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Research Paper Engineering

Development of slicing package of solid model for cone and sphere in rapid prototyping

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ABSTRACT

The present paper deals with the development of the slicing package of two geometry, cone and sphere, in rapid prototyping. Rapid prototyping is the technique of making prototypes with use of special rapid prototyping machines with various technique. It is called Layered Manufacturing or solid freeform fabrication technology also. This is the process of manufacturing prototypes making slices of whole component. As we know that development means to explore for understanding better way. Here cone and sphere two geometry are taken for the development. Through the programming various views of the cone and sphere are created. The aim of creating an explored view is achieved and real development of the slices is seen with uniform slicing.

Keywords : Rapid Prototyping, Slicing Package, Uniform Slicing, Development, Explored View

1. INTRODUCTION:

Rapid prototyping is the vast field for advancement and research. There are various technique like stereolithography, fused deposition manufacturing, selective laser sintering, laminated object manufacturing etc. all techniques have one common thing that all rapid prototyping techniques work on the principle of the slicing. Two types of slicing methods are recommended now a days, Adaptive slicing and Uniform slicing. Uniform slicing is the approach for slicing the components at same thickness throughout. If we consider it as a height of the component, than whole height will be divided into equal no. of slices or we can say that every slice has equal Z height.

Tessellation of the model or triangular faceted model gives the linear approximation view in STL format. A CAD model will look different in its STL model.

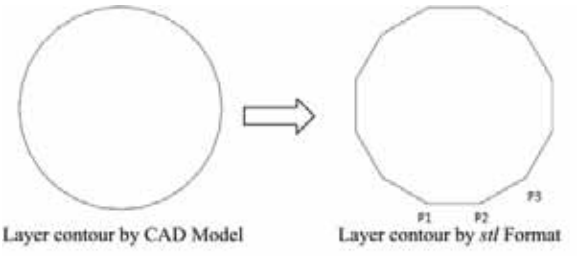

Figure 1. CAD model and STL format

As shown in figure 1, CAD model of circle will be converted into approximation model or polygonal view of the STL model. Because RP machines understand only linear interpolation. There are different techniques in different software for converting CAD models in STL format.

2. SLICING ERROR:

Slicing error is the issue of surface finish and accuracy of the prototype manufactured or generated. For that only for understanding one program is made to show that this kind of problem can be solved by generating more no. of generators in case of cone and sphere.

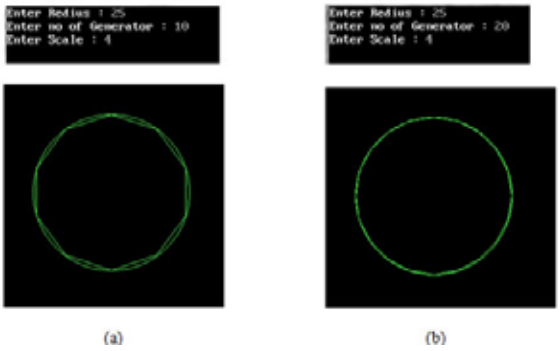

Figure 2. Solution of the chordal height error

As shown in figure 2, same radius circle with different no. of generators, which shows that if we make provision for selecting no. of generators than we can solve the error in slicing for chordal height, that is done for cone and sphere in this research. In (a) there are only 10 generators and radius is 25 mm., which gives the polygonal look and in (b) there are 20 generators with same radius as (a), though it gives smooth view than that of (a).

3. TRIANGULAR FACET OF THE STL MODEL

In STL model every triangular facet has three vertices, these three vertices have the geometrical data of x,y,z coordinates. Software will help us to find out the only vertex coordinates, not coordinates of the points on line segments of the facet. To find out those points we have the mathematical formula in the case of triangular facet, line of equation is used to find out the coordinates of the intersected points. These intersected points are the intersection of the triangular facet and the horizontal plane at the fixed height from the base. Considering a triangular facet intersected by a horizontal plane as shown in figure 3, it is clearly shown that Xa, Ya, Za are the Apex point coordinates and X1, Y1, Z1 and X2, Y2, Z2 are the base point coordinates.

