

***Hilarism* ~study about the period~**

Uetani Moeka, Kawai Sana, Sunami Ryota, Nakao Takaya, Maruo Rina, Watanabe Jun

Thesis adviser: Inoue Izuru

Abstract

We named the swinging movement of an object as it falls in the fluid “*Hilarism* movement,” and studied the *Hilarism* movement of the disk. Since periodicity was confirmed in the *Hilarism* movement of the disk, we focused on the periodicity in the horizontal direction and conducted experiments and discussions. As a result, it was confirmed that the thickness and the diameter of the disk are related to the *Hilarism* movement of the disk.

Experimental Method

We made three kinds of disks each of which has a hole in the center of it. (diameter:40mm,50mm,60mm thickness:0.75mm, and diameter of the hole:6.0mm). We made a device to drop the disk underwater and film the movement of the disk. We filmed the movement of the disk from the start of dropping to the end touching the bottom. Each disk was tested 50 times. We used Adobe Premiere Elements to give the image orthogonality coordinate and recorded position of the disk.

The results and analysis

We noticed that its speed changed periodically. We considered this movement occurred by continuous separation vortex behind the disk. To analyze the periodicity, we did Fourier transform and concluded it was periodical because of a certain dominant frequency.

Then, we regard a partial graph between minimum value and next one as one period of *Hilarism* movement. The result of this experiment showed that the longer disk's diameter was, the longer the period became.

For this result, we predicted that diameter, mass, or both of them might affect the period, and conducted another experiment. New disk, which was 40mm in diameter and 0.30mm thick. (We call this disk “thin disk” below.)

The thin disk showed periodicity in changes of speed in the same way as the other disks did. The thin disk has a wide range of period so we considered this is because its thinness makes the disk transform easily. Compared the thin disk to 40mm-diameter disk, there is little gap in periodicity (0.03). For this result, we think its mass little affects the periodicity.

Outlook

In this study, we did experiments on four kinds of disks. So the factors dealt with were inadequate to reveal relationship between period and diameter. From now on, we are going to deepen study by more kinds of disks. We analyzed only horizontal movement. So we are going to film and analyze vertical movement.

Bibliography

i 高速フーリエ変換ワークシート (FFT-PLOT-F-R8)

Y.Akiyama (akiyamay@zd5.so-net.ne.jp)

Research about Movement of Material on Plane Covered with Water

Researcher: Yamato Uehara, Yuto Ashida, Kensei Ishihara, Ryo Sakamoto, Masakazu Sugiyama

Instructor: Tamio Tsuboi

Abstract

We researched how water affects friction between a material and a flat surface using slope.

As a result, we found that atmospheric pressure prominently affected the data.

We also found that there were other complex conditions which affected this experiment.

Next, we increased the amount of water between the object and the flat surface using a horizontal plane. From the experiment, we found that the amount of water has a variety of effects on how the object slides.

1. Methods

(1) Experiment-1

- ① Put water (from 0.050g to 1.0g) between material(rubber) and a plane(aluminum).
- ② Research the relation between the amount of water and coefficient of static friction from tendency of the amount of material by making the angle of the plane larger .
- ③ Observe how the water spreads under the material by using acrylic transparent plate instead of the plane of aluminum.
- ④ From the result of ③, analyze how the movement of the material and coefficient of static friction was influenced by comparing each data.

(2) Experiment-2

- ① Changing the thickness of water from 1.0mm to 4.0mm, investigate the tendency of the movement of the material.
- ② Observe how the varying thickness of water influences the movement using a camera and computer .

2. Results/Discussion

In Experiment-1, we found that when there is the 0.050g to 0.70g of water under the material, the more water under the material, the higher coefficient of static friction. When there is the 0.80g or more of water, it is pressed on the plane by atmospheric pressure and it didn't move even if the angle of the plane increase to 90°. While the amount of the water increased, the influence on water changed. We are going to investigate this change to improve this research.

3. Reference

広中清一郎：新しい摩擦の科学 トライボロジー入門 発行所 講談社 発行年 1991 年

The relationships between instrumental sounds and non-instrumental sounds

Researchers: Suguru Yamaguchi, Keito Hishikawa, Keita Hideyasu
Instructor: Hitoshi Sori

Abstract

There are a lot of sounds in our daily lives. We wanted to know properties and regularity of these sounds. Then we tried to find the rules of sounds by checking their frequencies, sound pressure and so on, using FFT and Spectrogram software. Finally, we found that there are specific characteristics between instrumental and non-instrumental sounds.

