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P2_1 In a Blink of an Eye

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Abstract

The game World of Warcraft introduces the concept of teleportation over a short distance in almost an instant. Based on the description of the concept, we calculate the acceleration under drag force with a minimum value of 68.38 $\pm$ 0.17 g and maximum of 82.79 $\pm$ 0.01 g. We then compare the acceleration to those that people are able to survive in real life to find that a person will suffer discomfort with possible injuries.

Introduction

In the online game, World of Warcraft, you can choose to play as a class of "mage". The mage is equipped with a spell called "Blink" that allows him to travel 20 yards (18.29 m) in approximately 300 ms, in order to escape from dangerous situations [1]. We investigate the acceleration the mage would experience under the effect of this spell.

Theory

The dynamic equation of motion is required for the horizontal direction. This relates the time, t, the uniform acceleration, a, and the initial speed, u, to the distance traveled, s; as seen in Equation 1 [2].

$$s = ut + \frac{1}{2}at^2 \tag{1}$$

We apply physical motion to the act of teleportation, which is commonly associated with the process of traveling to another location in space without physically traversing the distance [3].

It is assumed that the spell accelerates the mage from rest, $u = 0$ ms^{-1}, and then decelerates them so that they are once again stationary. The time of the acceleration is half the total spell time and the distance he accelerates is half of the spell distance.

$$a = \frac{4s}{t^2} \tag{2}$$

The effects of air resistance were then considered for the accelerating body by accounting for the drag force, F_D:

$$F_D = \frac{1}{2}C_D A\rho v^2 \tag{3}$$

where C_D is the drag coefficient, A is the cross sectional area, ρ is the density of air, and v is the speed [2]. We assumed a human to be cylindrical with a height of 1.8 m and diameter of 0.48 m [6]. The C_D of the body is estimated to be 1.2 and the density of the air, ρ, is 1.293 kgm^{-3} [7].

Increments of 0.01 s were taken between 0 and 0.15 s to estimate the mage's speed during the uniform acceleration using Equation 4

$$v = u + at \tag{4}$$

Substituting into Equation 3, we evaluate the change of drag as speed increases. By subtract-

ing the drag force from the force applied by the spell we obtain the net force as seen in Equation 5.

$$F_{net} = F_a - F_D \tag{5}$$

A mass of $m = 70$ kg was used [2]. We subtracted and rearranged Equation 5 for net force to calculate the acceleration.

To determine whether the spell is survivable we looked at various real life situations. Jet pilots encounter acceleration up to 9 g, which can lead to fatigue, blackouts or death [5]. The world record for horizontal acceleration is held by John Stapp, who decelerated by 42.6 g in a second. It is noted that Stapp sustained damage to his eyes as a result [4].

Discussion

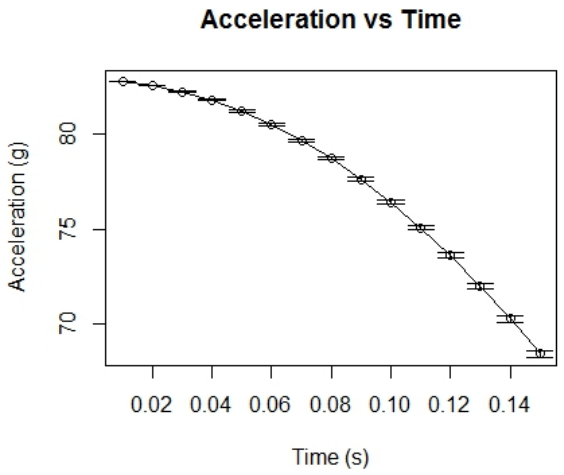

Figure 1: The change of acceleration with time modeled with 0.01 s time increment with drag force included.

After carrying out the method outlined, the acceleration of the mage ranges between,

$$a_i = 82.79 \ \pm 0.01 \ g \quad , \quad a_f = 68.38 \ \pm 0.17 \ g$$

The highest acceleration was reached before the mage picked up speed as would be expected from the relationship in Equation 3. Figure 1 shows this motion. This breaks the initial restrictions placed and renders the spell impossible. Deceleration was not computed, but could be the basis for further research.

The difference between the acceleration due to low friction and then drag, ranges from negligible to 17%. Errors arise due to the assumption of the human body being cylindrical and the time increment used.

Conclusion

In our investigation we have discovered that including drag force causes the spell to break. It would be necessary to develop possible modifications that would fulfill the given criteria. The accelerations from experiments make it difficult to estimate whether the spell would be harmful or not. The acceleration is experienced for a much shorter time period, 0.15 s, than the one by John Stapp, 1 s, but has higher magnitude; 82.79 and 68.38 g compared to 42.6 g. It is plausible the mage would survive the spell but it would cause great discomfort and could be detrimental to his health.

References

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