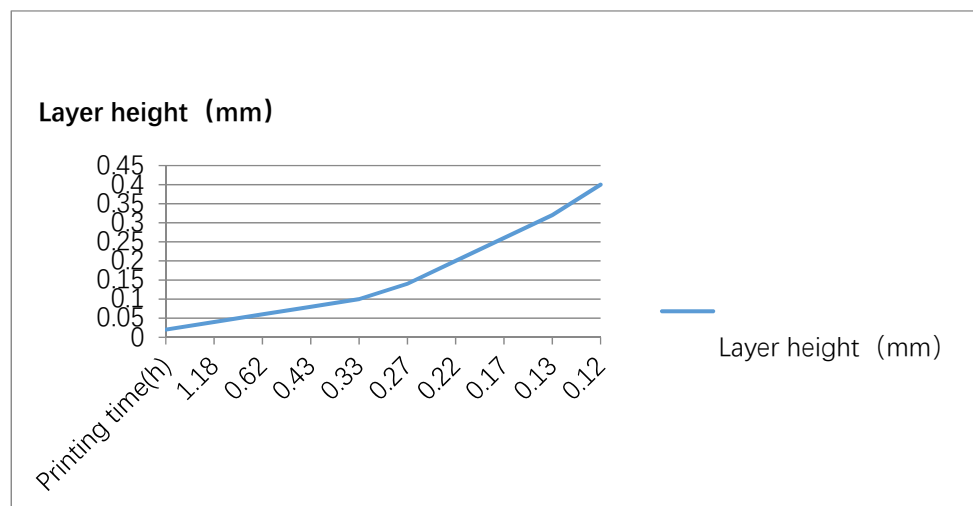


Figure 2-1 Layer height vs. print time

From the above experimental data analysis we can see that when the height of the layer is smaller, the printing speed is slower. When the layer is thicker, the speed is faster, but the model becomes rough. The change speed is gradually increasing.

### 2.2. The relationship between Layer height and printing supplies

According to the printing consumables required to set different floor height tests, the slicing software is used to measure the consumables of the printed products according to different floor heights, and the length of the printing consumables of each experimental sample is recorded, and the measurement

results are recorded in the table. The measured height of each sample and the length of the printing consumables are shown in Table 2-2.

Table 2-2 Print Layer Height and Printing Supplies Experimental Data

Layer height (mm)	0.02	0.04	0.06	0.08	0.1	0.14	0.2	0.26	0.32	0.4
Consumables(m )	0.36	0.36	0.37	0.38	0.38	0.39	0.41	0.43	0.44	0.47

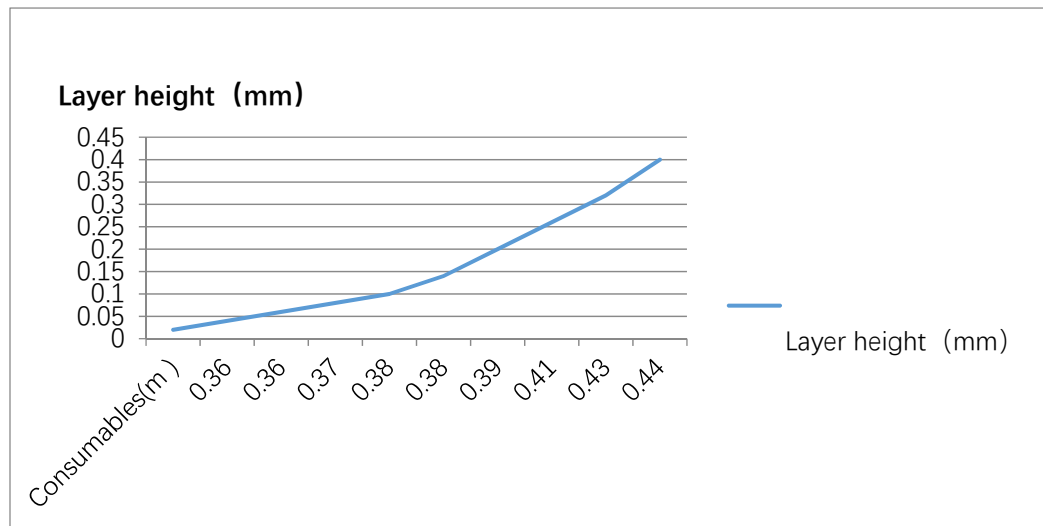


Figure 2-2 Relationship between store height and consumables

From the above data, it can be seen that consumables increase with the increase in floor height but have little effect.