1, Purpose

At first, we changed sounds which we recorded with a computer into visible things like data and graphs by using FFT and Spectrogram software. Then we confirmed characteristics of sounds, classifying them by certain similarities. Finally, we investigated whether certain characteristics determine instrumental and non-instrumental sounds.

2, Methods

- ① Checked changes in the sound pressure of the frequency components with the lapse of time, using Spectrogram.
- ② Checked instantaneous changes in the sound pressure of the frequency components, using FFT software.
- ③ Checked the wave form with FFT software.
- ④ Considering the results of ①,②,③, classified the sound and confirmed characteristics.
- ⑤ Searched the causes that determine instrumental and non-instrumental sounds.

3, Results

We confirmed the characteristics of the sounds that are considered as instrumental sounds in general.

- There is a main frequency component.
- In addition to the main frequency, they include overtones.
- They have a periodic wave form.

About the characteristics of the sounds that are considered as non-instrumental sounds in general.

- Each sound pressure difference of the frequency components are small.
- There is no regular sound pressure in frequency components.
- They do not have a periodic waveform.

4, Discussion • Prospect

We were able to confirm the characteristics of instrumental and non-instrumental sounds. However, we thought that there are other causes that determined them, such as high frequency components, temperature and so on. Through this experiment, we found that the hardness of the material may have something to do with instrumental sounds because most of the sounds which we classified into the instrumental sounds are made from metal. We thought that the object producing a sound must have the appropriate hardness that can vibrate regularly and periodically, which we found in the instrumental sounds. If materials are too hard or soft that they cannot vibrate regularly and periodically, they will break, or will not return to their original form, which we found in the non-instrumental sounds. Therefore, we would like to research the hardness of the material by checking the coefficient of restitution, bonding force, and natural frequency in the future.

5, References

音の科学（仕組みと図解）ナツメ社, 楽器の科学／サイエンス・アイ新書, 音と音律の科学/BLUE BACKS

The relationship between bubbles and concentrations of surfactant

Researchers: Daichi Takami, Akane Okamoto, Rin Sugimoto, Shota Inoue

Instructor: Wataru Kishi

Abstract

We predicted that the surface tension and the viscosity of the aqueous solution were related to the ability to form bubble. We prepared an aqueous solution of various concentrations with a commercially available detergent and measured the surface tension, viscosity and the ability to form bubble using some self-made devices. By the results of the experiments which we conducted by observing the bubbles and electrolyte, we ascertained that there is a correlation between the surface tension and the ability to form bubble. It was suggested a possibility that the essence had an interaction between surfactant molecules on the surface film of bubbles and water molecules maintaining bubbles.

1. Purpose

We joined a volunteer to make big soap bubbles for children, but we didn't know the best mix proportion, so I would like to apply this study to the one on thin film.

2. Method

1. We built a device modeled on Du Nouy Surface Tensiometer, and measured the surface tensions of surfactant solutions (Emul, polyoxyethylene alkyl ether 19%) at different concentrations.
2. We measured viscosity of these surfactant solutions with Ostwald's viscometer.
3. In order to measure how difficult the bubbles burst. We put 10 ml of the some surfactant solution into a 1L measuring cylinder. Then we breathe air into the solution through a tube to make a bubble. Then we measured how high the bubbles go up in the cylinder in each surfactant solution.

3. Result

As a result of the measurements of ① to ③ it was found that bubbles are less likely to break when both the surface tension and the viscosity are small. Also, in the case of high concentration AE aqueous solution, water moved to the lower part of the soap bubbles. But in the AE aqueous solution with an appropriate concentration, the bigger the soap bubbles become, less water moved to the bottom of the bubbles. From this result, we assumed that hydrophobic molecules are uniformly lined up on the surface in highly concentrated aqueous AE solution. Under this assumption, since the hydrophobic faces the inside of the membrane, I think the electrostatic interaction between the bubble film and water is weak. On the other hand, in the AE solution where bubbles are less likely to burst, we think that the interior hydrophobic group strongly interacts with water inside the foam membrane, so that bubbles that are less likely to burst can be maintained. Therefore, when we take off molecules of the outermost layer, it was thought that bubbles are less likely to burst. So we conducted some experiment by adding NaCl, MgCl₂, AlCl₃ with the positive charge of 2mol/L to the 19% AE solution. Our results, we found that as the valence of the cation increased, it become difficult for the bubble to burst. From our results, we concluded that the condition under which big bubbles are formed is when the surface tension is small and the interaction with water and detergent molecules is strong. We would like to add the hydrophobic substance to the AE solution and verify the change.

