DESIGNING THREE DIMENSIONAL GRAPHIC OBJECTS USING THE POLYNOMIAL OF TRIGONOMETRIC CURVES WITH A SHAPE PARAMETER AND THE SWEEP SURFACE

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Contents

5. Report

5.1 Proposed Executive Summary

Background of Research – CAGD/CAD is very widely used in the world for designing any shape of two and three dimensional objects. This project was focused in combining the polynomial of trigonometric with a shape parameter and rotation sweep surface method in designing three dimensional objects. This project will shows the effective of the equation used can manipulate the selected design and also can produce the variety three dimensional objects.

Objective - The objective of this project is to design the three dimensional graphic objects by using the uniform polynomial of trigonometric curve with a shape parameter and the sweep surface.

Research Methodology/Design/Approach – This project use the polynomial of trigonometric with a shape parameter, which are focus in uniform quadratic and cubic functions. Both functions will be combined with rotational sweeping method in designing three dimensional objects.

Expectation Outcome – From the study, there are many designs of the three dimensional objects can produced using the same method, equation, control polygon and control points. These characteristics can help designer produced any symmetrical three dimensional objects flexibly, easily and less costly in time of working the calculation.

5.2 Enhanced Executive Summary

The desired shape of Bezier and B-spline curves can be meeting by adjusting the control points, knot vectors and degrees. This adjustment was complicated and costly. In this project, the trigonometric polynomial with a shape parameter curves and rotational sweeping method was introduced as an alternative method in generating the variety of symmetrical three dimensional objects and designs easily, flexibly and less costly in time of working the calculation. The trigonometric polynomial curves were analogous to B-spline curves, but the curves can be manipulated based on the value of shape parameter, λ on a fixed control polygon and same control point. This property was an advantage in generating three dimensional objects using rotation sweep surface method, where the curve was rotated at y-axis with 360^{o} degree. This polynomial was studied based on open and close uniform curves and applied in rotational sweep method to create three dimensional objects. The shape of the vase was generated as examples of three dimensional objects and the variety designs were produced by manipulated the value of shape parameter.

Keywords: Trigonometric, Shape Parameter, Rotation, Sweep Surface, Vase

5.3 Introduction

Computer Aided and Geometric Design (CAGD) was widely used in many industries in the world. There are many types of polynomial that were already introduced by mathematicians and which were very useful in creating any shapes. In this project, the polynomial of trigonometric with a shape parameter will be used to generate a shape of three dimensional objects using sweep surface method.

Background of the study

Polynomial trigonometric with a shape parameter was introduced by Han (2002) for quadratic polynomial and this polynomial was further expanded by Han in year 2004 for cubic polynomial. This polynomial was created with a shape parameter that is λ, where has a function to manipulate the curve close or far from the control polygon in the specific range. The segment of quadratic curve is analogue to the B-spline curve which is plot by three consecutive control points and has C^1 continuity at each of the knots. While, the segment of the cubic polynomial was plotted by four consecutive control points and the curve obtain also look like cubic B-splines. The cubic polynomial has C^3 continuity for $\lambda \neq 1$ and has C^5 continuity for $\lambda = 1$. Since, the curve of the polynomial can be adjusted by the shape parameter, so that the surface also can be manipulated to generate the beautiful shape that a user wants.

The surface will be generated by using sweep surface method, focusing on rotational sweeping method. Sweep surface is an operation of a general freeform surface construction tool that can be found in practically any solid modeling (Elber, 1997), and it is also a powerful technique to generate surfaces in computer graphics (Wang and Joe, 1997). Besides that, Coquillart (1987) defined the sweep surface method was moving cross section along the path so that the cross section lies in the plane normal to the path, the path intersects the cross section's origin and the x-axis of the cross section coordinate system is in the direction of the quasi-normal.

The surface of rotation or revolution can be designed by rotating a two-dimensional entity such as a line or a planar curve, about an axis in space through a specified angle. This rotation will result a closed surface if the rotating angle is 360° and otherwise, it is an open surface (Lai & Ueng, 2000).