Surface Generation from a Non-structured Set of Vertices

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A number of methods exist for curve and surface generation from a number of data points (vertices). These data points are called "control points," and they define the shape of the curve or surface. This is the reason why they have in their name the word "control" – they control the shape of the resulting curve/surface.

Spline methods are the most popular methods for describing curves and surfaces. They are parametric functions, piecewise functions, and they have $k-1$ parametric continuity along the borders of adjacent pieces, where k is the degree of the polynomials. There exist two methods for defining the shape of curved surfaces. These are *interpolation* and *approximation.* In the case of interpolation the resultant surface passes through the control vertices whereas in the case of approximation the surface passes "near" the control vertices, approximating their shape.

This paper describes a recursive midpoint subdivision Bezier Spline. The method is derived from a standard cubic Bezier spline. At each step, it constructs a new set of points with more vertices closer to each other than the original set of points, resulting in a smooth curve/surface. Some of the new points lie near the edges connecting original control points, and these are called new edge points. The points corresponding to old control points are called new vertex points. In the case of surfaces some new points lie in the middles of the squares of the original mesh, and are called new face points. The importance of this method is that it is generalized to generate surfaces with an arbitrary topology of control points.

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