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| PHYS1521  **Math and Physics for Games**  Realistic Projectile  Simulation Report  Digital Media and IT  School of Applied Sciences and Technology |

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| **Section:** | A01 |
| **Date:** | March 22nd 2017 |
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*Fig. 1.* Screenshot of Projectile Motion Flash Simulation.

From “Projectile Motion” by Splung.com at <http://www.splung.com/content/sid/2/page/projectiles>

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# Introduction

Introduce your topic here. Give reason(s) why you chose this topic and the relevance to Game programming. Need at least one FULL paragraph.

Projectiles are moving objects that have plenty of physics associated with them. Our project is to create a virtual and realistic simulation involving launching projectiles at several angles. We chose this topic because it is familiar to us due to our Math and Physics for Games class at NAIT. We also see this as an excellent opportunity to translate our calculations into visual results.

There are plenty of video games that use projectile-like assets. The physics behind these assets are a lot more complicated than they may seem at first. For example, the game “Angry Birds” uses birds as projectiles and they are affected by multiple forces. All these forces must be programmed in, otherwise the projectile may act differently than a user may expect. For example, a projectile may slow down faster than a user expected, hence ruining their attempt at the shot.

This report will highlight our efforts towards creating a realistic projectile simulation and will go into detail on how each physics concept involved affects the projectile.

# Concept

Here you will have several paragraphs outlining the concept(s) of your project. You will need to go into depth on your project, i.e. outline all the key points relevant to Game Programming. For each key point below be sure to include diagrams/figures along with any math/code that is relevant to the key point. The diagrams and figures will need to be updated in the Table of Figures.

The simulation will involve two different scenarios. One scenario will have the projectile being launched from a cannon, and the other scenario having a ball being flung after multiple circular rotations around a center pivot. Our simulation will allow the user to change the variables in the simulation using a menu, this will demonstrate how well our mathematical calculations will react to the changes instead of being hard-coded values.

In our work, gravity’s acceleration will always be considered as -9.81 m/s2 as this is the constant we have been using in our physics class.

We’ll be using all the following concepts in our simulation, and they will be explained individually in this report:

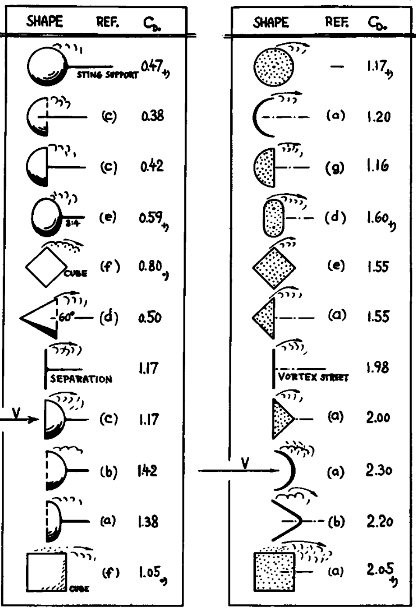
* Momentum Conservation between two colliding objects
* Air Resistance
* Linear Projectile Motion
* Rotational Projectile Motion
* Torque

## Air Resistance

### What Is Air Resistance?

Air resistance is a force that pushes in the opposite direction of an object’s velocity. Air resistance is dependent on an object’s velocity (Rit.edu, n.d.). So, the faster an object is moving, the more air resistance it will have. For example, a cube being dropped from a 500m high building will start with very little air resistance. However, as the object falls it starts to accelerate and the air resistance becomes a lot stronger. Since air resistance is a force moving against our velocity, this means that the object’s speed will eventually hit a maximum value. The velocity of the object will no longer increase, and the air resistance will stay constant as well.

Air resistance is also dependent on the shape of the object being used. A sphere for example, will have less air resistance than a cube would. The reason for this is the *Drag Coefficient (Cd)*.

The Drag Coefficient is a number that represents how much air resistance an object will have; it is dependent on the shape of the object being used. (engineeringtoolbox.com, n.d.). That is why modern vehicles have a very smooth and aerodynamic shape. Patrick E. George from HowStuffWorks.com gives the example of the Toyota Prius. He writes:

*“Among other efficient characteristics, its Cd of .26 helps it achieve very high mileage. In fact, reducing the Cd of a car by just 0.01 can result in a 0.2 miles per gallon (.09 kilometers per liter) increase in fuel economy.”*   
- Patrick E. George (March 2009)

### How Is It Relevant to Game Programming?

Fig. 2. Table of Drag Coefficients

From “Aerodynamic Drag” by Sighard Hoerner

## Torque

### What Is Torque?

Torque is a force that causes an object to rotate.

How Is It Relevant to Game Programming?

# Conclusion

Summarize the report by restating the reason for this topic and how the key points (covered above) make this topic relevant to Game Programming.

# References

Put all your references here.