Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231– 6345 (Online)
An Open Access, Online International Journal Available at www.cibtech.org/sp.ed/jls/2014/04/jls.htm
2014 Vol. 4 (S4), pp. 3231-3235/Saeid et al.

Research Article

THE H FRACTAL SELF-SIMILARITY DIMENSION CALCULATION OF PARDIS TECHNOLOGY PARK IN TEHRAN (IRAN)

***Saeid Rahmatabadi, Shabnam Akbari Namdar and Maryam Singery**
Department of Architecture, College of Art and Architecture, Tabriz Branch, Islamic Azad University, Tabriz, Iran
**Author for Correspondence*

ABSTRACT

The main purpose of this research is to find fractal designs in designing Pardis Technology Park in Tehran(Iran). In fact, we are seeking fractals in designing this work that has three characteristics of self-similarity, formation through repetition and lack of correct dimension. In this project, from the view of the author the site has a fractal, which is H- form that it is used in the plan and the plan form. We find the self-similarity dimension of the H fractal in this project.

Keywords: *Fractal, Self-similarity Dimension, Pardis Technology Park in Tehran(Iran)*

INTRODUCTION

Fractals are self-similar sets whose patterns are made out of littler scales duplicated of them, having self-similarity crosswise over scales. This implies that they rehash the patterns to an unendingly little scale. An example with a higher fractal measurement is more confounded or eccentric than the one with a lower measurement, and fills more space. In numerous commonsense applications, worldly and spatial examination is expected to portray and measure the shrouded request in complex patterns, fractal geometry is a proper instrument for exploring such unpredictability over numerous scales for common phenomena (Mandelbrot, 1982; Burrough, 1983). You will create many fractals using different hands-on construction methods:

- by using a "continuous process of removals"
- by creating "copies of copies"
- by playing the "chaos game"

Fractal geometry has been connected in architecture design generally to explore fractal structures of urban communities (Batty and Longley, 1994) and effectively in building geometry (Trivedi, 1989; Sala, 2002) furthermore design patterns (Bovill, 1996; Rahmatabadi, 2014).

MATERIALS AND METHODS

The Self-Similarity Dimension

"Dimension" is a term that we are used to talking about in our daily lives. We say that we live in a three-dimensional world. A box, for example, is three-dimensional (length, width, and height).

Whereas, an object such as a rectangle or a square is two-dimensional (length and width). A line is considered to be one-dimensional (length). And a point is said to be zero-dimensional (Rahmatabadi, 2014).

Let's try to look a little deeper into this idea of dimension. Maybe we can find out enough information about some common shapes that we will be able to develop a nice formula that can help us to easily find an object's dimension.

Let's look at a square that is 5 units long by 5 units wide. We can divide that square into 25 smaller squares, or "pieces", that are 1 unit long by 1 unit wide. We would need to "magnify" the length of each side of one of the smaller squares by 5 in order to return to the size of the original. Hence, there is a "magnification factor" of 5.

Using the familiar idea of exponents, we can see that there is a nice relationship between the number of pieces (25) and the magnification factor (5): $5^2= 25$. We notice that our exponent matches the expected "dimension" for a square which is 2.

Now, let's look at a cube to see that works out nicely as well for finding its "dimension." We start by looking at a cube that is 3 units wide by 3 units long by 3 units high. We can break the cube up into 27 smaller cubes, or "pieces." Also, if we take one of the smaller cubes and "magnify" the sides by 3, we end up with a cube that is the same size as the original. Hence, the "magnification factor" is 3.

Using the familiar idea of exponents again, we can see that there is a nice relationship between the number of pieces (27) and the magnification factor (3): $3^3 = 27$. We notice that our exponent matches the expected "dimension" for a cube which is 3.

So, if we use what we have found out so far, we can develop a formula for finding dimension.

"magnification factor" ^{d} = "# of pieces"

In order to have a more useful equation, we can solve for d by using logarithms.

log ("magnification factor" ^{d}) = log ("# of pieces")

d log("magnification factor") = log ("number of pieces")

d = log("number of pieces") / log("magnification factor")

Hence, this is a great formula that we can now use to find the dimension of our fractals.

$$self - similarity\ dimension = \frac{\log(the\ \#\ of\ pieces)}{\log(the\ magnification\ factor)}$$

We noticed in our last lesson that the Sierpinski Triangle had some really interesting characteristics. It had a zero area, and at the same times an infinite perimeter. It also had the characteristic of "self-similarity." Maybe these characteristics are why fractals end up being unique when we begin to discuss fractals dimension.

What would the "self-similarity dimension" be for the Sierpinski Triangle?