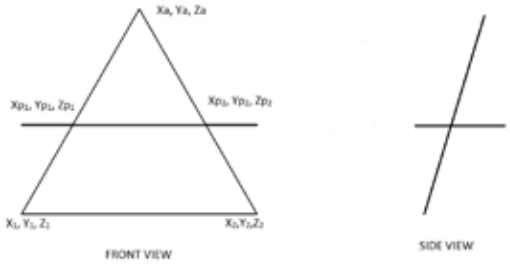

Figure 3. Intersected view of triangular facet

For line segment of (Xa, Ya, Za) and (X1, Y1, Z1) equation of line will be as under,

$$\frac{Xp1-X1}{Xa-X1}=\frac{Yp1-Y1}{Ya-Y1}=\frac{Zp1-Z1}{Za-Z1}=C$$

For line segment of (Xa, Ya, Za) and (X2, Y2, Z2) equation of line will be as under,

$$\frac{Xp2-X2}{Xa-X2}=\frac{Yp2-Y2}{Ya-Y2}=\frac{Zp2-Z2}{Za-Z2}=C$$

Once we found the constant C than we can find the other points lying on the line segment for the slicing and this is continued till the required or desired no. of slices are not obtained.

4. DEVELOPMENT OR EXPLORATION

4.1 DEVELOPMENT OR EXPLORATION OF CONE

Cone is such a geometry which gives the typical coordinates data information throughout its height. That means at every slice height it gives variation in X and Y coordinates, whereas Z will be same for that height. Here in this research work calculation process is done in C language and than after that calculation using graphics programming in C language various views of the cone is made. First view is plan or top view, second view is elevation or front view and the last view is the explored view or say developed view of the cone. Figures taken from the C program output.

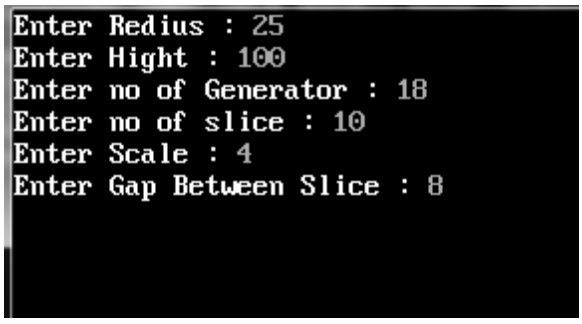

Figure 4. Input data for the development of cone

Here radius of the cone is taken 25 mm and height is 100 mm. For convenience center point of the cone is taken in first quadrant, so every point will give only positive values for X, Y, and Z coordinates. Generators are the slant edges on the cone, which divide the cone in no. of side like polygon, that means if no. of generator is 10 than output will come as polygon with 10 number sides only. Here as above shown in figure 4. no. of generators is 18, which is very dense than that of 10, and give better look. Though there can be more no. of generators for more accuracy and surface finish issue.

Once the input is given than the software will give the plan view of the cone.

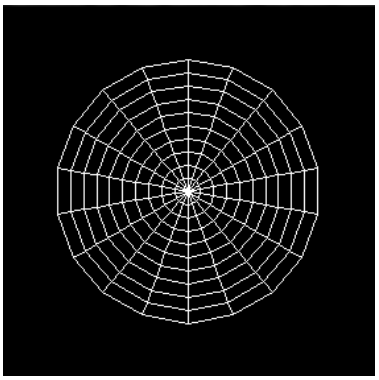

Figure 5. Plan view of cone

Next view will be elevation or front view, shown in figure 6. In this view still cone is only looking like divided in equal no. of slices, but not separated. There are 10 no. of slices are selected and figure gives the 10 slices but connected.

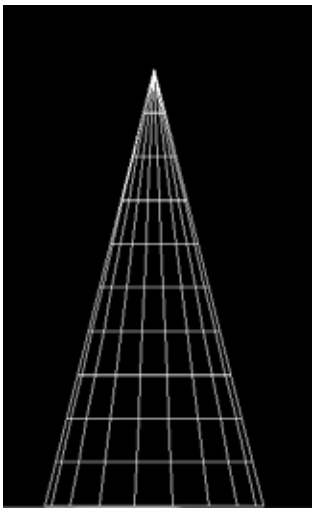

Figure 6. Elevation or front view of cone

Now third and last output result of the graphics program is the explored or developed view, with the gap between every adjacent slices. That is shown in figure 7.,which is the final result.

