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Tatsumaki Senpukyaku

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Abstract

This paper investigates the special move *Tatsumaki Senpukyaku* from the iconic video game franchise, Street Fighter. The practitioner of this special move, used in this paper, is one of the protagonists from the franchise, Ryu. By modelling the structure of Ryu as a normal British human and the horizontal flight of the Tatsumaki Senpukyaku to be helicopter-like it was found that while using this move Ryu would have to travel at a speed 30 ms^{-1} (~67 mph) through the air in order to maintain lift and stay afloat. This is a speed which is only 3 mph less than the motorway speed limit for cars in the United Kingdom (which is 70 mph).

Introduction

Tatsumaki Senpukyaku (also known as Hurricane Kick) is a special move appearing in the iconic video game franchise Street Fighter. To perform the *Tatsumaki Senpukyaku*, the practitioner jumps and while airborne rotates an outstretched leg, kicking a nearby opponent (see figure 1) [1]. This special move has been modified and portrayed differently by a few characters in the game franchise but the most famous practitioner of this move is the protagonist of Street Fighter, Ryu. It is noted that Ryu can perform the *Tatsumaki Senpukyaku* in two ways (as illustrated by several games in the franchise), by jumping then hovering parallel to the ground in a fixed place; or by jumping then flying parallel to the ground with forward velocity. The latter will be discussed in this paper. The aim of this paper is to investigate the forward velocity Ryu must travel at during the *Tatsumaki Senpukyaku* and to comment on the feasibility of the move.

Figure 1 – An image illustrating Ryu performing the Tatsumaki Senpukyaku [1].

Lift Force and Calculating the Horizontal Speed

During Ryu's *Tatsumaki Senpukyaku*, he stays airborne, hovering slightly above the ground for a length of time that seems impossible unless the rotating kick is spinning so fast that it produces a lift force to counteract his weight. In order to find the horizontal speed of the *Tatsumaki Senpukyaku*, the flight caused by the move will be modelled as a helicopter's flight with Ryu's outstretch leg acting as a propeller blade. This allows lift to be calculated using the following equation [2]:

$$L = \frac{1}{2}\rho v^2 A C_L, \qquad (1)$$

rearranging this to make v the subject gives:

$$v = \sqrt{\frac{2L}{\rho A C_L}}, \qquad (2)$$

where *L* is lift force, ρ is air density, *v* is true airspeed, *A* is planform area and C_L is lift coefficient.

The lift force can be calculated using the equation below, where *m* is mass and *g* is the acceleration due to gravity (9.81 ms^{-2}):

$$F = mg \qquad (3)$$

As the lift counteracts the weight of Ryu as he hovers in air, the lift force must be equal to 83.6 kg x

9.81 ms^{-2} which is 820.116 N, assuming Ryu has the mass of an average British man [3]. Assuming standard conditions, air density is 1.2754 kgm^{-3}. The C_L value can be calculated using the following equation:

$$C_L = 2\pi\alpha \qquad (4)$$

where α is angle of attack which is estimated to be 5° or 0.0873 radians. Therefore C_L will have a value of 0.549 (3 sf).

Finally, *A* can be found by calculating the area of the circle created by Ryu's rotating kick:

$$Area\ of\ circle\ created\ by\ spinning\ kick = \pi r^2 \qquad (5)$$

where *r* is the length of Ryu's leg taken to be 0.9 m as this is within range for the average man [4]. This gives an area of 2.54 m^2.

Using these values *v* can be found from equation (2):

$$v = \sqrt{\frac{2 \times 820.116}{1.2754 \times 2.54 \times 0.549}}$$
$$v = 30\ ms^{-1}$$

The velocity Ryu must travel at during the Tatsumaki Senpukyaku is 30 ms^{-1} or 67 mph (2 sf). This is a speed much higher than the speed at which humans can run and is only 3 mph less than the speed limit for cars travelling on motorways in the United Kingdom (which is 70 mph [5]).

Conclusion
In conclusion, the form of *Tatsumaki Senpukyaku* which causes the practitioner to fly parallel above the ground with forward velocity is a technique which is physically impossible for a normal human being and would require the practitioner to hover with a forward velocity equal to 30ms^{-1} (~67 mph) a speed which approaches the motorway speed limit for cars, in the United Kingdom.

References
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