

Cihan University-Erbil



Fractal Geometry Function

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*Fractal geometry is the study of set called fractals.

*It is very rough-looking and it can be cut into parts which quite like a smaller version of the set that was start with it .

*Also the fractal have a dimension which is not what people would expect'

Fractal Features :

- 1-It has a fine structure at arbitrarily small scales.
- 2-It is too irregular to be easily described in traditional Euclidean geometry language.
- 3-It is self-similar (at least approximately).

4-It has Hausdorff dimension which is greater than it's topological dimension

5-It has a simple and recursive definition

Fractal Function

Simple non-linear deterministic equations can self-generate irregular outputs :

Let $H(x)$ & $h(d)$ is a space matrix and $f(x)$ be a function :

$$f(s) = \{f(x) : x \subset s\}.$$

The metric space can be given by the equation:-

$$A' = TA$$

Where A is a point in initial area.

A' is a new point in under matrix operation (T)

The matrix (T) is given by:-

$$T = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$$

The transformation (W) in Euclidean plane can be given by:

$$W(x, y) = (ax + by + e, cx + dy + f)$$

The points **a**, **b**, **c**, and **d** define rotation and scaling operations to be applied to the point and are called affine transformation. The **e** and **f** points define a translation to be applied to the point.

There for the W can be as follow :

$$W(x) = W \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} e \\ f \end{pmatrix}$$

$$W(x) = Ax + T$$

$Ax =$ the matrix

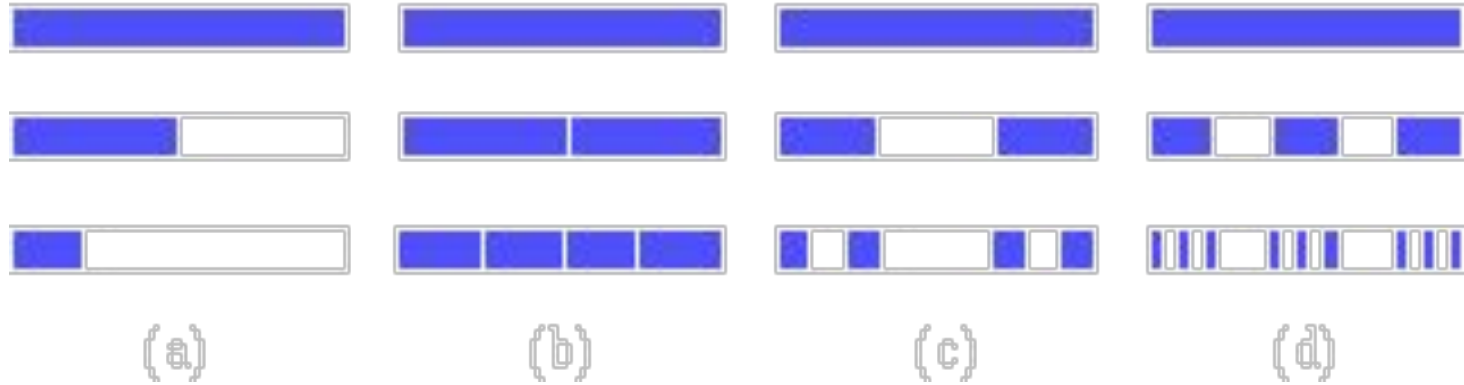
$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$

$T =$ the horizontal vector

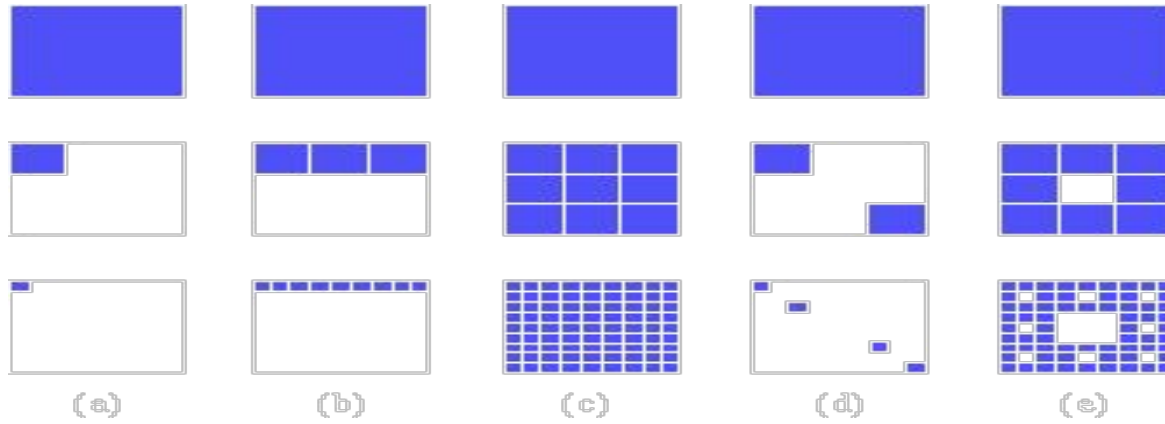
$$\begin{bmatrix} e \\ f \end{bmatrix}$$