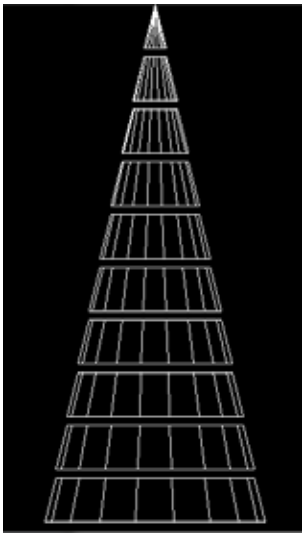

Figure 7. Explored view of cone

4.2 DEVELOPMENT OR EXPLORATION OF SPHERE

Same technique is used with little change in calculation of coordinates using x2+y2+z2=r2 and sin and cos. First of all program is run and required input data are given as shown in figure 8.

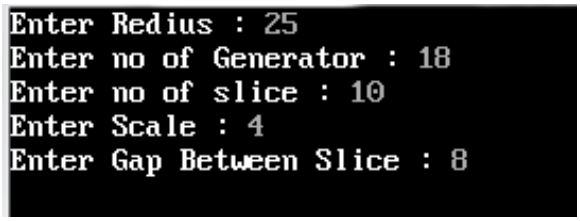

Figure 8. Input data for the development of sphere

Here radius is 25 mm and no. of generators are 18. The first result will be plan of the sphere.

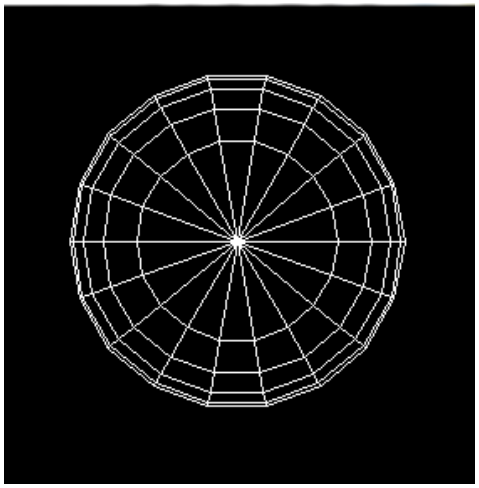

Figure 9. Plan or top view of sphere

Next result will be elevation or front view of sphere, it looks little odd at the top and bottom slice, due to consideration of uniform slicing, but there is also a solution, if no. of slice will increased than this error can also be compensated.

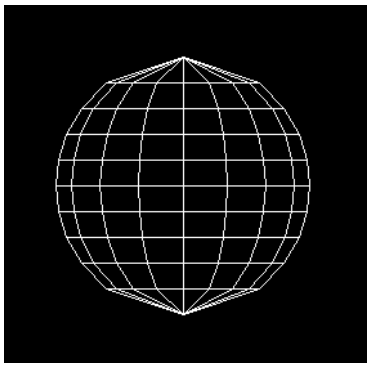

Figure 10. Elevatio or front view of sphere

The final result of the sphere with explored view is shown in figure 11. With the gap between two adjacent slice development of the sphere is done.

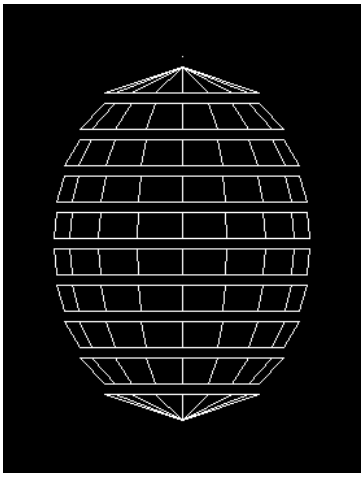

Figure 11. Explored view of sphere

CONCLUSION:

Work done over here is the attempt to give an idea how Rapid Prototyping Machines work. Explored view of cone and sphere give the information about how slices are processed. A general idea can be developed about the generation of slices in slicing package.

FUTURE WORK

Generation of part program of G code from the data, collected from the program output, and generate prototypes with better accuracy and surface finish.

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