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P3_8 Saving Springfield

D. Worthy, R. Garner, J. Gregory and J. Taylor-Ashley

Department of Physics and Astronomy, University of Leicester. Leicester, LE1 7RH.

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Abstract

The Simpsons Movie concludes with Homer saving the day by riding a motorcycle on the inside of a glass dome and throwing a bomb out of the hole at the top. This paper considers the centripetal force involved along with the loxodrome path and determines whether he has enough time to throw the bomb. It is concluded that Homers apparent loxodromic path up the dome is the correct path to reach the top within the time limit. However this requires a speed of 188ms^{-1}, much higher than the land speed record for a motorcycle.

Introduction

In The Simpsons Movie (2007), the town of Springfield becomes trapped inside a giant glass dome with the only exit being a small hole at the peak of the dome. A bomb is dropped inside the dome in order to destroy the town. With the bomb timer ticking, Homer takes it upon himself to ride his motorcycle up the inside wall of the dome and throw the bomb out of the hole and saves the day [1]. This paper investigates whether such a feat is possible.

Globe of Death

Homers stunt is based on the Globe of Death, a famous carnival stunt. In this stunt, a motorcyclist is able to ride around the inside of a sphere, even upside-down. This can be achieved due to the centripetal force acting on the motorcycle and rider, ignoring any aerodynamic effects. The centripetal force, F_c, is given as

$$F_c = \frac{mv^2}{r}, \tag{1}$$

where m is the mass of the object, v is the objects tangential velocity, and r is the radius of curvature. In order for the rider to be able to travel upside down, this force must be greater than the force of gravity acting on the rider,

$$F_g = mg, \tag{2}$$

where g is the acceleration due to gravity, equal to 9.81ms^{-2}. Hence the minimum required velocity for this stunt is calculated by equating equations (1) and (2);

$$v_{min} = \sqrt{rg}. \tag{3}$$

Homer's Path

When attempting to save the town, Homers path to the top of the dome is not a direct one. Instead, it is a loxodrome; a straight path along a spheres surface which spirals to the peak of the sphere, as in figure (1). Due to the nature of cartoons, it is hard to tell the exact shape of the dome. However if it is assumed to be a hemisphere then the following equation will apply.

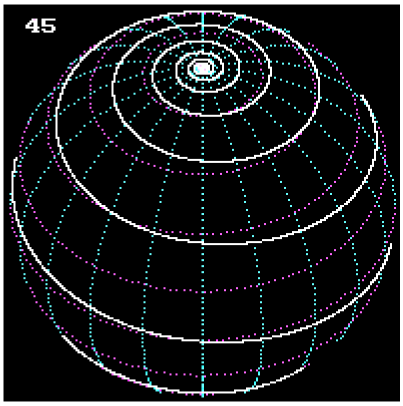

Fig. 1: Loxodrome from pole to pole. [2]

The equation for the length of this path on a sphere is, as derived in *Mathematics Magazine Vol. 77* [3],

$$D = R|L_2 - L_1||sec\theta|, \tag{4}$$

where D is the length of the loxodrome, R is the radius of the sphere, L_1 and L_2 are the initial and final latitudes respectively in radians, and θ is the bearing of the path, where a path directly aimed at the peak has a bearing of 0rads.

Dome Dimensions

The dome is pictured as covering the majority of Springfield town and does not cover Springfield Gorge. As the size, shape, and layout of the town is inconsistent throughout this sitcom it is hard to estimate the size of said dome. However, Springfield has been cited as based on Springfield, Oregon [4]. This city has the same population as its fictional counterpart and covers an area of 40.8km2. It shall be assumed that the hemispherical dome covers this area, giving a radius of 3600m.

Detonation Time

In the film, the bomb has a countdown timer on it. 20 seconds before Homer mounts the wall of the dome the clock is shown to have a time of 1:20. As he reaches the top and the bomb is thrown it shows a time of 10 seconds [1]. Hence the total wall ride time, t, is 50 seconds.

Discussion

The minimum velocity required for Homer to maintain contact with the dome, calculated from equation (3), is 188ms^{-1} (equivalent to 420mph). This velocity is unrealistically high; the land speed record for a motorcycle is 376mph [5]. However, if it is assumed that this record breaking speed is possible, the question still stands, will Homer reach the top in the given time limit?

To answer this, equation (4) can be used; substituting $D = vt$ and rearranging for θ, the required path angle can be determined. If this path angle is of reasonable value, as compared to the approximate angle in the film, then Homer can save the day and the Simpsons writers can be applauded for their correct use of physics.

The values of L_1 and L_2 are taken to be 0rads and $\pi/2$rads, respectively (i.e. at the base and at the peak of the hemisphere). Substituting these values into equation (4) the bearing θ, is calculated as 53.0°. Hence the angle of attack (see figure 2) from the ground is 37.0°.

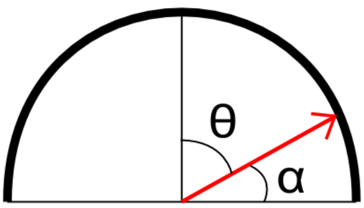

Fig. 2: The bearing θ is the is the angle from the north pointing line and the angle of attack α is the angle from the horizontal ground.

As with all cartoons and films, it is hard to estimate the exact angle of attack; however, after review of the footage, it seems that the angle of attack is somewhere between 30° and 40°. Confirming that the film agrees with the physics.

Conclusion

The velocity required to achieve this stunt, realistically, is unachievable. Hence this stunt would be impossible. However, given that the size of the dome is fixed (to the size of the town), the film has appeared to follow the laws of physics. Homer sets off up the dome at the correct angle given his time limit and required speed.

However, *The Simpsons* is a cartoon; the laws of physics may differ in this cartoon world and the required speed may be achievable.

References

[1] *The Simpsons Movie*, 2007, David Silverman (Director), 20th Century Fox

[2] http://en.wikipedia.org/wiki/Rhumb_line last accessed on 03/11/2013

[3] J. Alexander, *Mathematics Magazine Vol.77* (5 December 2004) P.349

[4] http://simpsons.wikia.com/wiki/Springfield last accessed on 03/11/2013

[5] http://www.fim-live.com/en/media/news/2010/news-detail/article/1286193134-new-fim-world-record-bonneville-raceway-utah-usa/ last accessed on 03/11/2013