

The Study of Rotational Motion Perception on the Dynamical Sphere of the Surface Spiral Pattern from the Angle of Line

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Abstract

The research is based on the basic design and art to explore the characteristic of a dynamical sphere. And because previous studies only in the main form of the cylinder and the cone. Therefore, the purpose of this study is using a sphere as the main shape, to explore the best angle of line on the spiral pattern of the dynamical sphere. This study is divided into two parts, the first part, the literature research and analysis theory to explore the characteristics of the sphere, and regulated the angle of line that suitable for the sample. And the second part was used the adjustment method of psychophysics to experiment. With total of 30 subjects, half composed by the men and women. And the test results, defined the best angle of line on spiral pattern on the surface of dynamical sphere. Not only can promote the dynamical shapes but also can have contribute to some basic of the motion perception. Besides, it can be extended for use in performances or stage effects.

Keywords: basic design and art, dynamical sphere, motion perception, spiral pattern

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Introduction

In the past, the study of basic design and art are more study in 2D shape or 3D shape. But when the Movement Structure appeared, increase the time elements in the original static shape. It made the basic design and art more abundant and more powerful.

The research is based on the basic design and art to explore the characteristic of a dynamical sphere. And because previous studies only in the main form of the cylinder and the cone. Therefore, the purpose of this study is using a sphere as the main shape, to explore the best angle of line on the spiral pattern of the dynamical sphere.

The Movement Structure can separate to a shape and a viewpoint-movement of movement form. In this, the shape of the movement is based on motion perception. In this study, the shape of movement as be the goal. In order to explore the motion perception of this shape movement, the sphere as the shape, in that surface drawn a spiral pattern and through the rotation of the motor as artificial power.

Motion perception can be divided into Autokinesis, Induced Movement, Apparent Movement and Movement After-Image. In this study, we only used Induced Movement and Movement After-Image, the Autokinesis and the Apparent Movement are not be discussed. Because of the shape is sphere with continuous smooth surface and no edge.

In the dynamic form of the performance of the work, the resulting movement form can be divided into two major categories, Regular Movement and Irregular Movement (Chin-Wei Lin, 2015).

In this study, we choice spiral movement as the movement form, its in the Dimensional Movement of Regular Movement. And the movement form is like climbing spiral staircase with rotary feeling(Guang-Dah Chen, 2004).

Methods

This study is divided into two parts, the first part, the literature research and analysis theory to explore the characteristics of the sphere, and regulated the angle of line that suitable for the sample. And the second part was used the adjustment method of psychophysics to experiment. With total of 20 subjects, half composed by the men and women.

Measured methods

The psychophysical method can be used to obtain the relationship between the sensory system and the physical stimulus by threshold measurement (Chin-Wei Lin, 2015). This means that if a stimulus value enables the subject to detect the presence of the stimulus, it represents that the stimulus value is the lower absolute threshold of the sensory system. On the other hand, if a stimulus value causes the subject, who originally found the presence of the stimulus, to become the presence of a perceived lack of stimulation, it represents that the stimulus value is the upper absolute threshold of the sensory system.

However, the interval between the upper absolute threshold and the lower absolute threshold is called the velocity threshold because the stimulus value of this study is the rotational speed.

Equipments

In order to control the motor speed accurately, we use the digital frequency conversion and wireless control system which the maximum speed can reach 1300rpm, and in order to record the stimulus value of the subject more clearly, we adopt digital panel to reduce the experiment process of the error and improve the credibility of the experimental results.

