The Velocity of Different Objects

New Mexico Adventures in

Supercomputing Challenge

Final Report

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Team 40

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Table Of Contents

Executive Summary

Our project was started by a fascination with paintball gun. The variables in this project are barrels, projectiles, and PSI we are trying to improve a paintball's projectile by shaping the object into 3 different shapes. These shapes will hopefully have different distances in the velocity and distance. We will have 3 different PSI's (pounds per square inch) that should have an impact on these objects. The last thing would be different sizes of barrels in which we shoot from them to tell if it makes a difference in velocity or distance.

We have faced a few problems along the way to put the right information in to calculate velocity and distance. We needed to find a solution to velocity and configure it to meet the standards of a paintball to find a way for distance and how fast it would go. The distance was very hard to configure because every time you shoot a paintball it's always different. To propel the paintball so it can make the distance but each time it gets lower and lower so we have to figure out a way so this experiment will give us the right velocity and distance.

To accomplish what we are trying to do we will use a table to calculate and store our information, which will be used for our project conclusion. The table will be used as an object to keep information in order.

This information is vital to our conclusion in the velocity of objects and to see if we can make an advance projectile for future use.

Introduction

Paintballs are not made of paint. They are gelatin capsules containing a colorful, water soluble, biodegradable, non-toxic mixture of vegetable oil, food color and soap detergent. The same machines that make bath oil beads and vitamins encapsulate Paintballs. R.P. Scherer, the world's largest soft gel encapsulation company, was the first company to produce paintballs. Over one billion paintballs are produced annually. All paint guns are powered by compressed gas or CO2 that is released from a refillable tank or small CO2 power let. The released pressure shoots the paintball. The velocity of the paintball at the barrel end is usually 250 to 300 feet per second (fps); 300fps is the maximum allowed speed internationally (www.paintballzone.com). The project of finding the solution of 3 different objects with the same density will figure out what happens when we construct the paintballs in 3 different shapes of teardrop, bullet, and an sphere. These objects will presumably have different velocity and distance. The objects will all have the same density and will have the same weight the shape will be very different. We are wondering if these objects will be

aerodynamic: Or will they lose control because of air drag and lack of rifling! It can not hold the pressure of the air and the force of the barrels.

Methods

The methods to explain this project was a pretty simple task. First looking for the research to find velocity and distance. With that I started to look for how fast a paintball can go with a website which pretty much had everything I needed. We really didn't know what we were looking for but we managed with the velocity and distance equations along with the drag of objects when thrown.

Another method to manage was to see how fast a paintball will go so a experiment was set up to test this prediction. The paintball was to fast to stop a stop watch because we were going to get that and calculate how fast it was going and at what speed. So we will look at some paintball sites on the web to see if they have a conclusion on how fast a paintball projectile can go.

To conduct our experiment was to construct our own gun with a three barrel change out, with three projectiles (teardrop shape, oval shape, and a bullet shape), along with a 3 PSI of (100, 150, 200). Hopefully this experiment will give us a difference in each result but nothing is certain with the outcome. The barrels of the gun will be tricky to turn into a paintball

gun barrel, with that said a paintball barrel has ridges in it and that's what give it mostly is accuracy and distance. So hopefully we can make a few ridges in the barrels so the experiment can work properly. If we can get that to work the methods will work and all the calculation will pay off.

Project Description

Description of the project is a pretty simple concept to grasp because it mostly concerns velocity and distance along with drag. With that we can put it in a graph we have constructed to keep our calculations in order. This graph is designed on Microsoft Excel© in a 3D table to calculate certain problems around the cube. This will insure we are calculating our math correctly and efficiently. This is entirely because all this project is math and to tell if we are correct. We should shoot each projectile with the different barrels and PSI so we can calculate how they differ in each state. We will hopefully discover different speeds so when we finish this project we can make the ultimate paintball that could be revolutionized to play paintball games but it would probably hurt more than a regular paintball. The projectiles will all have the density as a regular paintball and efficiently so we can have the results we need instead of making them different weights and our calculations would be wrong. The excel which will be helping in our project will be used for calculating our major equations and we then can

give the computer different variables to give us different answers. Mostly why we picked this project was to show how a paintball gun really works and then we took it a little further by adjusting the PSI and the barrels along with the projectiles and other attributes to the gun. The study of the velocity equations was the hardest of them all by figuring out what equation we would use to figure out to find the solution. This solution is to help find the distance in the theory of our project experiment and to verify that our findings will be true and understandable for any one who looks at our findings. The test of the findings that we will present will help us in telling the people what we are understanding the concept and revealing the concept to the people. In figuring out this whole situation of not stressing under the pressure we should be able to present the final in a calm and simple matter and explain all the facts. In this the equations, the tables, projectiles, barrels, PSI, and a computer are the helpful things to figure out everything and to show us something new each day while we progress farther into this project.

