Velociraptor jumps - theoretical approach

Heikki Pitkänen

October 25, 2010

”and they’re astonishing jumpers...”

Contents

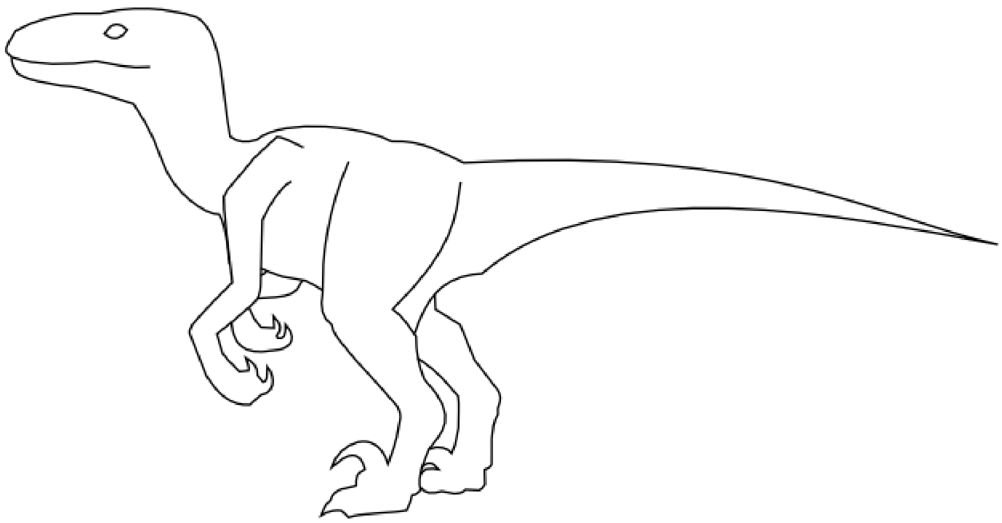

Figure 1: Velociraptor

Introduction

Since year 1993 when movie Jurassic park, directed by Steven Spielberg, was released people have been afraid of velociraptor attacks. The most important questions evoked by this threat are how far and how high a velociraptor can jump. There's no theoretical basis for answering these questions, so in this work we will try to create one.

In first parts we introduce velociraptor and two essential types of jumps. In the latter part of the work we do the math and try to approximate constants needed in the calculations. Last part explains the importance of this work.

1 Velociraptor

Velociraptors described in the movie were about 3 metres long and they weighted approximately 80 kg. These killing machines were equipped with huge and leathal claws. According to movie they could reach the speed of a cheetah, about "fifty, sixty miles an hour if they ever got out into the open", that is 22 to 26 metres per second. This description conforms the official details of dinosaur deinonychus. Bypassing this fact in this work we still call these creatures velociraptors.

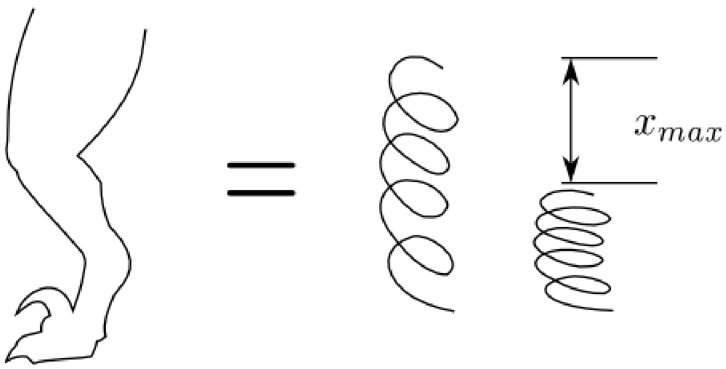

Figure 2: Assumption on the leg

2 Theory

2.1 Defining the constants k and x_{max}

We can assume the leg of the velociraptor work as an elastic spring, with spring constant k and maximum deviation x_{max}. See figure 2.

$$\begin{cases} v & = \\ x & = \\ y & = \end{cases}$$

2.2 Jump 1: Distance

When building a moat for your protection one of the most important thing is to know whether a velociraptor can jump over it.

