Eva

Traction Tester

As you saw in the video, to measure traction you need to calculate the coefficient of friction, or Mu. A sport researcher I met told me how you can measure the horizontal force and vertical force for outsoles to calculate Mu. Remember Mu (μ)= horizontal force / vertical force. In this activity you will use a simple traction tester to calculate the coefficient of friction for different outsoles.

Materials you'll need to complete the Mission:

1. Force sensor (either digital or a spring scale) that measures Newtons.
2. A flat smooth surface to drag outsoles across.
3. Paper clips to attach to shoe and force probe.
4. Various outsoles to test (can be shoes you have in classroom).
5. Procedure and data table to organize force data, calculate Mu and make sense of your findings. (Your mentor will provide these.)

Edward
Sport Researcher

What you need to do:

Work with your team and use the traction tester, procedure and data table provided by your mentor to do the following:

- For each outsole provided, measure and record the horizontal (Frictional) force and the vertical (Normal) force.
- Record notes on each outsole tested (What material is each made from? What are the physical properties of the material? What are the patterns on the outsole? What do you think the outsole was designed for--ideal surface and activity?)
- Calculate the coefficient of friction (μ) for each outsole (divide horizontal by vertical).
- Share your data with other teams if your mentor has set up a data table. You can use the pooled data to compare measurements and discuss variation between teams and how it might be improved.

At the bottom of your data table write down which outsole might be best to use as a model (if any) for your Parkour shoe design.

Andee
Biomechanics
Researcher

I use a lot of tools, like the traction tester, a force plate, and high speed video to measure and understand the forces generated during activities. This helps me understand how forces impact different parts of the body and how we might create designs that will help an athlete perform better and also reduce injury. I work closely with athletes and designers to provide data they can use to make evidence-based decisions.

Dr. Ted

Traction Tester - Procedure

There are a variety of ways to measure traction that model how it is measured in a sport reseearch lab. Depending on hardware you have access to, and the time you have available, you can use either technique below to allow teams to collect data to use for an estimate of the coefficient of friction (μ) for a variety of outsoles. You can also use the extension provided if anyone wants to create a better traction tester for their own research for a science fair project.

Procedure for measuring traction:

1. Select an outole to test and enter the number for the outsole in the Outsole/Material column of your data table.
2. In the Notes column, write down observations about the physical properties of the outsole. (What material is it made of? What are the patterns on it? etc.)
3. Position the outsole toward the back of the flat surface so that there is enough room to pull it smoothly in a straight line path.
4. Place the weight on the part of the outsole where you want to measure the coefficient of friction.
5. Attach the force sensor you will use to the paper clip.
6. With a slow deliberate motion, pull the outsole along a straght path and once it begins moving smoothly, read the force (in Newtons) it takes to keep it moving over 3 seconds. (Note: the initial force will be higher than the force required to keep it moving in a smooth motion. Why?)
7. Record the amount of force you read off the sensor in the Horizontal Force column of your data table.
8. Repeat steps 1-7 for all the outsoles you have to test.
9. Once all the outoles are tested, fill in the vertical force (you used a 5 lb weight, so convert to Newtons (1 lb = 4.45 N) and enter this value in the Vertical column.
10. Calculate the Coefficient of Friction (μ) and make any further notes related to each outsole.
11. Answer the questions at the bottom of the data table.
12. Share your data (if you have time) and discuss with other teams.

This image of a traction tester shows a Vernier Force Sensor which stores the force data on a computer for analysis. With the spring scale, you will have to read the force directly from the scale as you pull. In this instance the heel area of the outsole is loaded with the weight to measure Mu for that part of the shoe. Other outsoles are in the background. In general, the higher the coeeficient of friction, the better the traction. The lower, the less traction and the greater the liklihood of slipping. Remember though, the surface can have a lot to do with traction. How might the coefficient of friction change if you replaced this surface with ice? Would different outsoles be better on different surfaces?

Andee
Biomechanics
Researcher

Traction Tester - Data Table

Use this data table to write down observations. Remember, the coefficient of friction is calculated by dividing the horizontal force by the vertical force. You only need to calculate the vertical force once as you used a standard weight of 5 lbs. (Remember 1 lb = 4.45 Newtions). Complete the table and answer the questions at the end. You will use this data and uour observations to help you design an outsole as part of a later deliverable during this Milestone.

Outsole	Vertical Force (N)	Horizontal Force (N)	Coefficient of Friction (μ)	Notes

Questions:

1. Which outsole do you think provides the most traction? Why?
2. Which outsole do you think provides the least traction? Why?
3. Which outsole do you think would be the best for Parkour? Why?
4. Which outsole do you think would be the worst for Parkour? Why?
5. Which outsole do you think would wear out the fastest? Last the longest? Why?
6. Which outsole was least flexible? Why? Does it matter?
7. Why do you think patterns or materials vary on different outsoles or on different parts on the same outsole?
8. What activity do you think each outsole was designed for? Why?