Some Examples

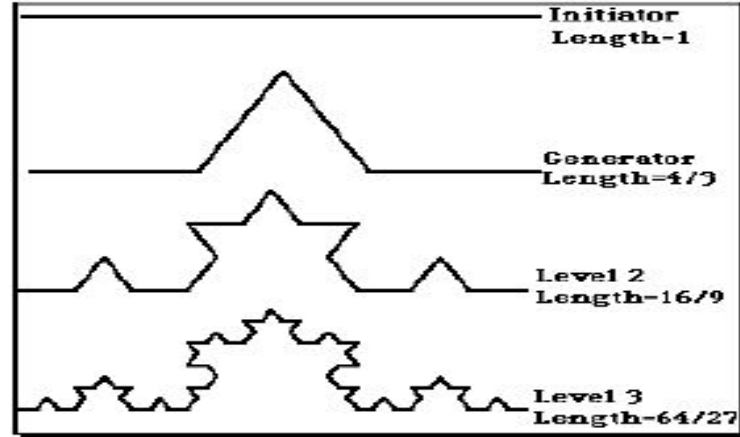
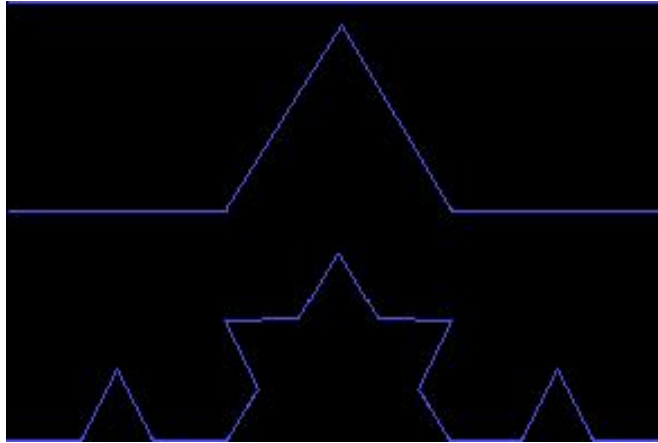
The Element is Line



