

Hong Kong Student Science Project Competition 2023

Template of Extended Abstract (Investigation)

(Word Limit: 1,600 words, Pages: 3 pages only)

Team Number: SBPE096

Project Title: Investigation in the relationship between shoe sole patterns and friction

Project Type: Investigation

*To our best knowledge, there are no * similar works in the field;*

The enhancement our project made / the difference with related research are:

<https://www.archyde.com/consumer-council-hiking-shoes-north-face-slip-resistance-score-2-points-6-shoes-have-poor-waterproof-performancethere-are-two-brands-that-do-not-enter-the-water-after-soaking-for-6-hours/>

(Reference)

As there are no prior studies specifically on our topic, our most useful reference will be from the HongKong customer council, as the council tests a big variety of products. The customer council didn't really specifically test for the grip of the shoes but rather focused more on other functions for example waterproof. Thus we would like to raise customer awareness about their shoe soles which is something that people seldomly care about but can make a big impact in the right time.

**Please delete if not applicable. The competition values the originality of works. Students must do enough literature research to ensure that their works are unique and list relevant reference materials before starting research or invention.*

I. Background

- Provide background information of project and/or state the problem to tackle
- Provide highlights of the **literature review** with the support of pertinent and reliable references
- Provide an overview of work and mention the **research gap that the project is trying to fill**

Companies are constantly aiming for higher revenue so they tend to boast about how good their product is. This phenomenon was the same for shoes, some say that their shoes contain advanced waterproof technology and the premium materials used on the shoe, so that consumers would believe that the shoe would make their hiking experience safer. But we believe that the crucial factor of friction on shoes is the sole. Unfortunately, no one has designed a perfect shoe sole in order to prevent any slips. This inspired us to think about: Instead of designing complicated shoe sole patterns, why don't we use basic geometric shapes and find out the best width and shape of patterns on shoe soles?

II. Objectives

- **We aim to study the effects of the width and shape of shoe sole patterns on friction.**

III. Hypothesis

1. Friction would increase if the pattern spacing is more narrow
2. Shapes with more contact surface area would have more friction
3. A wet surface would decrease the friction between the shoe sole and the ground

IV. Methodology

Materials

3D printed modified shoe soles

Longboard

Ruler

Procedures

Add paper clay onto soles until it weighs 200 grams each.

Use cling paper to wrap the paper clay.

Place the sole onto one end of the styrofoam platform.

Slowly rise the platform until the sole slips to another end.

Measure the length of the hypotenuse and the opposite side of the risen styrofoam platform.

Calculate the angle (θ), which is given by $\sin \theta = \text{opposite side} / \text{hypotenuse}$.

Repeat the experiment with the same sole sample 3 times to increase precision.

Repeat steps 1-7 with other sole samples and with the wet terrain.



We analyzed the results by measuring the angle of elevation between a fixed distance against a fixed horizontal surface by using the tangent function. The angles can be a metric or quantifier to define 'best' and 'effectiveness'

V.

- Present the **data** with figures, tables or photos
- **Data analysis** (if any, with emphasis on data reliability and the reproducibility based on statistics)

- Interpret the results and its implication
- Discuss **limitation** and compare with existing related works (if any)
- Discuss the importance or impact of the research and how it is applicable to real problems

Please note that all data is corrected to the nearest 3 significant figures.

	Triangle	Circle	Dodecagon
Wide spacing	normal: 27.4 degrees wet: 31.3 degrees	normal: 31.7 degrees wet: 25.9 degrees	normal: 30 degrees wet: 30.0 degrees
Narrow spacing	normal: 36.2 degrees wet: 30.3 degrees	normal: 33.3 degrees wet: 29.3 degrees	normal: 34.1 degrees wet: 34.1 degrees

Limitations

- 1.Can't prevent some human error
 - 2.Can't test for 'roughness' also can be known as some irregular surfaces due to the fairness of test
- So we cant 1:1 simulate the most realistic situations although our results can already prove the effectiveness of different patterns

Impact of research

Having the conclusions from our experiment, we can see that based on our measures, the narrower the spacing is, the greater the friction. Therefore, consumers could be more aware to choose the right shoe sole for the right purpose.

VI. If your team will compete the Sustainable Development Award, please indicate the specific sustainable development goal the project is related to, and provide justification for competing for this award. (Word limit: 300 words)

Our project is related to SDG 17 'Partnerships For The Goals' the definition of this goal cited from <https://sdgs.un.org/goals> is to Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development. Shoes might not be the solution for those big flashy goals like solving world hunger, but I would say that the shoe is an 'unspoken language' that connects the world. In the year 3500 bce, the first shoe was made, it was a revolutionary invention that brought humans closer together as it allows people to walk for longer distances while preventing injuries. There are lots of problems out there in every corner of the world waiting to be unraveled or solved and people out there

hoping for salvation. Goal 17 of the SDG acts as a supporting role, just like our shoes. By wearing the most effective shoe soles, people can conquer harder domains and terrains potentially helping more people and solving more problems. Taking the literal meaning of what Saul Bellow once said, 'Whoever wants to reach a distant goal must take small steps.' We hope that our generalization on shoe soles can one day help others take their 'first step'.

**VII. If your team will compete the Social Innovation Award, please list the target group or social issue the project focuses on, and provide justification for competing for this award.
(Word limit: 300 words)**

One target group that our project focuses on would be hiking lovers. Accidents happen every year in the world, according to statistics, there were an estimated 4,000-5,000 injuries related to hiking each year in the U.S. We hope that by using the results of our project we can raise the customer awareness to the public. The next time when they go hiking, they will be ready and know what shoe fits the best for them to tackle different challenges.

VIII. Conclusion

From the data collected, it can be concluded that:

1. With the same mass, the more narrow the spacing between the pattern of the sole is, the greater the friction.
2. Soles with dodecagon have the greatest friction, followed by circle, and triangle at last.
3. The addition of water decreases both the angle of inclination and the opposite side length, therefore the friction in the wet terrain is lower.
4. With the same mass, the greater the contact surface area of the shoe sole on the floor, the greater the friction.
5. The effectiveness of shoe sole can be impacted by the type of patterns used in a great range

These echo our hypotheses at the beginning.

*** Our project is developed based on previous project and the enhancement is below:**