Measuring of degree of washing the stain out by the digital image

Tsuyama high school

Takeuchi Akihito, Ikeda Kento, Suzuki Mayu, Doi namiki, Yoritsune Yuki

Abstract

In general, it is said that the longer time goes by, the more difficult it is for you to remove stains on cloth. We tried to verify this theory using a familiar digital camera. We think an image of a digital camera is supposed to express the degree of washing the stain out. In our experiment, we stained a piece of cloth and washed the stain out of it. We compare the image of washed cloth with the concentration of stain dissolved in the washing solution. We verified whether it was possible to quantify the degree of the stain.

Research contents

- I Imaging procedure: pictures of stained cloth taken inside the self-made device named “Research kun”.
- II How to analyze the image of cloths stained by black ink.
- III How to analyze the image of cloths stained by red and blue ink
- IV The degree of washing out the grape juice stains.

Result

- I “Research kun” enabled to keep the RGB color values constant.
- II There is a correlation between the RGB values of the stain and the amount of the black ink stains washed away.
- III There is also a correlation between the RGB values of the stain and the amount of the red and blue ink stains washed away.
- IV The longer we left stains on the cloth, the harder it became to remove the stain.

Consideration

- I It is necessary to take pictures of stained cloths with papers whose RGB values were already checked and whose colors are similar to the stains on the cloths.
- II The RGB values of the stained cloths got closer to those of the clean cloths, after the stains were washed away.
- III After the red ink stain on the cloth was washed away, its R value didn’t change. However, its B value and G value become closer to the RGB values of a clean cloth.
- IV The longer we left the stain, the more particles enter the cloth, which cause difficulty in washing the stains out.

The effect of *Rhizopus oligosporus* on saccharides

Researchers: Uehara Shoto, Irio Yudai, Uchida Ryuki, Takemura Naoki, Namba Syusei, Namba Takuhiro

Instructor Kojima Shohei

Abstract

We focused on the tempeh, which is a kind of food made of fermented soybean, eaten mainly in South East Asia. Especially, we focused on the amount of saccharide in the tempeh. In order to research the effect of *Rhizopus oligosporus* on saccharide, we compared the amount of saccharide which is contained in beans before and after fermentation process. We also compared the amount of saccharide in *Sachiyutaka*, common soybeans in Japan and *Gongo* beans, the local soybeans in Tsuyama. As a result, we found differences in the quantity of saccharide, and the result suggested that *Rhizopus oligosporus* uses saccharide to ferment beans.

1 Purpose

The previous research about the changes of components in soybean by *Rhizopus oligosporus* are found at research that focused the amount of change about Isoflavones and GABA, but the study that focused the amount of change about saccharide.

The purpose of this study is to understand the change in the amount of total sugars and reducing sugars in soybeans through the fermentation process.

We also focused on the difference of the change in the amount of sugar between different kinds of soybeans.

2 Experiment method

We used *Sachiyutaka*(white soybean:Tsuyama,Okayama) and *Gongo beans*(green soybean:Tsuyama,Okayama).

① We made the boiled soybean to which we added the tempeh bacteria and the one which we didn't add the tempeh bacteria in these two varieties of soybeans.

② We crushed each soybeans and extract its ingredients.

③ We deproteinized solution of ② and purified water for blank.

④ We measured total sugars that are included in tempeh and soybean before the processing by phenol-sulfuric acid method.

⑤ We measured reducing sugars that are included in tempeh and soybean before the processing by Somogyi-Nelson method.

3 The result

Through fermentation, the amount of total sugars that are included in *Sachiyutaka* has decreased, and the amount of total sugars that are included in *Gongo* beans has hardly changed. By effect of *Rhizopus oligosporus*, reducing sugars in each type of soybean has increased, and non-reducing sugars in each type of soybean has decreased.