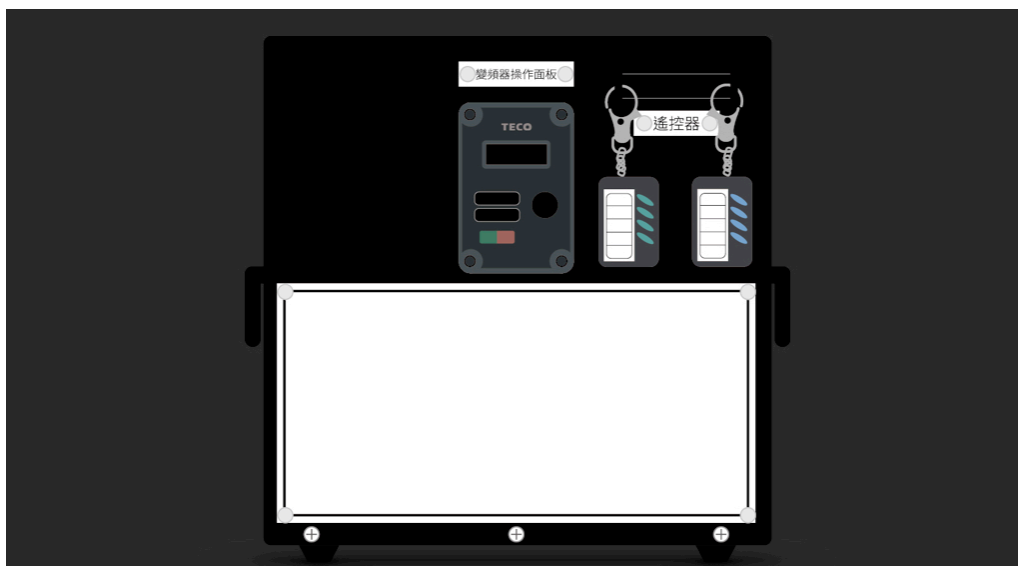


Figure 1: Digital Frequency Conversion and Wireless Control System

Subjects

For the purposes of this study, we selected subjects trained in art or design in order to ensure that subjects were able to perceive more accurately the changes in shape and pattern; And 20 subjects were all from the judgment sampling of the non-probability sample, and 10 of the boys and the girls, and their eyesight were normal or corrected normal vision.

Experimental Design and Procedure

At the beginning of this experiment, all subjects will be able to understand the relevant knowledge of motion perception. Select the experimental sample and start the test. From the Induced Movement, slowly increase the rotational speed stimulus value (rpm) until the subject discovers the presence of the Induced Movement, and note the lower absolute threshold.

This is followed by a continuous increase in the rotational speed stimulus value (rpm) so that the subject perceives that the Induced Movement is no longer present and records the upper absolute threshold. After a sufficient rest, the subject will continue to receive the rotational speed stimulus value (rpm) until the Movement After-Image

appears and the lower absolute threshold is recorded and stopped the test. All other experimental samples were also carried out according to these procedures.

Result

Sample

This experiment is based on the results of Guang-Dah Chen's research in 2008. "In a rotating dynamic cylinder, the line angle of 15 degrees and the thickness of 10mm, allows the subjects to produce the largest range of velocity threshold of motion illusion".