Demonstration of fractal dimensions with Euclidean line segment

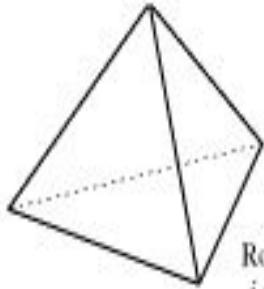


Demonstration of fractal dimensions with Euclidean planes



The Kock Curve

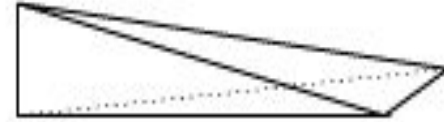
The Element is Triangle



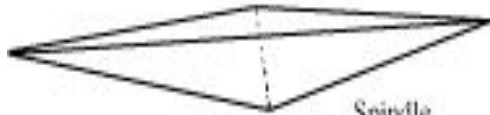
Round
 $j = 0$



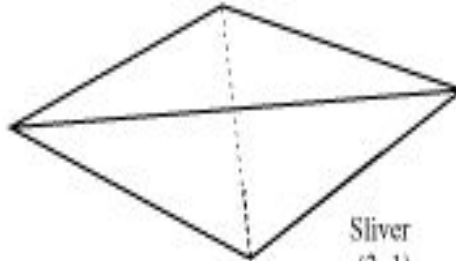
Needle
 $(1, 2)$



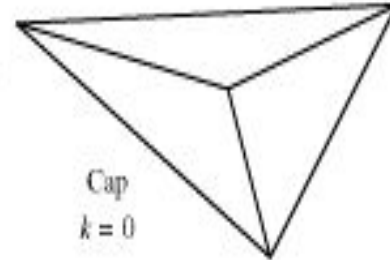
Wedge
 $(2, 2)$



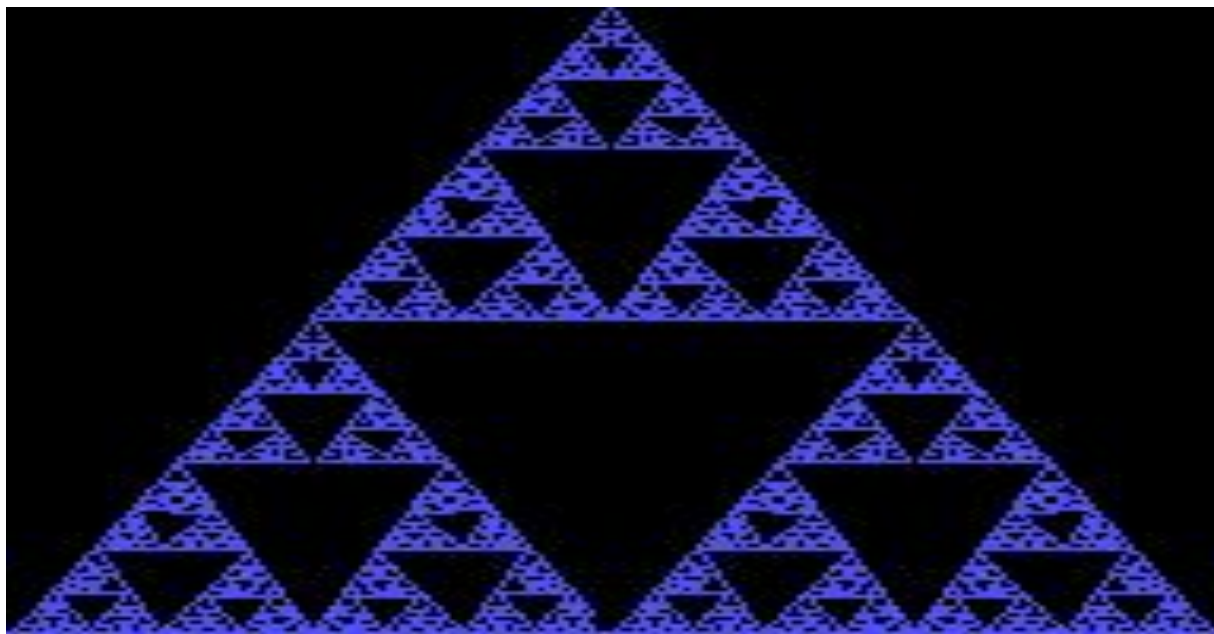
Spindle
 $(1, 1)$