### 2.3 . The effect of layer height on the print size accuracy

The dimensional accuracy of the printed product is tested according to the different layer heights set up, and then the dimensional error of the workpiece is measured. The measuring instrument used is a digital caliper, which measures the print size error from the X, Y, Z directions. And based on the results of the measurement, the average size error is recorded in the table. The measured height parameters and dimensional errors of each sample are shown in Table 2-3.

Table 2-3 Print layer height and dimensional accuracy test data

Layer height (mm)	0.02	0.04	0.06	0.08	0.1	0.14	0.2	0.26	0.32	0.4
Error(%)	2	2.5	2.8	4	5	6	6.5	7	7.7	8

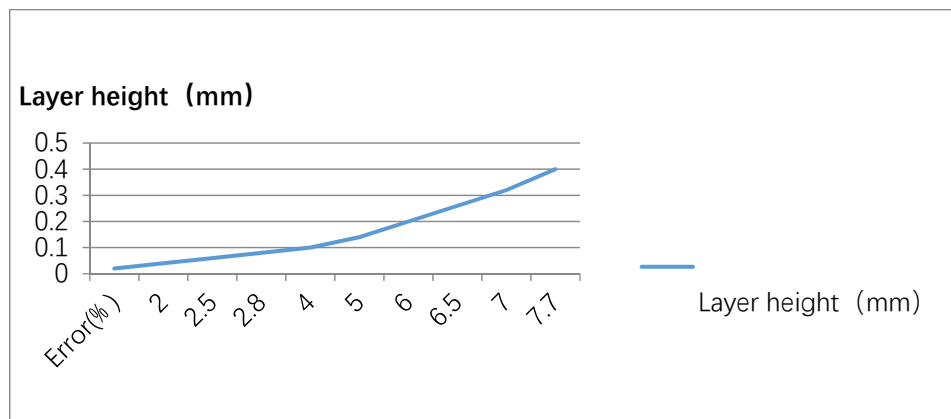


Figure 2-3 Relationship between storey height and consumables

From the analysis of the experimental data above, we can see that the smaller the height is, the higher the dimensional accuracy is. With the increase of the height, the rate of dimensional accuracy change tends to increase.

### 3. Conclusion

According to the experimental data of print height and printing time, consumables, and precision, the relationship between layer height and print time, consumables, and precision is shown in Figure 3-1.

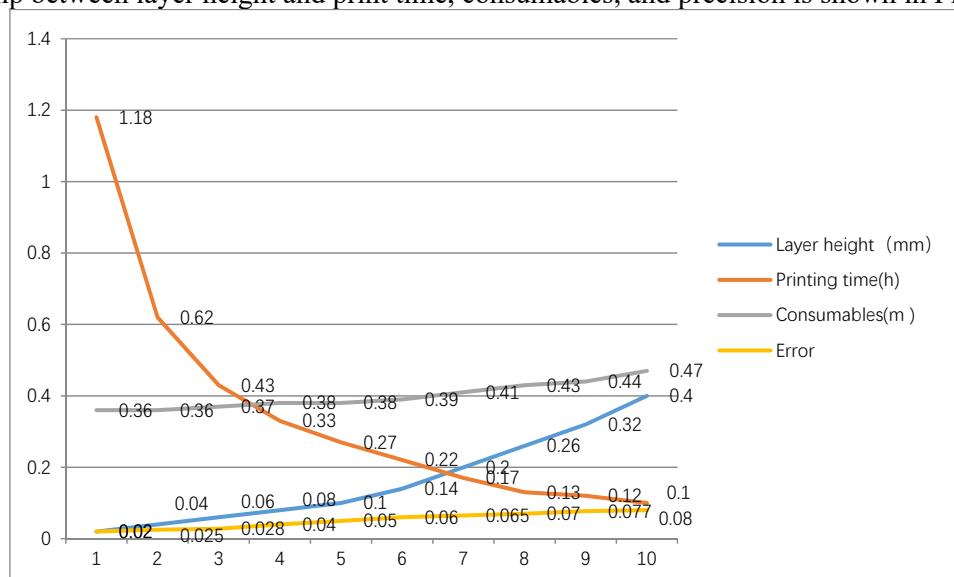


Figure 3-1 Layer height, printing time, consumables, and accuracy

From Figure 3-1, we can see the change trend between layer height, printing time, consumables, and precision. Based on the above figure, the experimental results show that when the layer height is 0.14mm, the shortest printing time can be obtained under the premise of ensuring the print quality.

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