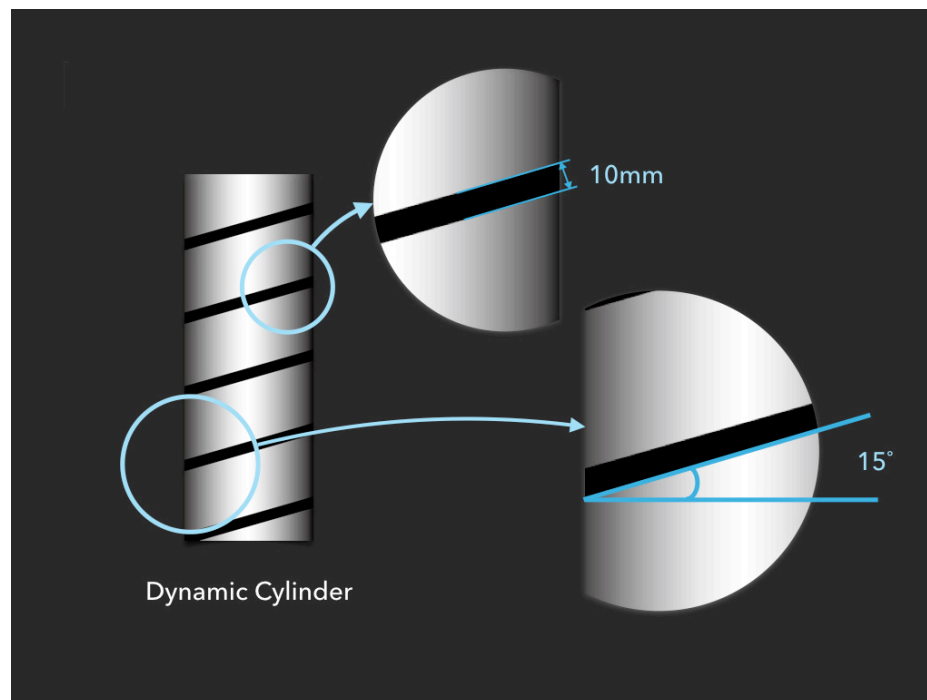


Figure 2: Benchmarks for experimental samples

In this experiment, the sphere is taken as the sample, the line thickness is 10mm, and the angle of the line is 15 degrees as the benchmark, and the shape limitation of the sphere is taken into account. By adding angles and reducing angles to get five kinds of line angle samples, respectively 5 degrees, 10 degrees, 15 degrees, 20 degrees and 25 degrees.

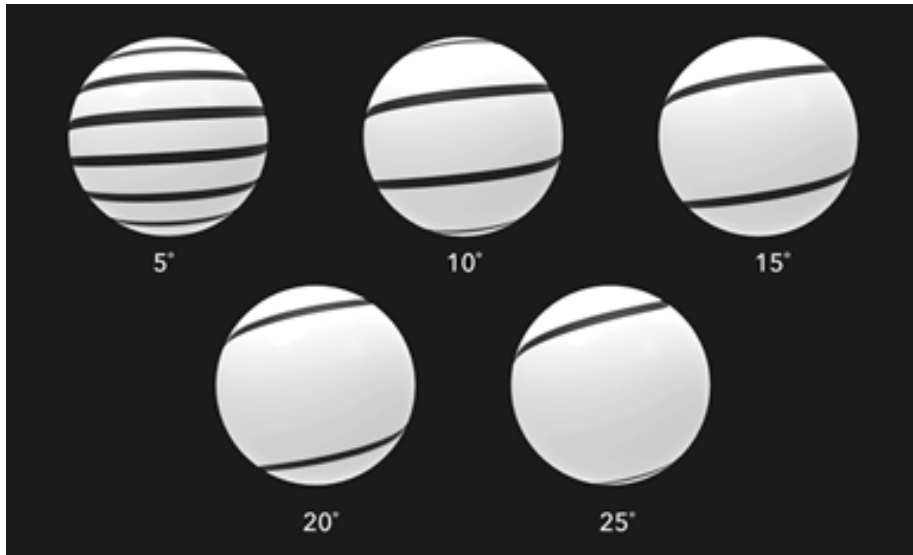


Figure 3: experimental samples

Experiment Results

The results of this experiment were to show the subjects' induction movement and Movement After-Image through the rotational speed of Samples, and got different stimulus values. We analyzed the upper absolute threshold, lower absolute threshold and the velocity threshold and get some results below:

1. From the figure 4, it can be found that 5 degrees is the optimal angle of induced movement, and the more the angle is, the worse the perception effect of induced movement is.