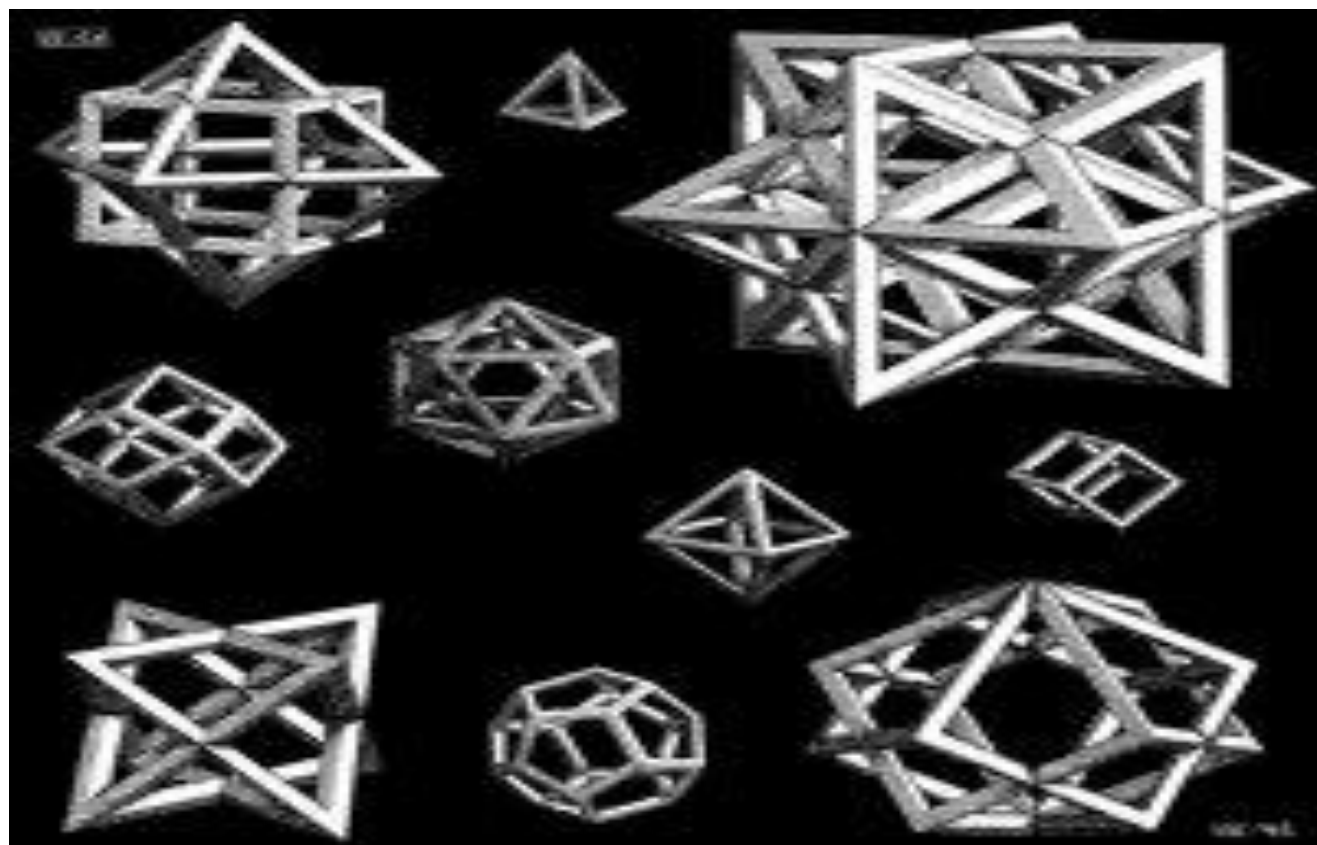
Sliver
 $(2, 1)$

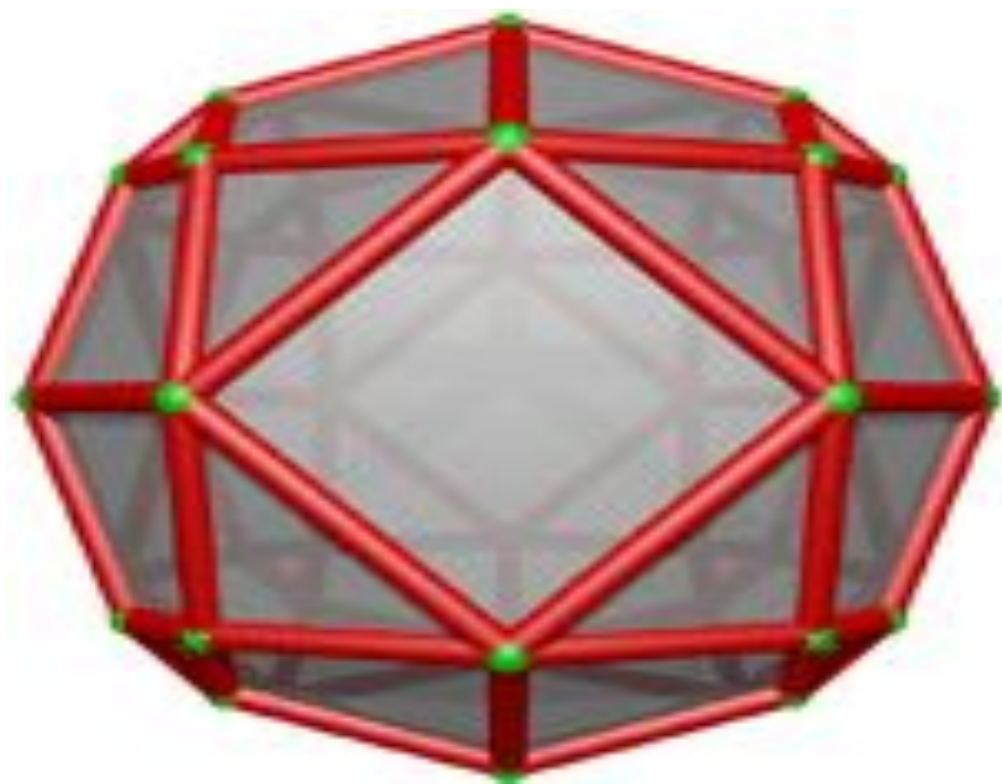


Cap
 $k = 0$

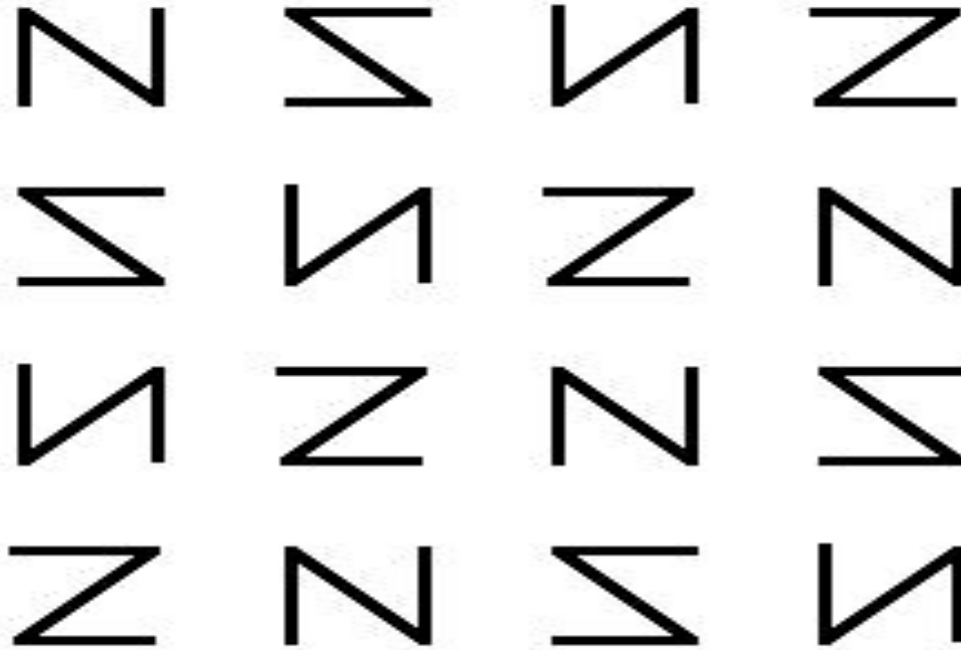


The Sierpinski Triangle





The Element is letter

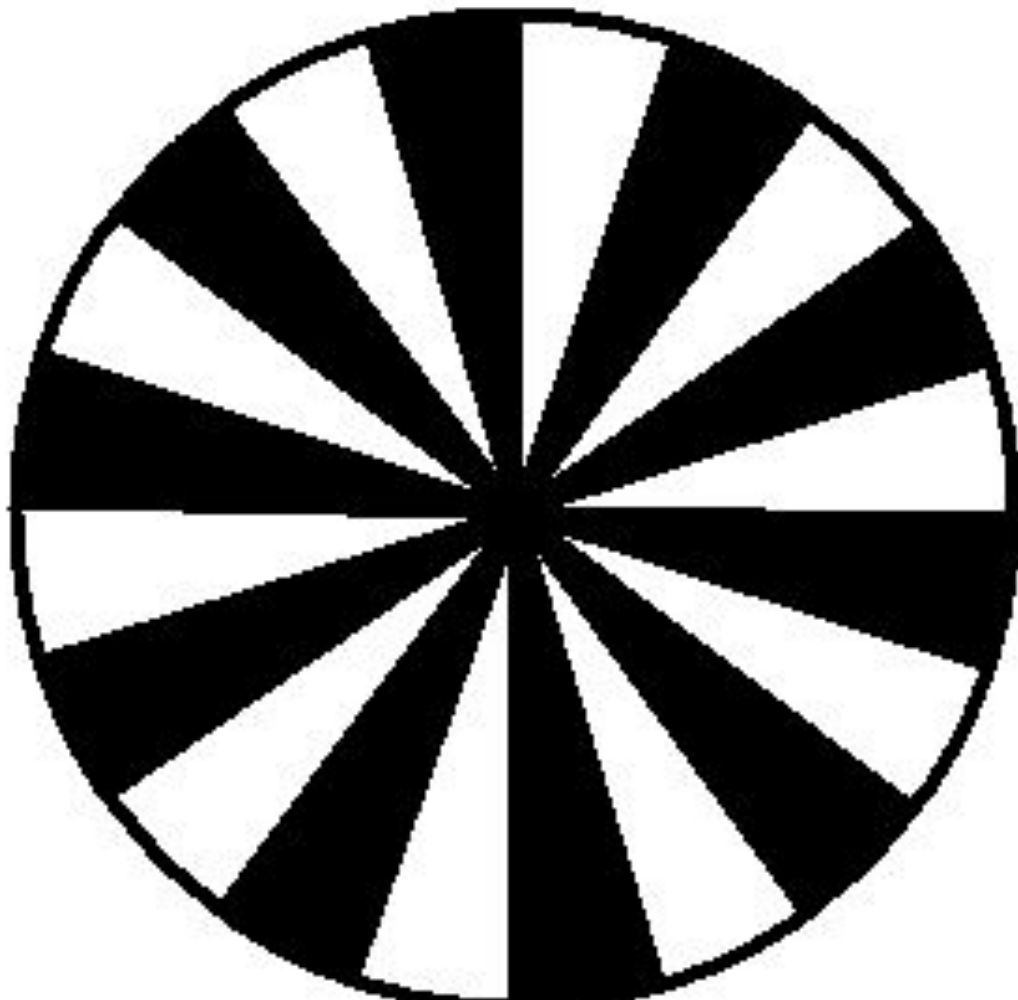


Using Fractal Geometry

