THE STUDY OF HEXAGONAL PHENOMENA TO FIND THE MATHEMATICAL RELATIONSHIP IN GEOMETRICAL AXIS

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Gold Medal in Computer Science & Mathematics Category i-RYSCE 2017

1. Introduction

People discovered that everything in this world seemed to have and make a pattern. This drives my curiosity to discover more about what the nature is trying to reveal its secrets. Giant's Causeway, where the volcanic eruption leaves hexagonal block has shown that there is something special in the hexagonal pattern. Hexagons are 6-sided polygons. Regular hexagons have all the sides the same length. The typical orientations for hex grids are horizontal (pointy) and vertical (flat). The regular hexagon, that has all sides equal, is called proportional hexagon based on calculation. Geometrical axis consists of the *x, y* and *z* axis. Herman Tulleken (2013) stated that $x+y+z=0$. I want to see the possibility that the axis can be used to determine the length. By knowing its relationship with the geometrical axis, I might be able to discover the secrets of hexagons and use it in other aspects.

2. Research Method

I observed the hexagonal phenomena in the honeycomb and the turtle's shell. However, the honeycomb is too small to be measured. The pattern of the turtles' shell was measured using a vernier. Then it was drawn into a sketch. From this sketch, the *x* and *y*-axis can be seen. To find the *z*-axis, the sketch should be drawn proportionally in a computer. After the *x*, *y* and *z*-axis are obtained, the ratio between *x+y* and z are calculated.

The average and the standard deviation of it are used to determine the ratio of the geometrical axis.

Fig.2, Hexagonal Phenomena

3. Result and Analysis

The ratio between *x+y* and *z* has an average of 1.2, and has the standard deviation of 0.08. This means that this data is significant. It can be used to create a new type of hexagon that is proportional based on nature.
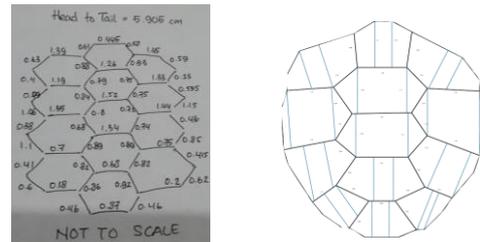

Fig.3, Draft and computer sketch.

4. Conclusion

The geometrical axis (*x, y* and *z* axis) contributes as the basis of the proportional hexagon based on nature. The *x* and *y* axis also contributes to the length of the hexagon, as the horizontal length is twice the *x* or *y*-axis. The proportional hexagon based on nature is proven to fit effectively to the desirable area. It is more efficient than the proportional hexagon based on calculation. In the future, I hope that the proportional hexagon based on nature can be applicable in other area.
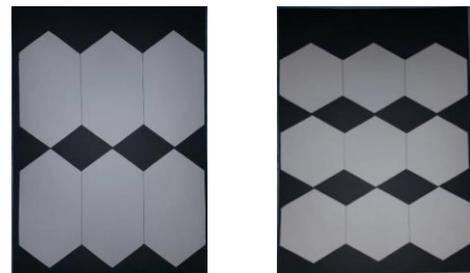

Fig.5, Comparison between regular hexagon and hexagon based on nature.

Moreover, the improvement of this can be used to determine the new artistic pattern based on the program that I created with the geometrical transformation. The program needs us to input the x and y-axis, and the rest will be generated automatically. Then if we input the distance between the hexagons, we can create a new pattern. The pattern making will

be based on the examination of hexagon patterns in nature. The pattern will look like fractals, however this new pattern will have finite perimeter and create infinite area. Hence, through the help of the technology, we can make hundreds of new patterns as shown below.
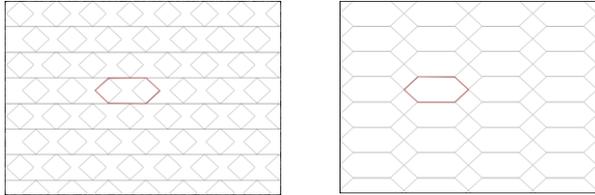

Fig.6, Pattern examples.

As a study, this research is progressing over and over. So, with a certain amount of time and more technology used, there will be a lot of new discoveries.

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