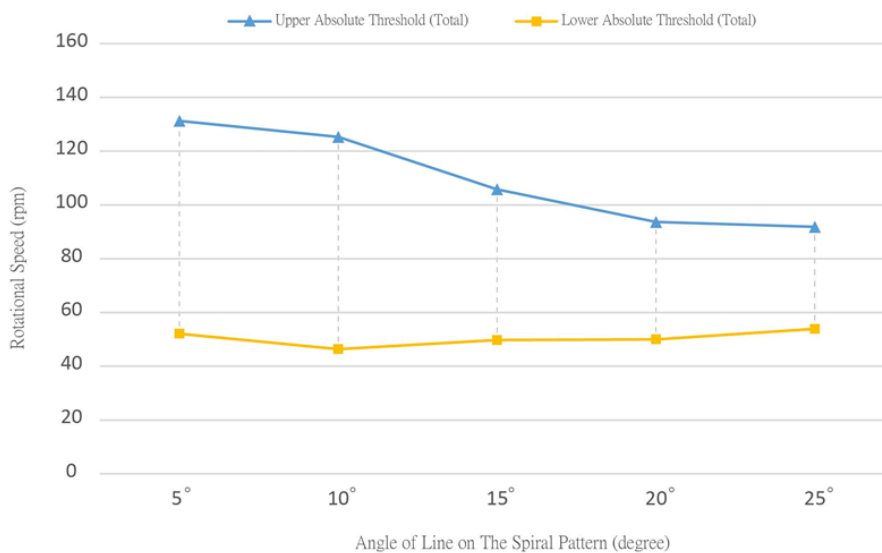


Figure 4: Induced Movement (Total)

2. In the male analysis chart, we can see a clear trend: 5 degrees is the best; 25 degrees is the worst, in addition, from the figure 5, on the upper absolute threshold, can also be seen when the angle of line becomes larger, the upper absolute threshold of the Induced Movement will decrease significantly and the lower absolute threshold of the Induced Movement will increase slowly, so the velocity threshold will become smaller gradually.



Figure 5: Induced Movement (male)

3. Although the optimal angle of the female is 10 degrees, the velocity threshold is not much different from that of the 5 degree; therefore, this study will not be affected. In addition, male and female showed the trend is similar, that is, the velocity threshold is gradually smaller.

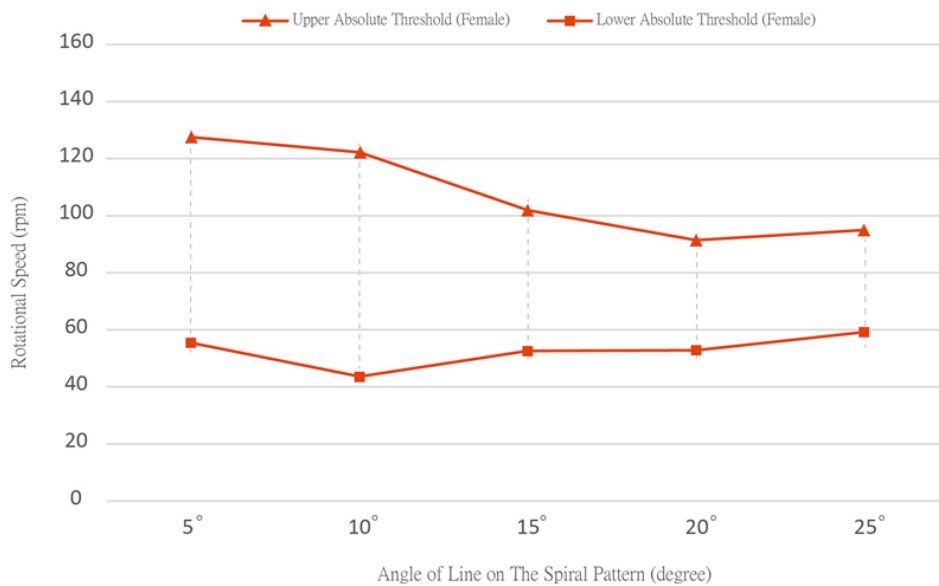


Figure 6: Induced Movement (female)

4. From the figure 7, we can see that the bigger the angle is, the faster the perception Movement After-Image will appear