We started with our Base shape of 1 triangle and applied the Motif, which had us remove the middle triangle. We were then left with 3 smaller triangles, or 3 "pieces." We also reduced the length of all of the sides of our Base by 1/2 . In order to change one of our 3 smaller triangles from the Motif shape back to the same size of the Base shape, we need to "magnify" each side by a factor of 2. Hence a "magnification factor" of 2 is used.

Let's input these numbers into our formula (above) to find the self-similarity dimension of the Sierpinski Triangle.

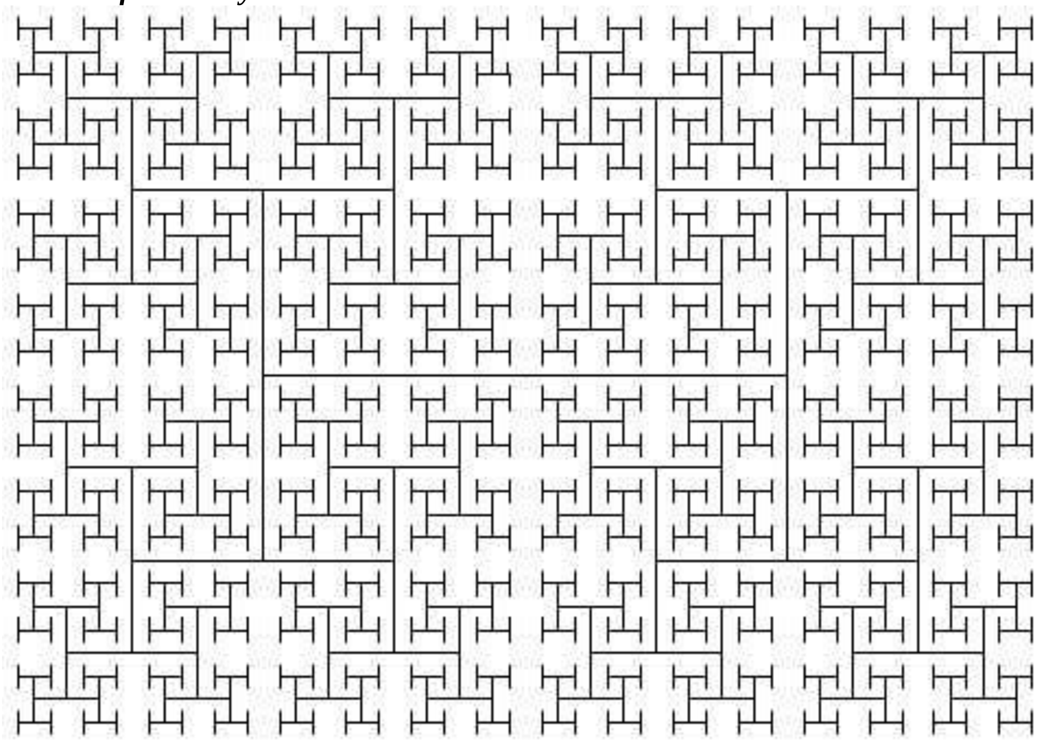
$$self - similarity\ dimension = \frac{\log(3)}{\log(2)} = 1.58$$

Throughout these lessons, we will be using the self-similarity dimension quite often to find out a fractal's dimension.

Also, in fractal lesson 9, we will study another one of the definitions (formulas) for fractal dimension called the "box counting method (2,5,6,7,8,10,12,15,17 web pages).

The H Fractal in Pardis Technology Park [in Tehran(Iran)] Plan

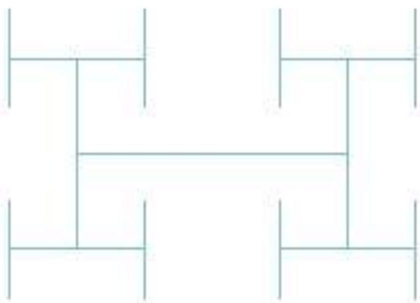
The H Fractal Self-similarity Dimension Calculation

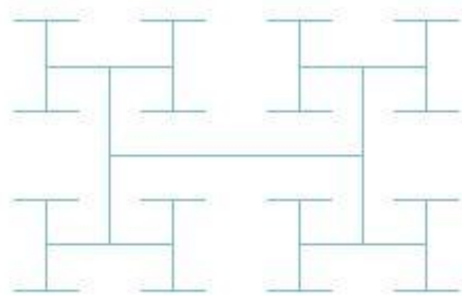


The H fractal is going to be completed using the "Copies of Copies" technique.
Here are the steps that you just can got to follow so as to draw every level of the H fractal.
Level 1. On an outsized sheet of paper draw a horizontal line that's one foot long. On the chart below, fill within the length of the shape at this level, which we are going to decision length one.
Create AN H form by attaching two vertical segments to our horizontal segment. These vertical lines ought to be copies of the initial "Base shape" segment however smaller by a contraction issue of sqrt(2) / two = .71 Since the length of our previous phase was one, our two new vertical segments ought to be (1)(.71) = .71. On the chart below, fill within the length of the shape at this level, which is 1 + 2(.71) = 1 + 1.42 = 2.42.