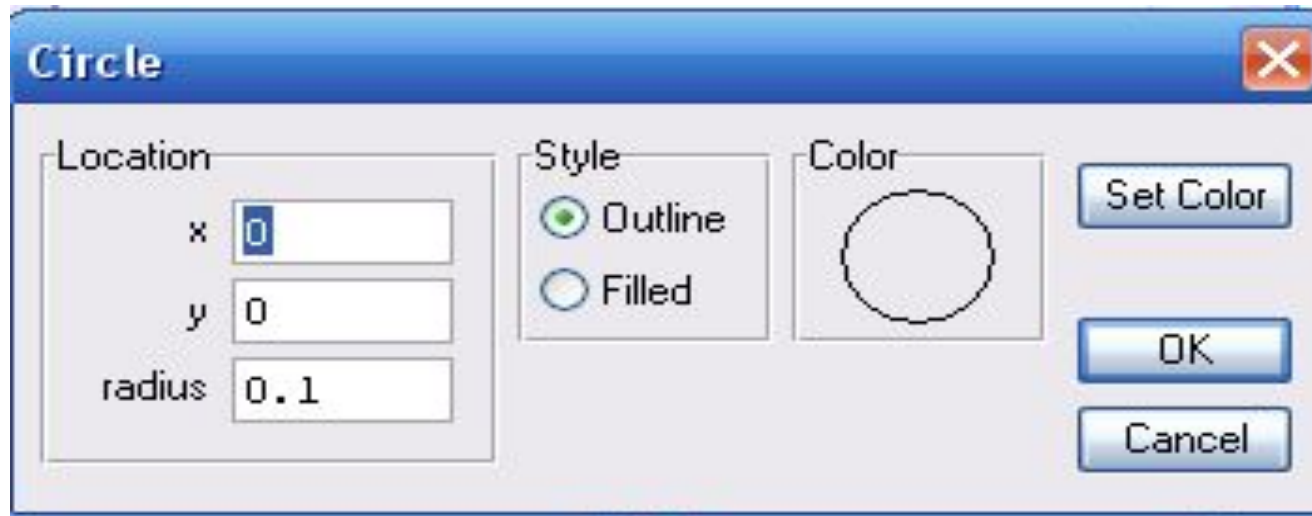
in

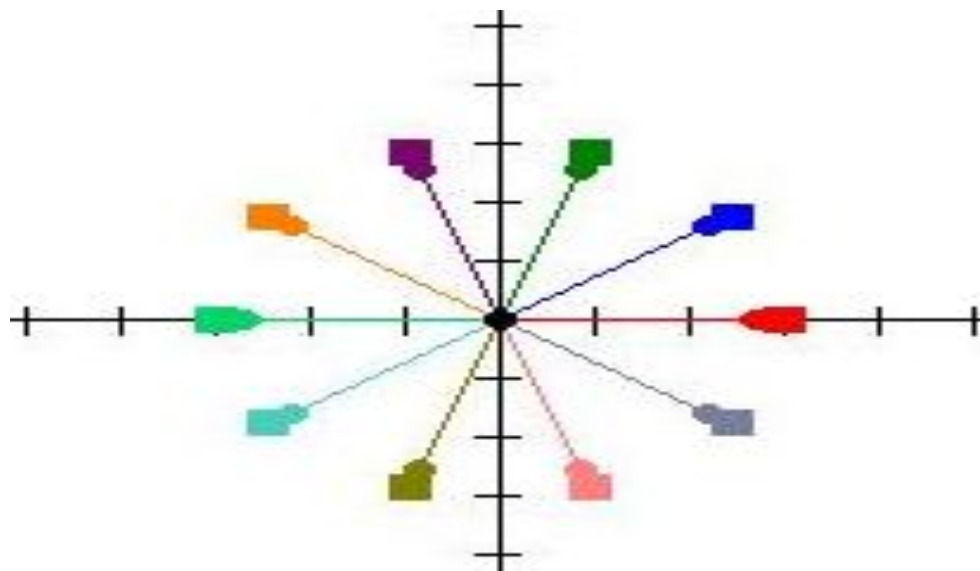
Modulator Design

Normal Modulator Design



1-The Element is Circle





The initial shape of the first pattern



2-The element is Triangle

Triangle [Close]