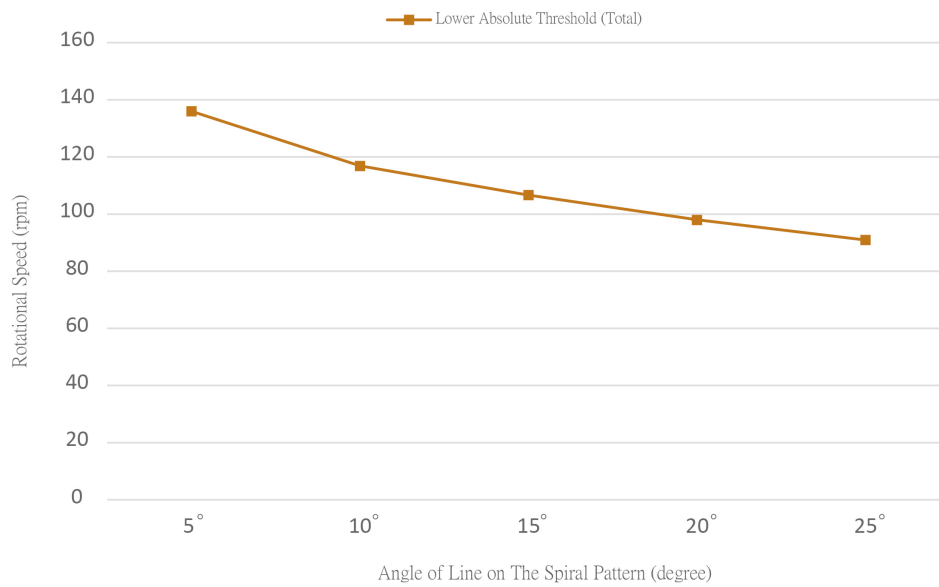


Figure 7: Movement After-Image (Total)

5. In the figure of Movement After-Image for male and female (Figure 8 and 9). We can see that the trend is obvious decline, it found that male and female in the perception of Movement After-Image on the results are similar.

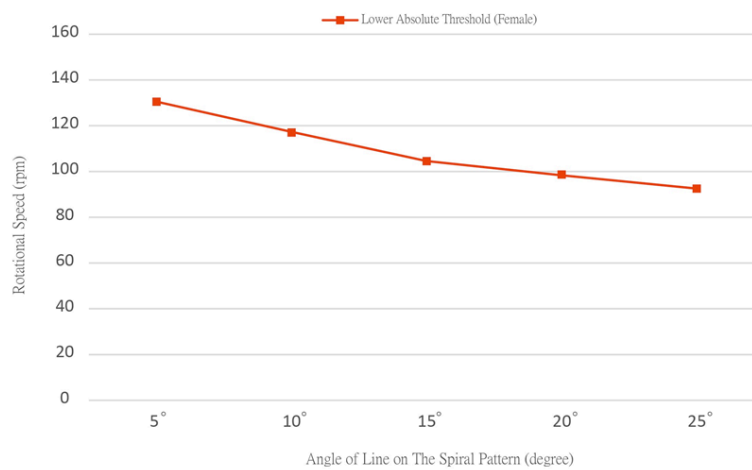


Figure 8: Movement After-Image (female)

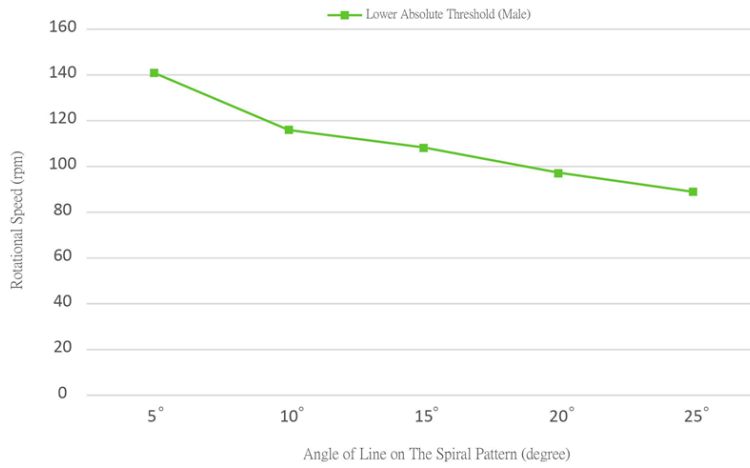


Figure 9: Movement After-Image (male)

