Shivam Srivastava

CS-33

R.no:- 20 (1705410129)

Computer Graphics Assignment

Assignment:-04

Q-1 ⇒ Write an algo to draw beizer curve. Make a comparison of beizer & B-spline algo for curve generation.

⇒ **Beizer Curve:-** It defined curve used in 2D graphics application like abode illustrator, inkscape etc. Curve is defined by four point: the initial position & the terminating position i.e P_0 & P_3 resp. & two separate middle point i.e P_1 & P_2.

Algo:- * **Evaluation & subdivision algo:-** It can be evaluated at a specific parameter value & the curve can be split at that value using the de casteljau algo, where eqn $b_i^k(t_0) = (1-t_0) b_{i-1}^{k-1} + t_0 b_i^{k-1}$,

$k = 1, 2, \ldots n$ $\quad i = k, \ldots n$ is applied to obtain the new control point.

* **Continuity Algo:-** It can be represent complex curve by increasing the degree & thus the no. of control points. Alternative, complex curve can be formed by joining several Bezier curve end-to-end. One set of continuity condition are geometric design by letter G_1 with integer exponent.

$$\gamma^a(1) = \gamma^b(0)$$

* **Degree elevation:-** It permit to increase the degree of Bezier curve from n to n+1 & no. of control point from n+1 to n+2 without charging shape of curve. The new control point b_i^{n+1} of degree n+1 curve are

given by $b_i^{n+1} = \frac{i}{n+1} b_{i-1}^n + \left(1 - \frac{i}{n+1}\right) b_i^n$,

$i = 0, \ldots, n+1$ where $b_{-1}^n = b_{n+1}^n = 0$. The degree elevation algo for bezier curve from degree n to n+r is given by

$$b_i^{n+r} = \sum_{j=\max(0,i-r)}^{\min(n,i)} \frac{\binom{n}{j}\binom{r}{i-j}}{\binom{n+r}{i}} b_j, \quad i = 0, 1, \ldots, n+r$$

Comparison of beizer & b-spline algo for curve generation:-

There is no big comparison, B-spline are piece wise polynomial. The area of validity for each piece is limited by so called 'Knot points'.

Usually some constraint are put at Knot point, for example that we should have a continous curve, may be also first & second derivative should be same there. Beizer curve are instead global polynomial with set of point $\{P_0, \ldots, P_n\}$ to aim for

$$\sum_{K=0}^{N} \binom{N}{K} (1-t)^{n-t} t^K P_K$$

Q-3:- Write short notes on:-

① Properties of B-spline curve:-

* The polynomial curve has degree d-1 & C^{d-2} continuity over the range of u.
* For n+1 control point, the curve is described with n+1 blending functions
* Each blending function $B_{K,d}$ is defined over d subinterval of total range of u, starting at Knot value u_K.
* Range of parameter u is divided into n+d subinterval by the n+d+1 value specified in the knot vector.
* Each section of spline curve is influenced by d control point.
* Any one point can effect the shape of atmost d curve section.

(II) Blobby Objects :- Object which are non-rigid & do not retain their fixed size. It is object which change their shape & size on the basis of their state. In motion or in other such states, they show a flexible or non-rigid behaviour & hence, change their shape & size.

(III) NURBS :- (Non Uniform rational B-spline) It is used in graphics for generating & representing curve & surface. It offer great flexibility & precision for handling both analytic & modeled shapes. It commonly used in computer aided design, manufacturing & engg & are part of numerous industry wide standard.

(IV) - Blending function :- Used to determine in generating a curve that allow closer approximation of a control polygon defined by four control points. The curve interpolate both endpoint & direction of tangent line at each endpoint & direction of tangent of the direction of the respt. end of control polygon.

(V) - Hermite interpolation :- It is used to interpolate b/w key-point like object movement in key-frame animation or camera control). It is simply we to calculate but also more powerful.

Q-4 :- Explain parametric representation of geometry with examples.

:- It represent the functional relationship b/w several variable by means of auxiliary variable parameter.

This function yield a parametric representation of functional relationship b/w x & y, & eqn (*) are said to be parametric eqn of corresponding curve.

It define a grp of quantities as function of one or more independent variable called parameter. It is commonly used to express the coordinate of the point that makeup a geometric object such as curve or surface, in which case the eqn are collectivity called a parametric representation.

It is generally nonunique, so the same quantities may be expressed by no. of diff parameter. It commonly used in Kinematics, where the trajectory of an object is represented by eqn depend on time as parameter. Because of this application, a single parameter is often label however, parameter can represent other physical quantity.