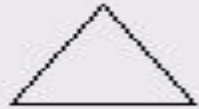
Type

Equilateral
 Right

Style

Outline
 Filled

Color



Set Color

Lower Left Corner

x
y

Size

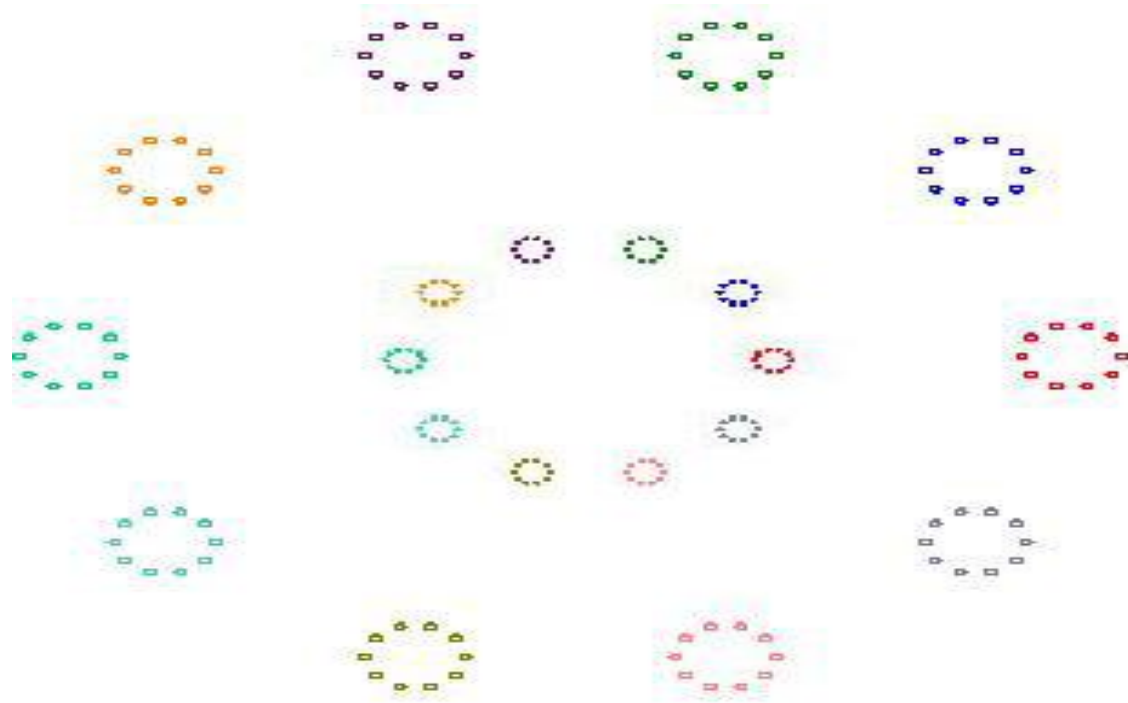
width
height

OK
Cancel

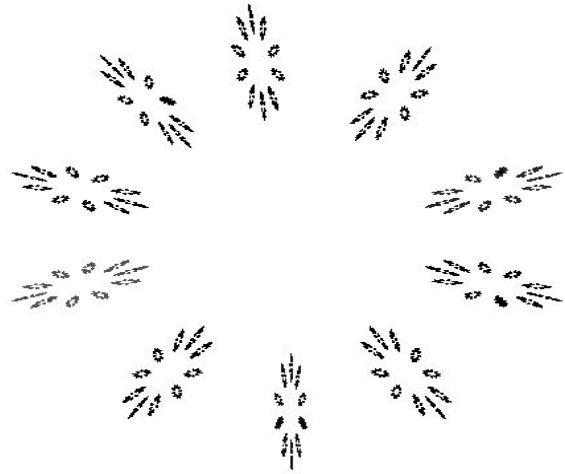
The initial shape of the second pattern



