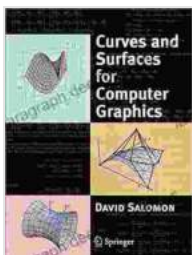


Curves and Surfaces for Computer Graphics: A Comprehensive Guide

Curves and surfaces are fundamental elements in computer graphics. They are used to represent a wide variety of objects, from simple lines and circles to complex 3D models. In this article, we will provide a comprehensive overview of curves and surfaces for computer graphics, covering their mathematical foundations, techniques for representing them, and applications in various fields.

Mathematical Foundations

Mathematically, curves are defined as one-dimensional objects that can be parameterized by a scalar variable. Surfaces, on the other hand, are two-dimensional objects that can be parameterized by two scalar variables.



Curves and Surfaces for Computer Graphics

by Emmanuel Mazer

★★★★☆ 4.5 out of 5

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Screen Reader: Supported

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The most common type of curve is the parametric curve, which is defined by a set of parametric equations. These equations specify the coordinates

of a point on the curve as a function of a scalar parameter. For example, the parametric equations of a circle with radius r centered at the origin are:

$$x = r * \cos(t) \quad y = r * \sin(t)$$

where t is the scalar parameter.

Surfaces can also be defined parametrically, using a set of parametric equations. However, surfaces can also be defined implicitly, as the set of points that satisfy a given equation. For example, the equation of a sphere with radius r centered at the origin is:

$$x^2 + y^2 + z^2 = r^2$$

Representing Curves and Surfaces

There are a variety of techniques for representing curves and surfaces in computer graphics. The most common technique is to use polygonal approximations. A polygonal approximation is a collection of polygons that approximate the shape of the curve or surface.

Another technique for representing curves and surfaces is to use splines. Splines are smooth curves that are defined by a set of control points. The control points determine the shape of the spline, and the smoothness of the spline is determined by the type of spline used.

Finally, curves and surfaces can also be represented using implicit surfaces. Implicit surfaces are defined as the set of points that satisfy a given equation. The equation of an implicit surface is typically a polynomial

equation, and the shape of the surface is determined by the coefficients of the polynomial.

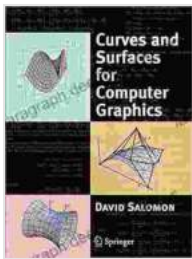
Applications

Curves and surfaces are used in a wide variety of applications in computer graphics. Some of the most common applications include:

- **Modeling:** Curves and surfaces are used to model a wide variety of objects, from simple lines and circles to complex 3D models.
- **Animation:** Curves and surfaces are used to animate objects. For example, a spline can be used to define the trajectory of a moving object.
- **Rendering:** Curves and surfaces are used to render objects. For example, a surface can be used to define the shape of a light source.
- **Collision detection:** Curves and surfaces are used to detect collisions between objects. For example, a surface can be used to define the boundary of a room.

Curves and surfaces are fundamental elements in computer graphics. They are used to represent a wide variety of objects, from simple lines and circles to complex 3D models. In this article, we have provided a comprehensive overview of curves and surfaces for computer graphics, covering their mathematical foundations, techniques for representing them, and applications in various fields.

We hope that this article has been helpful. If you have any questions, please feel free to leave a comment below.



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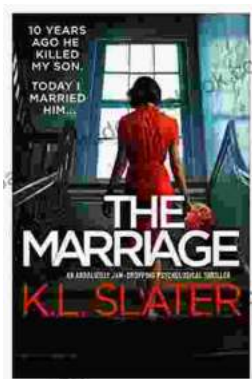
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