4 Discussion and view

According to the experimental result when fermentation of soybean proceeds, tempe bacteria utilizes sugar in soybeans. However, it is presumed that its use method differs according to variety. Focusing on the total sugar content, the total sugar content of the *Sachiyutaka* tended to be lower than the total sugar amount of the *Gongo* beans. Also, in *Gongo* beans, since the amount of reducing sugar increased and the total sugar amount hardly changed, it is considered that the Tempe bacterium changes non-reducing sugar into reducing sugar. According to previous research about saccharides, calories in simple sugars such as glucose is higher than non-reducing sugar which has same amount of sugar. So we can get more calories by eating food that is fermented by *Rhizopus oligosporus*.

What color do you like ? ~ *Danio rerio* Ver. ~

Researcher: Minori Nakanishi, Ai Kishimoto, Aoi Kikuri, Naoko Nishishita

Teacher: Akio Konishi

Introduction

It is known that *Euglena* indicates phototaxis and especially gather in blue light. We conducted a study of the reaction of *Danio rerio* of multi-cellular organisms to the color. The goal of this study is to investigate what differences there are between the reactions to color of multicellular organisms and those of unicellular organisms.

Methods

1. We transferred twenty *D. rerio* into an experimental water tank separated into several areas by three or five colors (Red, Green, Blue, Black and White).
2. Thirty pictures of the tank were taken with a digital camera at one-minute intervals.
3. We rotated the water tank for each experiment because room light may influence results of experiment.
4. Measured the number of fish gathered at each color.
5. We repeated the experiment in a dark room using LED lighting that standardizes brightness in the water tank.

Results

- Under the room light, *D. rerio* was more sensitive to the brightness of the light than to the color because the brightness was different in each colored area the water tank.
- In the dark room using LED lighting, *D. rerio* tend to gather in red.

Discussion

The result shows that *D. rerio* tend to gather in red color. That's because red light is less likely to scatter and disperse and therefore it becomes easier for them to find the enemies that are far away.

However, why didn't they gather in the red in all experiments? If they act instinctively, they always gather in the same color. We considered that they avoid bright place because they are easily found by enemies. On the other hand, they gather in the red because it becomes easier to find the enemies that are far away in the standardized brightness environment. However, these two ideas are mutually contradictory. When they find enemies easily, they also are easily found by enemies. We thought that *D. rerio* can decide its actions by using their brains depending on the situations.

Researching formation process of landform in eastern Tsuyama

Researchers : Shingo Kakiuchi, Masaya Komoto, Takuto Kobayashi, Hiroya Hasegawa

Teacher: Takashi Yamamoto

Abstract

It is said that Tsuyama was once a warm sea (We call it Tsuyama Sea) 16 million years ago. We were interested in the process of its disappearance and the current landform formation. We focused on Oike Pond in Hiroka Okayama prefecture where we can see the terrain that is descending towards the south. We analyzed the history of the terrain formation in the Tsuyama area by testing the electrical conductivity and pH value of the soil we collected in Hiroka. We also used the terrain data of eastern Tsuyama for this survey.

Introduction

There once be a sea in Tsuyama, and now layers of Neogene Period which are easily weathered remain there. Previous study shows that the transgression and marine regression happened, and Backbone mountains rose.

Research before deciding hypothesis

- By field outcrop exploration in Hiroka, we found gravel layer .
- There is a thrust fault, called mimasaka thrust fault, in Hiroka.
- We tested the electrical conductivity and pH value of the soil we collected in Hiroka. And it turned out that that soil was carried by river.

Hypothesis

We can see the evidences of Tsuyama sea formation in modern land formation.

Ways for research

- Analysis of topography, and research the distribution of tertiary Neogene layer around northern Okayama and north-eastern Hyogo.

Result

- The level of eastern point of Mt.Nagi is lower than nearby area.
- There are both the Mesozoic and the Neogene layers in Hiroka
- We could find landform that looks like Rias coast in eastern Nagi area.
- The level of Tsuyama was lower than north-eastern Hyogo and western Okayama.

Conclusion

In Neogene period, transgression and marine regression formed rias coast. After that, north-western Hyogo, western Okayama and backbone range rised. At the same time, the Mesozoic layer was thrust by the movement of mimasaka thrust fault. We think the sea water had gone nearby Mt.Nagi. This is how Tsuyama sea had disappeared. In quarternary period, the Mesozoic layer was encroached by revers which were running from west to east. So, we can see talus accumulation in Hiroka now.