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FACULTY OF ENGINEERING & TECHNOLOGY

BCS -504 Computer Graphics & Multimedia

Lecture-17

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OUTLINE

- **CURVES**
- **TYPES OF CURVES**
- **BEZIER CURVE**
- **PROPERTIES OF BEZIER CURVE**

Curves

In computer graphics, we often need to draw different types of objects onto the screen. Objects are not flat all the time and we need to draw curves many times to draw an object.

Types of Curves

A curve is an infinitely large set of points. Each point has two neighbors except endpoints. Curves can be broadly classified into three categories − **explicit, implicit,** and **parametric curves**.

Types of Curves

Implicit Curves
Implicit curve representations define the set of points on a curve by employing a procedure that can test to see if a point in on the curve. Usually, an implicit curve is defined by an implicit function of the form −
f x,y = 0

Explicit Curves
A mathematical function y = fx can be plotted as a curve. Such a function is the explicit representation of the curve. The explicit representation is not general, since it cannot represent vertical lines and is also single-valued. For each value of x, only a single value of y is normally computed by the function.

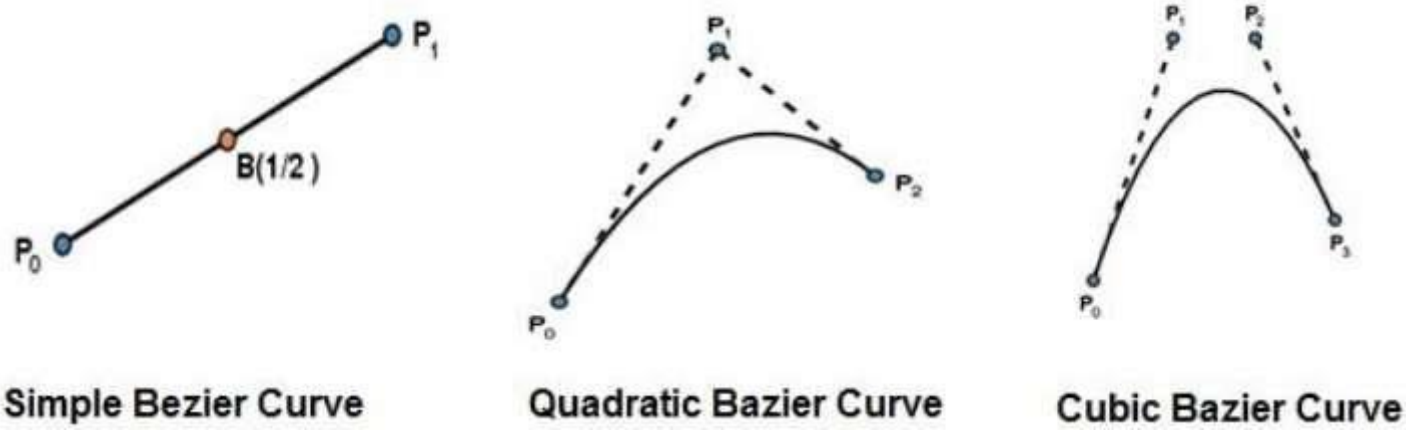
Parametric Curves
Curves having parametric form are called parametric curves. The explicit and implicit curve representations can be used only when the function is known. In practice the parametric curves are used. A two-dimensional parametric curve has the following form −
Pt = ft, gt or Pt = xt, yt
The functions f and g become the x,y coordinates of any point on the curve, and the points are obtained when the parameter t is varied over a certain interval [a, b], normally [0, 1].

Bezier Curves

Bezier curve is discovered by the French engineer **Pierre Bézier**. These curves can be generated under the control of other points. Approximate tangents by using control points are used to generate curve. The Bezier curve can be represented mathematically as −

\sum_{k=0}^{n} P_{i}{B_{i}^{n}}(t)

The simplest Bézier curve is the straight line from the point P0 to P1. A quadratic Bezier curve is determined by three control points. A cubic Bezier curve is determined by four control points.



Simple Bezier Curve

Quadratic Bazier Curve

Cubic Bazier Curve

Properties of Bezier Curves

1. They generally follow the shape of the control polygon, which consists of the segments joining the control points.
2. They always pass through the first and last control points.
3. They are contained in the convex hull of their defining control points.
4. The degree of the polynomial defining the curve segment is one less that the number of defining polygon point. Therefore, for 4 control points, the degree of the polynomial is 3, i.e. cubic polynomial.
5. A Bezier curve generally follows the shape of the defining polygon.
6. The direction of the tangent vector at the end points is same as that of the vector determined by first and last segments.

Properties of Bezier Curves

1. The convex hull property for a Bezier curve ensures that the polynomial smoothly follows the control points.
2. No straight line intersects a Bezier curve more times than it intersects its control polygon.
3. They are invariant under an affine transformation.
4. Bezier curves exhibit global control means moving a control point alters the shape of the whole curve.
5. A given Bezier curve can be subdivided at a point t=t0 into two Bezier segments which join together at the point corresponding to the parameter value t=t0.

Multiple Choice Question

MUTIPLE CHOICE QUESTIONS:

Sr no	Question	Option A	Option B	OptionC	OptionD
1	The intersection of two conductors in transformation defines a …….	pivot position	point position	pixel position	state position
2	Flat panel device is known as a …….	passive matrix CRT	active matrix LCD	passive matrix LCD	active matrix CRT
3	Which matrix LCD transistors are used at each (x, y) grid point	In active	active	both a & b	never active
4	Transistor can also serve as a……. for the state until it is changed.	storage	memory	collection	techniqu e
5	Which one is changed in when Transistor cause crystal to change their state quickly ?	control degree	state has been changed.	grid state	a & b

REFERENCES

- http://www.engppt.com/search/label/Computer%20Graphics