The first & second pattern in one Modulator



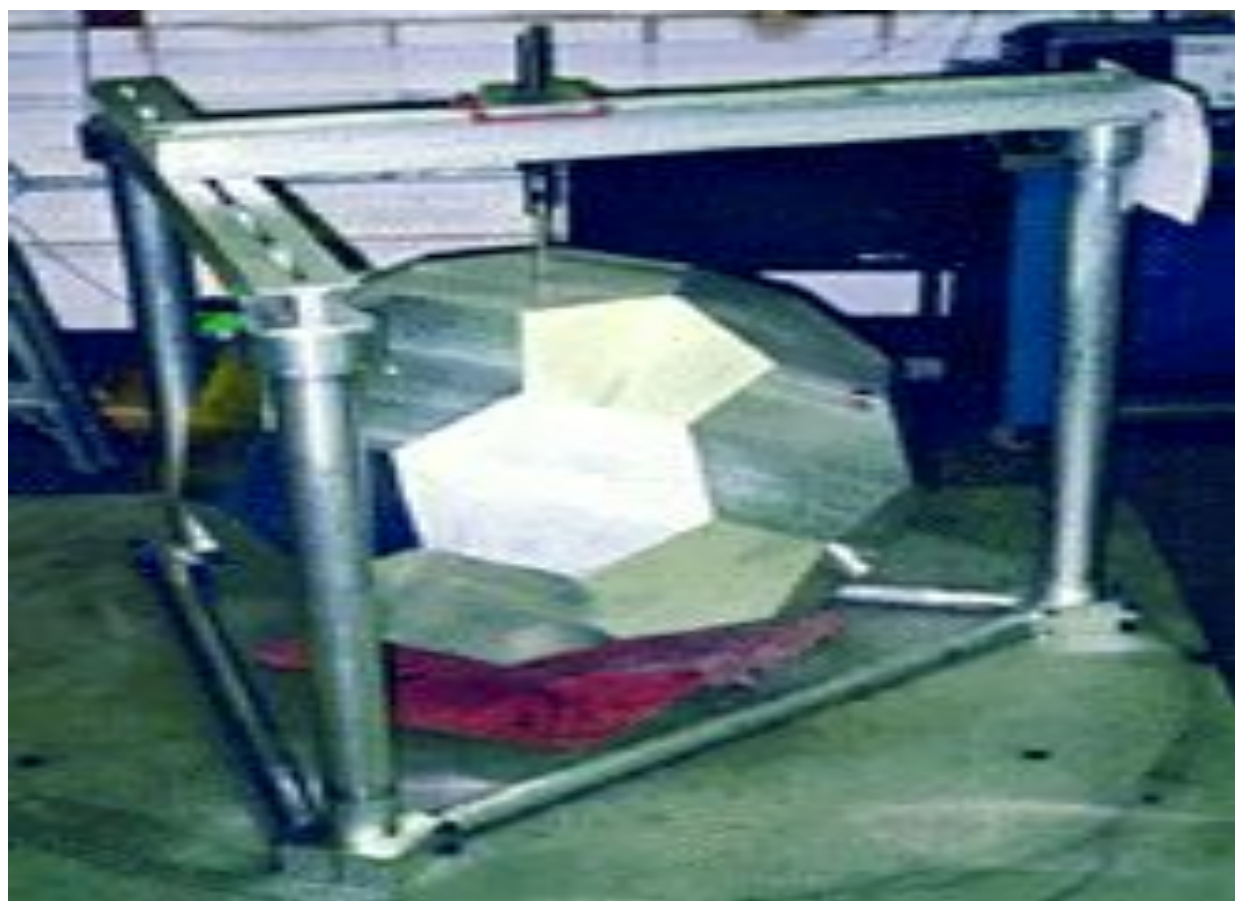
Fractal Function Modulator Design



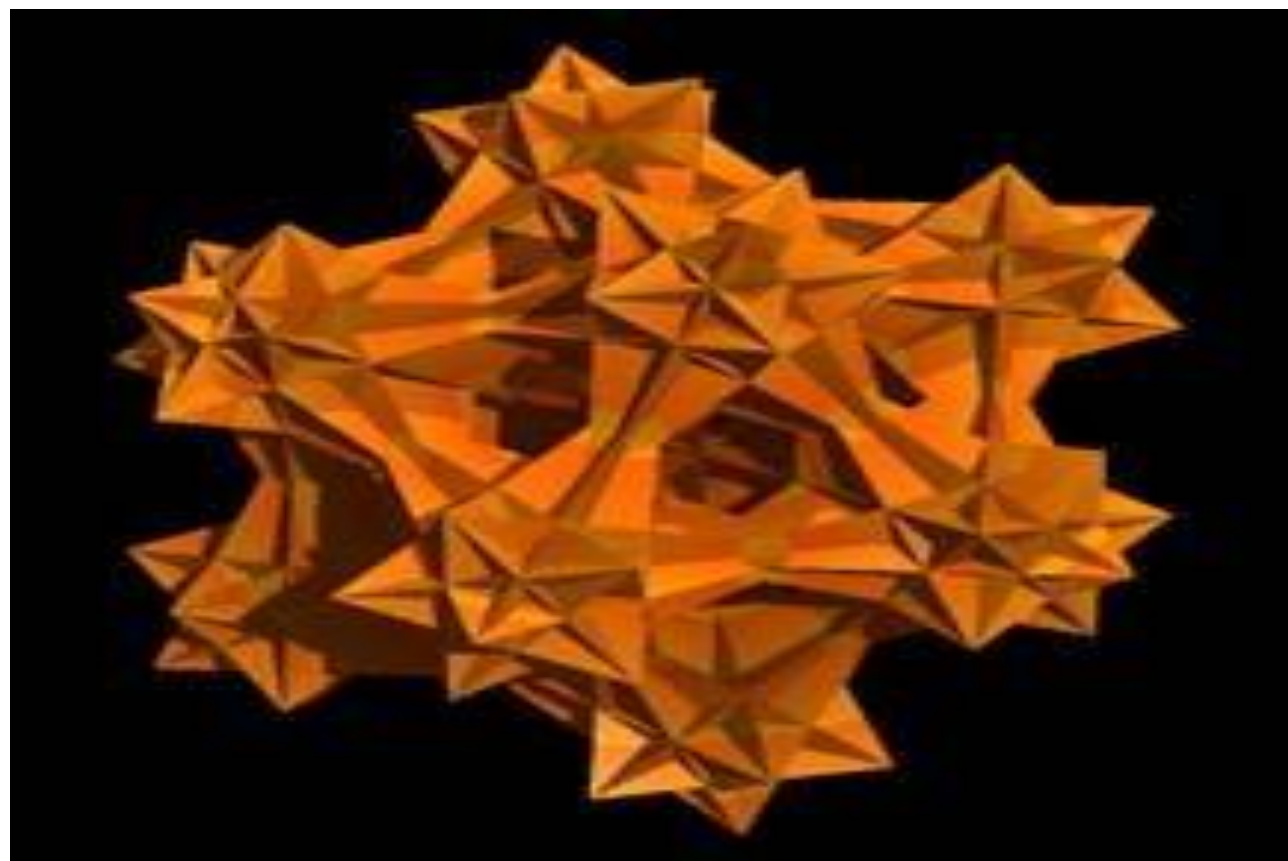
Some Application of Fractal Geometry in Building Design



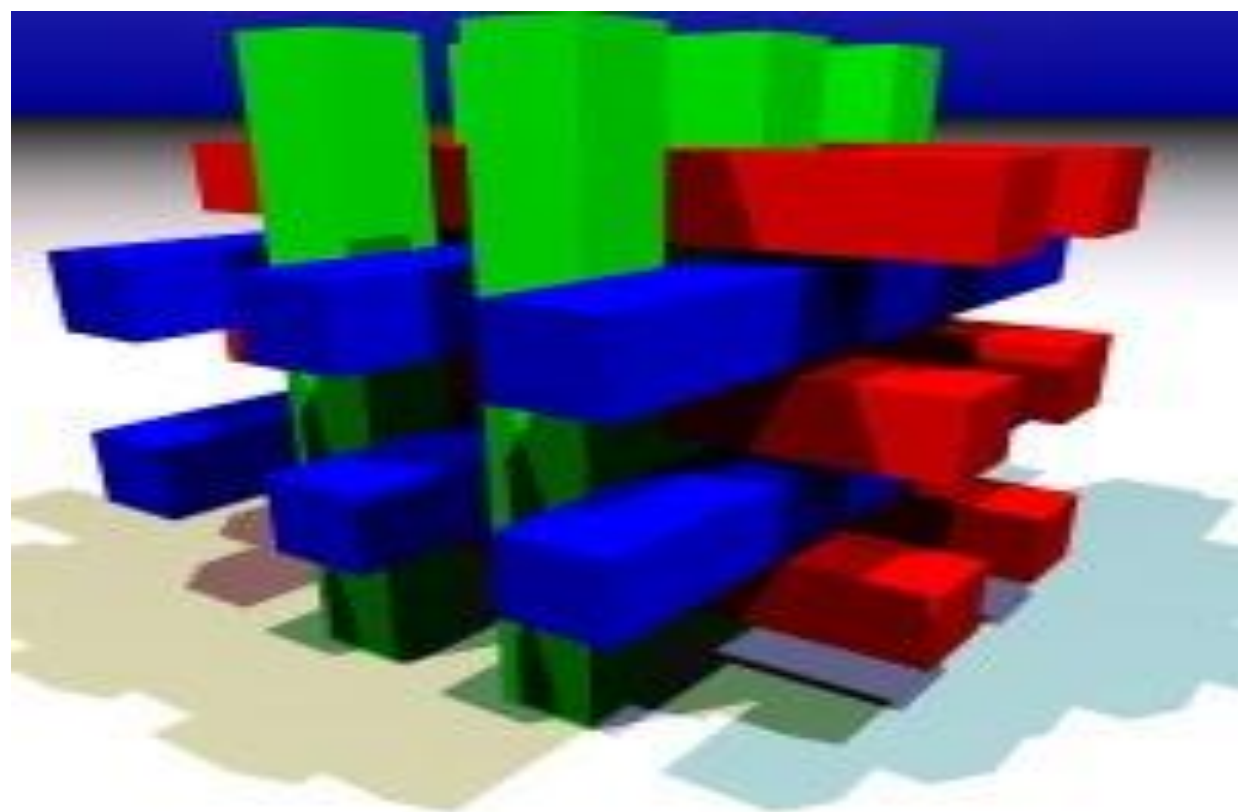












Thank You for Your Attention