Math Model

Theory

Our project requires assistance of equations of velocity, speed, drag and other helpful equations so we can put our project together. The list of equations will hopefully let you understand the concepts of why we need them.

The List:

Velocity

$$\mathbf{v} = \frac{d\mathbf{r}}{dt},$$

Where r is the position vector and d/dt is the derivative with respect to time. Expressed in terms of the arc length,

Speed

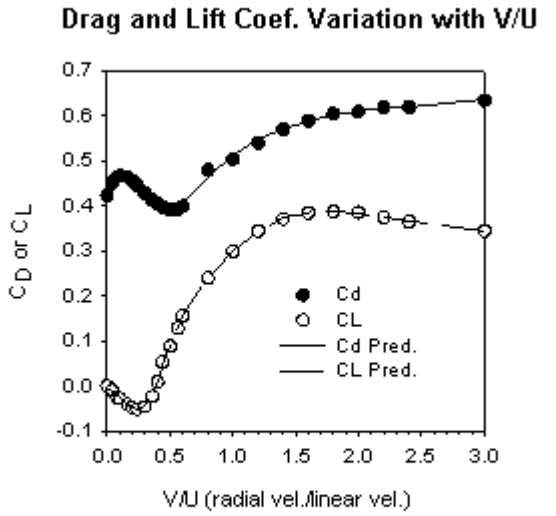
Where $\hat{\mathbf{T}}$ is the unit tangent vector, so the speed (which is the magnitude of the velocity) is?

$$v \equiv |\mathbf{v}| = \frac{ds}{dt} = |\mathbf{r}'(t)|.$$

Drag

The drag coefficient on a non spinning ball was calculated using the data of Achenbach that is displayed in the section on the Magnus Effect. To obtain the proper value of the drag coefficient at every time interval, the curve was fit to an arbitrary function of a type known as a rational equation. The points to fit were manually transcribed off the published graph.

Theory



Data from Mehta; Davies; Maccoll; Bearman

Rational equations have the general form:

$$y = \frac{a + bx + cx^2 + dx^3 \ldots}{1 + ex + fx^2 + gx^3 \ldots}$$

(www.comcast.net)

Results

The result of our project of the velocity of different objects is a task of our Excel chart and the equations that are in it. The Excel graph will be presented at the Los Alamos, Expo. We have found out that our equations for velocity, drag, etc, are equations we had, but we then made it our own to match what physical standards we needed. We also have found out that paintballs even with the same weight will have different variables to them with distance and velocity. There is however certain ways that this project can be expanded for a long time by applying other varibles in the Excel graph.

Conclusion

For this project, we chose an extremely difficult task to tackle. Learning about this subject was an intriguing. Thing to learn by taking on the responsibility of this task by finding out what to look for and how to put it in this project. By understanding the needs for the project. Along the way we have had help with numerous things like learning about drag which we never even knew it involved with this project. But we had a great year we have learned new things and hopefully we will enter next year with an even better project.

References

1. Mathematics Dictionary – page 415-416
2. Plane Trigonometry – page 92-94
3. The Physics of Paintball – http://home.comcast.net
4. Paintball math and physics – http://paintballzone.com
5. How paintball works – http://howstuffworks.com

Achievement

Our most significant achievement was to persevere the entire year without quitting and keeping the task at hand. This is the most important because if we quit then there would be no project to present and no one would know how much time and effort we actually put in it. We have learned new things about mathematics and how a object is when it is thrown from one point to another by the velocity, distance, and drag. The project had its ups and downs but all things do. We have achieved a new kind of paintball that could be later used in the near future.

Acknowledgement

First, our thanks to our teachers Becky Raulie and Alan Daugherty for helping us get in the program and to help us with obstacles that where in our way. They both stayed after school and weekends just so we could get the project done. This whole year they have done there best not to let anyone quit and to tell us to keep going.

Further thanks to Nick Bennett for helping us contribute to our math skills by providing us a theory for drag and velocity and helping us to set up a table in Excel to calculate equations for answers. And also coming to our school to help us out.

Thanks to AISC for helping us when we e-mailed them for help on our mathematics also. And e-mailed back with the helpful things we needed very fast.