Level 2: Continue this method by attaching two horizontal segments to every of the vertical segments that were created in Level two. Every of those new horizontal segments ought to be shorter than the previous level's new segments by the contraction issue of .71. In different words, the new segments ought to be of length (.71) (.71) = .50 . On the chart below, fill within the length of the shape at this level

Continue this process for at least 2 more levels.





Level	Length of a new segment	# of new segments	Total Length of Fractal
1	1s	1	1s
2	.71s	2	1.42s
3	.5s	4	3.42s
4	.36s	8	6.3s
n	$(.71)^{n-1}$s	2^{n-1}	$.71^{0}s + 2(.71)^{1}s + 4(.71)^{2}s + 8(.71)^{3}s + \ldots + (2^{n-1})(.71)^{n-1}s$

Our total length is obtaining longer at every level by a more and larger quantity each time. We will thus conclude that because the variety of levels approaches infinity, the length of the H shape is infinite.now we can find the self-similarity dimension of the H fractal

$$self - similarity\ dimension = \frac{\log(the\ \#\ of\ pieces)}{\log(the\ magnification\ factor)}$$

As we went from the first level to the second level, 2 new pieces were added. Therefore, the # of pieces in our formula is 2.

In addition, our contraction factor was sqrt(2) / 2 . Therefore, since the magnification factor is the multiplicative inverse (or reciprocal) of the the contraction factor, our magnification factor is 1/[sqrt(2) /2] = sqrt(2). We can multiply the shorter 2 segments in our "motif shape" by sqrt(2) and we end up with the length of our "base shape" (2,5,6,7,8,10,12,15,17 web pages).

$$\boldsymbol{self - similarity\ dimension = \frac{log(2)}{\log(sqrt(2))} = 2}$$

Conclusion

Fractal geometry has been connected in architecture design generally to explore fractal structures of urban communities and effectively in building geometry furthermore design patterns

Research Article

It is interesting that in many works the observance of fractal geometry have been done without knowledge. We have found the self-similarity dimension of the H fractal in this project.

ACKNOWLEDGEMENT
We are grateful to Islamic Azad University, Tabriz branch and Dr. Reza Toushmalani, for their useful collaboration.

REFERENCES

Batty M and Longley P (1994). *Fractal Cities* (Academic Press) London.
Bell ET (1986). *The Men of Mathematics* (Simon and Schuster, Inc.).
Benoit Mandelbrot (1977). *Fractals: Form, Chance, and Dimension* (W.H. Freeman and Company).
Bovill C (1996). *Fractal Geometry in Architecture and Design*, Birkhauser, Boston.
Brown CT and Witschey WRT (1977). The fractal geometry of ancient Maya settlement.
Burrough PA (1981). Fractal dimensions of landscapes and other environmental data. *Nature* **294** 240–242.
Cynthia Lanius (1996-2007). A Fractals Unit for Elementary and Middle School Students, Rice University, Available: http://math.rice.edu/~lanius/frac/index.html [Accessed 10 May 2014].
Emergent Nature - Patterns, Growth and Scaling in the Sciences, *World Scientific* 273-282.
Fractal Geometry Webpage (2007). Edited by Michael Frame, Benoit Mandelbrot, and Nial Neger, at Yale University, http://classes.yale.edu/Fractals/ [Accessed 10 May 2014].
Fractals Unleashed Website (No Date). http://library.thinkquest.org/26242/full/ [Accessed 10 May 2014].
Fractint (No Date). A free fractal generator: http://spanky.triumf.ca/www/fractint/fractint.html. http://infohost.nmt.edu/~blewis/html/selfsimilaritydimension.html[Accessed 10 May 2014]
Mandelbrot B (1982). *The Fractal Geometry of Nature* (W.H. Freeman and Company).
MSWLogo Toolkit Software (No Date). Free software download of setup kit from Softronics.com, Available: http://www.softronix.com/logo.html [Accessed 10 May 2014].
Rahmatabadi S (2014). Design of science and Technology Park with approach chaos theory in new pardis town (Master's Thesis).
Sala N (2002). The presence of the Self-similarity in Architecture: some examples.
The Great Logo Adventure (1998). *Discovering Logo on and Off the Computer*, edited by Jim Muller (Doone Pubns) Available: http://www.softronix.com/logo.html (has CD) [Accessed 17 May 2014].
Trivedi K (1989). Hindu temples: models of a fractal universe. *The Visual Computer* **5** 243-258.
Turtle Geometry (1981). *The Computer as a Medium for Exploring Mathematics*, edited by Harold Abelson and Andrea diSessa (MIT Press).