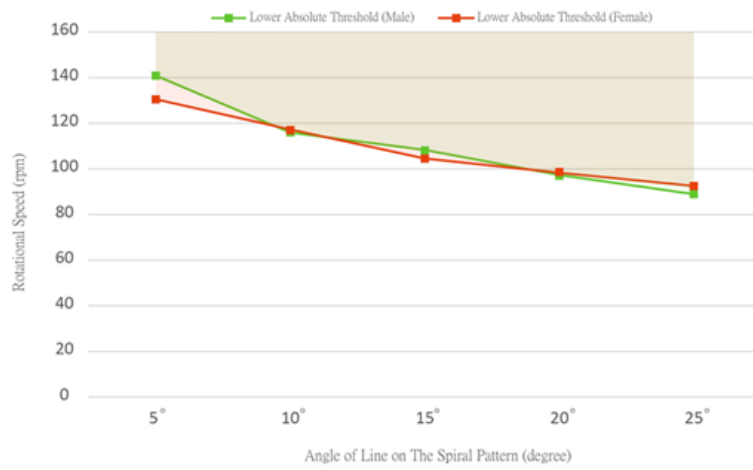


Figure 10: Movement After-Image (male & female)

Conclusion and Discussion

Conclusion

From this study, we can see that "the best angle of line on the spiral pattern of the dynamical sphere is 5 degree". And It can be seen that the smaller the angle of the line (the more the number of lines) can accelerate the Induced Movement and extend its perceptual effects. On the other hand, the bigger the angle of the line (the smaller the number of lines), the less likely that the subject will produce Induced Movement and Movement After-Image.

Discussion

1. Figure 11 shows the difference in velocity threshold between male and female. It can be found that the velocity threshold of male is bigger than that of female, and it can be deduced that the ability of male to perceive Induced Movement may be higher than female.

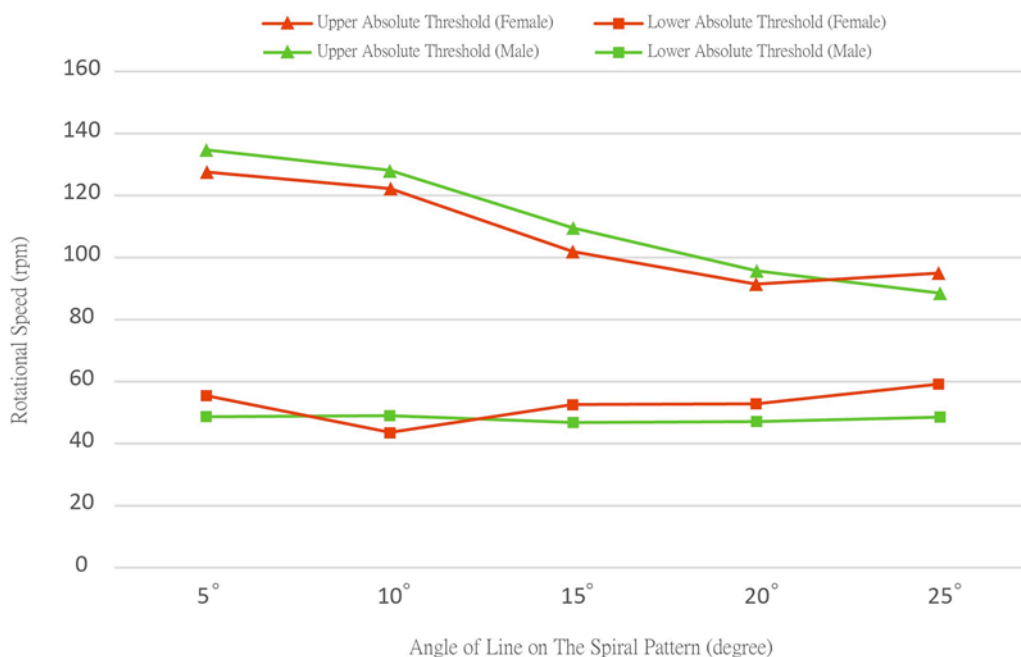


Figure 11: Movement After-Image (male & female)

2. In the experiment, we found that if the subject in the process does not have enough rest time will be easy to fatigue, it is not easy to perceive the motion illusion, and may affect the study data. Therefore in the future study, can be more further explore the reasons for its impact.

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