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P6_1 Bart the Daredevil

J. Phelan, J. Campbell, B. Warne, A. Alam

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

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Abstract

This paper examines the feasibility of a planned attempt by Bart Simpson to jump Springfield Gorge on a skateboard. In order to clear the gorge, we have calculated that Bart would need to reach a speed of $22 \pm 4.3ms^{-1}$. In order to reach this speed we estimate the drop-in to Springfield Gorge would require an angle of descent > 50 degrees.

Introduction

In the episode of The Simpsons - Bart the Daredevil, Bart Simpson plans to jump Springfield Gorge on his skateboard. In the episode Bart's jump is interrupted by Homer Simpson who, scared for Bart's safety, tackles Bart off the skateboard mid-way through his run-up.

We have calculated the run up conditions, had Homer not tackled him, necessary for Bart to make this jump.

Springfield Gorge

In order to calculate the required take-off speed, the distance from one side of the gorge to the other is needed. A still of the gorge taken from The Simpsons Movie can be used to estimate these values.

In The Simpsons Movie, Homer and Bart jump the gorge on a motorbike. We have used this motorbike as a ruler of sorts to measure both the length of the gorge in the still and also the height they reach in their flight. The bike used in the film is similar to one seen earlier in a 'Globe of Death' circus act, typically the bikes used in this act are 100 cc dirt bikes. We have assumed the bike used is also a dirt-bike but with a larger engine to compensate for the extra weight. Using the average length of five 250 cc dirt-bikes and the average seat-height of eight 250 cc dirt-bikes[1] the height reached in the jump can be estimated to be 8 ± 1.5 m and the distance of the gorge to be 47 ± 3.5 m. The errors in these measurements have been estimated using the error inherent in the instrument used to measure the motorbike from the movie still. Errors have thus been propagated through any further calculations described in this paper.

Time of Flight and Take-Off Speed

The time taken for Bart to travel from the peak of his flight path back to the earth will be equal to half the total flight time. This time can be calculated using $\triangle y = v_{0y}t + (1/2)a_y t^2$[2] which due to $v_{0y} = 0$ rearranging to get in terms in t gives.

$$t = (2 \triangle y/a_y)^{1/2}, \tag{1}$$

Where t is the time taken for Bart to fall from the peak of his trajectory back to earth, $\triangle y$ is the distance travelled in the y-direction and a_y is the acceleration in the y-direction.

The total time of flight can be found using $t_{total} = 2t$, this gives $t_{total} = 2.6 \pm 0.2$ s, having calculated the time of flight it is possible to find the x and y components of the initial speed. The x-component of velocity was calculated to be $v_{0x} = 18.1 \pm 3.1$ ms^{-1} and the y-component to be $v_{0y} = 12.5 \pm 1.7$ ms^{-1}. Calculating the vector sum of these two quantities then gives $v_{take-off} = 22 \pm 4.3$ ms^{-1}.

Required run-up Length

To find the required run-up length we have calculated the component of Bart's gravitational force acting parallel to the ramp and also the frictional force between Bart's skateboard wheels and the ramp. The force due to friction can be calculated using

$$F_{friction} = \mu F_{normal}, \tag{2}$$

Where F_{normal} is the component of gravity acting on Bart in a direction orthogonal to the slope and μ is the coefficient of friction. Typically recreational skateboards are fitted with 90A-95A Polyurethane wheels[3] and so an average of the two μ values associated with these wheel classes has been calculated, giving a value of $\mu = 0.69$[4].

The component of Bart's gravitational force acting down the slope is related to the angle of declination ϑ through a $\cos(\vartheta)$ relationship, the consequence of this is that as the angle ϑ increases, the force acting parallel to the slope also increases.

The resultant force can then be used to calculate Bart's acceleration, using $F = ma$. In these calculations we have taken the mass to be 32 kg [6]. Once the acceleration is known the run-up distance can be calculated by substituting the values into a rearranged equation of motion given by

$$S = (v_{take-off}^2/2a), \tag{3}$$

Where S is the distance of the run up and a is Bart's acceleration[2]. Figure 1 illustrates how the angle of declination affects the distance of run-up required, this graph can be used to estimate the likely declination of the ramp at Springfield Gorge.

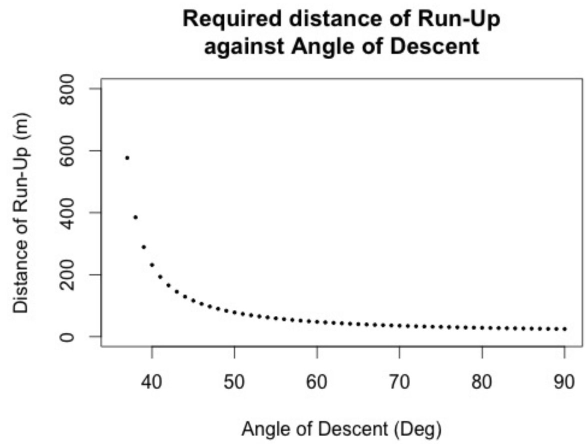

Figure 1: Plot showing the length of run-up Bart would require to clear the gorge for a variety of angles of descent.

Conclusion

By modelling the Springfield Gorge run up on the mega- ramp owned by professional skateboarder Bob Burnquist, we can assume the run up distance to be ~ 55 m[5]. Thus from Figure 1, we can estimate that in order for Bart to complete the jump the angle of descent would need to be > 50 degrees.

References

[1] `goo.gl/zOJL88` Accessed on : 23:10:16

[2] Tipler, Page 52 Accessed on : 23:10:16

[3] `goo.gl/2SnkUn` Accessed on : 23:10:16

[4] `goo.gl/vWjWlH` Accessed on : 23:10:16

[5] `goo.gl/ojRuiZ` Accessed on : 23:10:16

[6] `goo.gl/BZQLNc` Accessed on : 23:10:16