Knowing the mass of a velociraptor m, constant k, maximum deviation x_{max} and angle α, we can easily calculate the maximum lenght of the jump, denoted as d in figure 3 on page 5. We can forget air resistance[1] and therefore let α be 45°. We also assume that the raptor is not running when jumping. Afterwards we derive lenght for another jump when a velociraptor has speed $v_x = v_{max} = 26\ m/s$.

2.3 Jump 2: Height

If the moat has been wide enough and velociraptor has now dropped on its floor, next significant question is whether your moat is deep enough. If you don't have aqua regia to fill up your moat, it's very important to have moat deep enought to keep velociraptors on its floor. Remember! Velociraptors

[1] Velociraptors are fucking slick bastards!

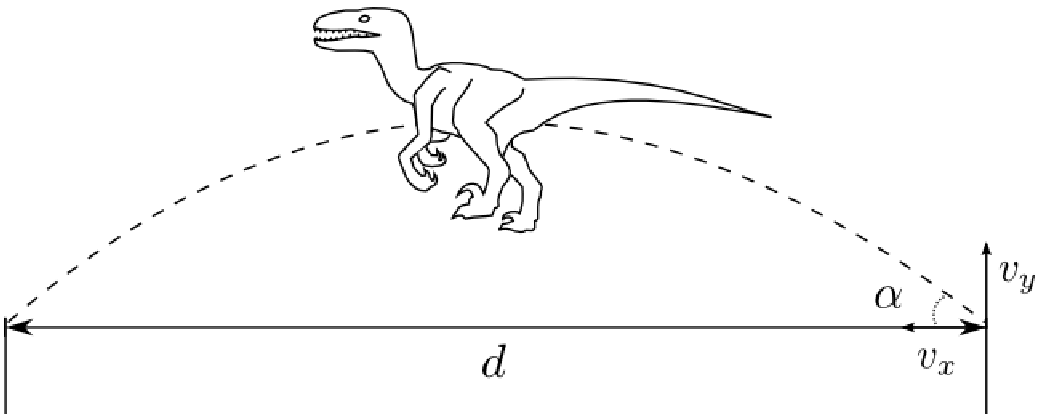

Figure 3: Jump 1: Distance

are smart and it's only matter of time when they learn how to climb out of the hole if you don't shoot them.

Denoted as h in figure 4 on page 6, the maximum height of the jump can now be calculated from known constants using the law of conservation of energy.

Energy stored in to the spring:

$$U_{spring} = \int_0^{x_{max}} kx \text{ dx} = \frac{1}{2}kx_{max}^2$$

and the potential energy of velociraptor on the top of the jump related to starting point of the jump:

$$E_{pot} = mgh$$

so we then derive:

$$U_{spring} = E_{pot} \Rightarrow h = \frac{k}{2mg}x_{max}^2$$

3 Calculations

3.1 Jump 1

3.2 Jump 2

4 Conclusions

We are doomed.

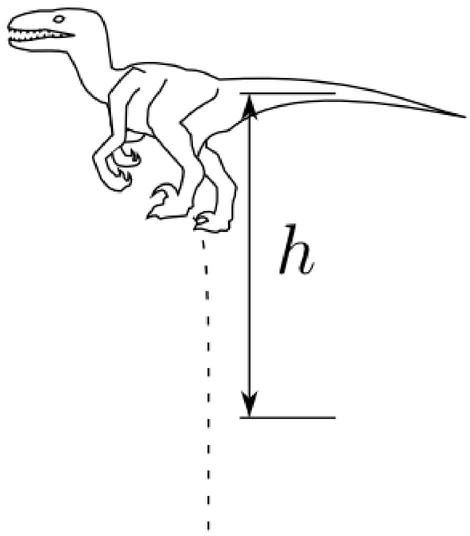

Figure 4: Jump 2: Height

References

[1] Steven Spielberg: *Jurassic Park,* movie 1993

[2] Young & Freedman: *University Physics with Modern Physics,* 11th edition 2003