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Coarse : CS-537 A Interactive Computer Graphics

Due-Date: Feb 8th, Week 2

Title : Computer Rendering of Fractal Curves And Surfaces

Author : Loren C. Carpenter

Summary:-

The paper, Computer Rendering of Fractal Curves and Surfaces written by Loren C. Carpenter presents a simple method of statistical division for displaying and generating fractal surfaces. Carpenter introduces a method of statistical division in which a geometric entity is sub divided into smaller entities. His method, makes sure that the statistical property of the geometric entity is maintained while dividing it. The geometric entity is represented as a set of points and a statistical factor related to its geometry. The paper also talks about some other previous methods used for generating fractal curves at the times when the paper was published, which include the Shear Displacement Process, in which a line , cutes the line at a uniform random points and moves the right and left part of the line in vertically opposite directions; The Markov Process which produces the fractal sequences of dimension 1 through 2; and the Fourier Transform which depends upon the I/F power spectrum property of fractal sets.

Carpenter, Subdivision method is based on conventional subdivision method. His method, splits the fractal region into sets of finite size in a way that the statistical property of the fractal set is maintained. The midpoint of the fractal curve is determined by a constrained random process and the character of the resulting set is identified. The new midpoint becomes the common endpoint of the two new fractal curves, which makes the final shape independent of scale. The inner scale of the graphical representation of the curve represents the tolerance for the subdivision process. The fractal character extends from the starting point to the geometric primitive sub-elements. However, this method is only valid for small subset of fractal curves and surfaces, but the advantages of this method overcomes that fact. For-eg Calculations required for this method is very cheap when compared to other methods and many more.

Personal comments :-

- In my opinion, the paper was very well written. Author was certainly successful in explaining his thoughts both theoretically and practically. The mathematical derivation he used to describe his thoughts, proves that his thoughts and technique were clear and to-the-point. The best part of this research paper was that, the author was precise and also talked about some other techniques that were used at the time when his paper was published. He was able to explain his thoughts clearly and made it really easy for a novice reader to understand his Subdivision method.

- At first, theoretically, I didn't find this topic interesting, but once I had a look at its practical implementation in one of the Youtube videos, I was really amazed, that how we can easily represent fractal curves and surface by using his Subdivision method. After carefully observing the video, I was amazed that how dividing the curved surface into smaller parts can be used to represent complex terrains, mountains or trees.
- I liked the research paper because presented a different and an easy approach to tackle fractal curved surfaces. In addition, I also liked the fact that author also covered the disadvantages of this method and also the fact that this method can only be useful for a finite set of curved surfaces.

Additional Write-up:-

To understand fractal image, we first need to know what Hausdroff-Besicovitch dimension is. Hausdroff-Besicovitch dimension is a concept in mathematics which serves as a measure of the local size of a set of numbers, taking into account the distance between each of its members. Therefore, A fractal is a set for which the Hausdroff-Besicovitch dimension strictly exceeds the topological dimension. Some of the famous Fractal curves are Sierpinksi Triangle, Koch Snowflake. Mandelbrot set and many more. Sierpinksi triangle is a fractal figure with an overall shape on equilateral triangle. This equilateral triangle is sub-divided into recursive smaller triangles. This triangle can be constructed in many different ways which includes removing triangles, shrinking and duplication, Arrowhead curves and many more. The Koch Snowflake is another geometric fractal curves. The progression of this figure converges to 8/5 times the area of an equilateral triangle. On the other hand, the perimeter diverges to infinity and therefore the Koch Snowflake has a finite area but an infinitely long line. The Kock snowflake can be constructed by altering the line segment of an equilateral triangle. 'Mandelbrot Set' - The term is used to represent the general class of fractal sets. It can also represent a particular instance of such set. It is one of the most stunning and famous fractals. Mandelbrot sets uses the concept of iteration and complex numbers. Since it is the oldest and most famous fractal, it is often referred in fractal art. The fractal was named after the mathematician Mandlebrot. In his book, Mandlebrot said that many forms in nature can be described mathematically as fractals. He said that we can create a fractal by taking a smooth shape and breaking it over and over again. Carpenter was able to achieve this within three days. He used his method, of breaking the triangle into smaller parts again and again to achieve the final figure.

References :-

Videos :- https://www.youtube.com/watch?v=y5moYMIp8iU

Links :- http://www.cut-the-knot.org/do_you_know/dimension.shtml

:- https://en.wikipedia.org/wiki/Hausdorff_dimension

:- https://en.wikipedia.org/wiki/Sierpinski_triangle#Properties

:- https://en.wikipedia.org/wiki/Koch_snowflake

:- http://www.fractal-explorer.com/mandelbrotset.html