The Tennis Racquet Theorem

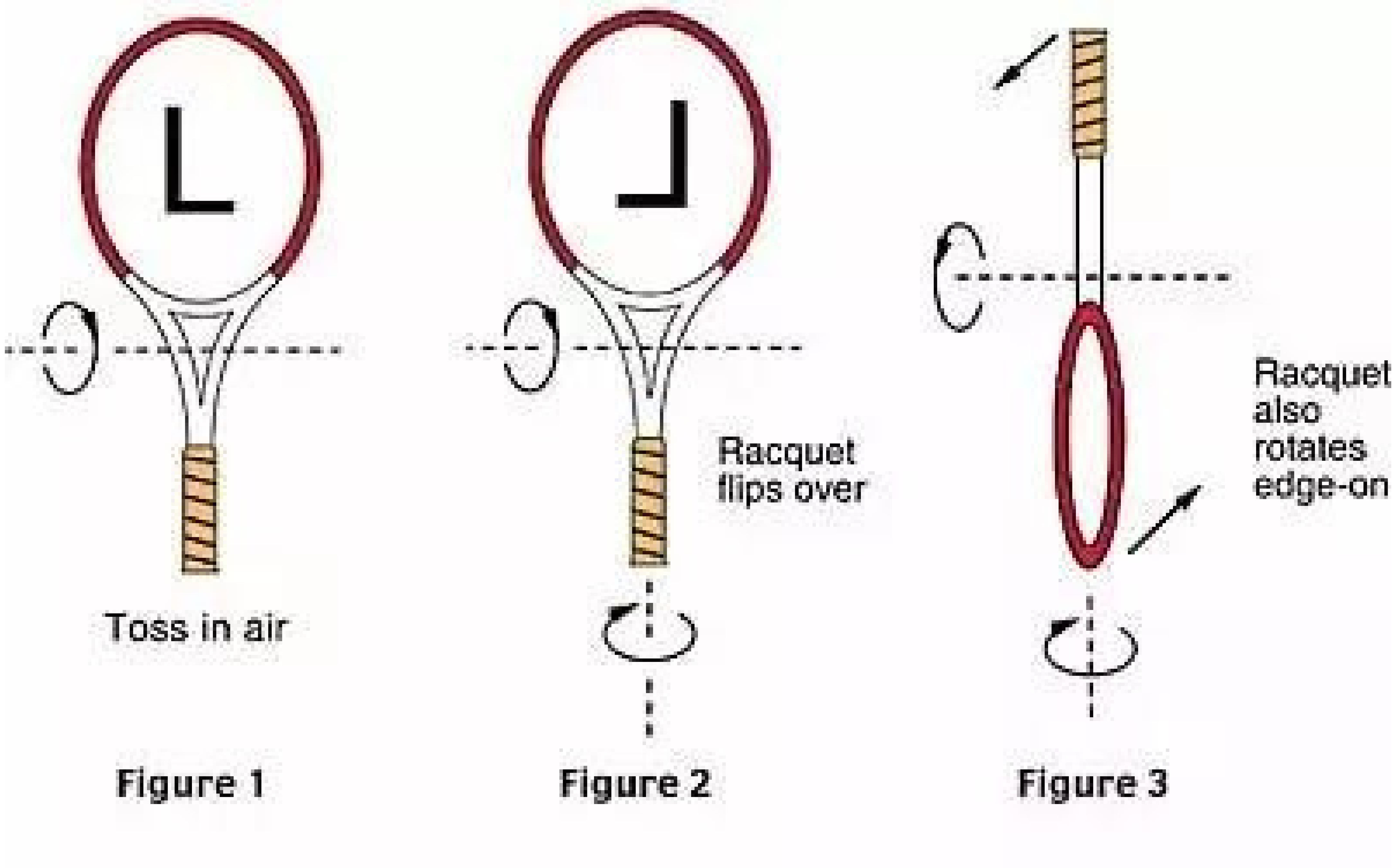
MA 203

Numerical Methods

Introduction

There lies a mystery, something that defies the most fundamental laws of physics. An object, when rotated in space, ***undisturbed***, about a particular axis shows strange behaviour, Whereas, about a different axis, it's normal.

The answer is:
"Tennis Racquet Theorem"



https://www.quora.com/What-is-Tennis-racket-theorem-Djanibekov-effect

Methods Used

1. Euler's Method
2. R-k Methods

Equations

Tennis racquet theorem can be understood using Euler's equations , as listed below.

$$I1\,\dot{\omega}1 = -(I3 - I2)\,\omega3\,\omega2$$
$$I2\,\dot{\omega}2 = -(I1 - I3)\,\omega1\,\omega3$$
$$I3\,\dot{\omega}3 = -(I2 - I1)\,\omega2\,\omega1$$

***Assume I1<I2<I3.**

Unstable Rotation about I2:

When rotating about I2

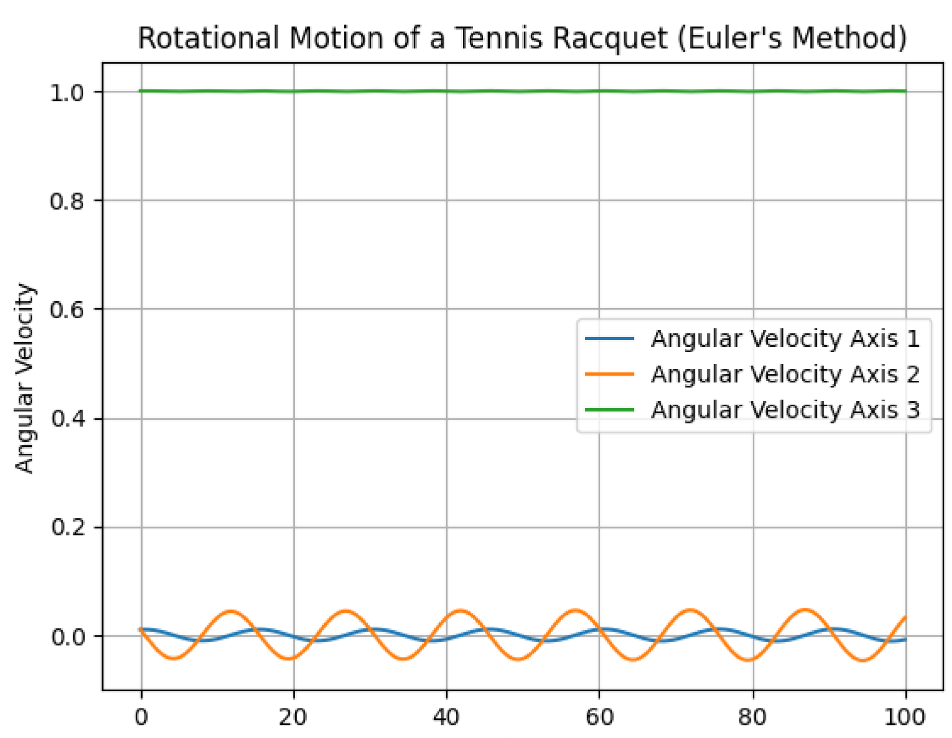
$$I1\,\dot{\omega}1 = -(I3 - I2)\,\omega3\,\omega2$$
$$I3\,\dot{\omega}3 = -(I2 - I1)\,\omega2\,\omega1$$

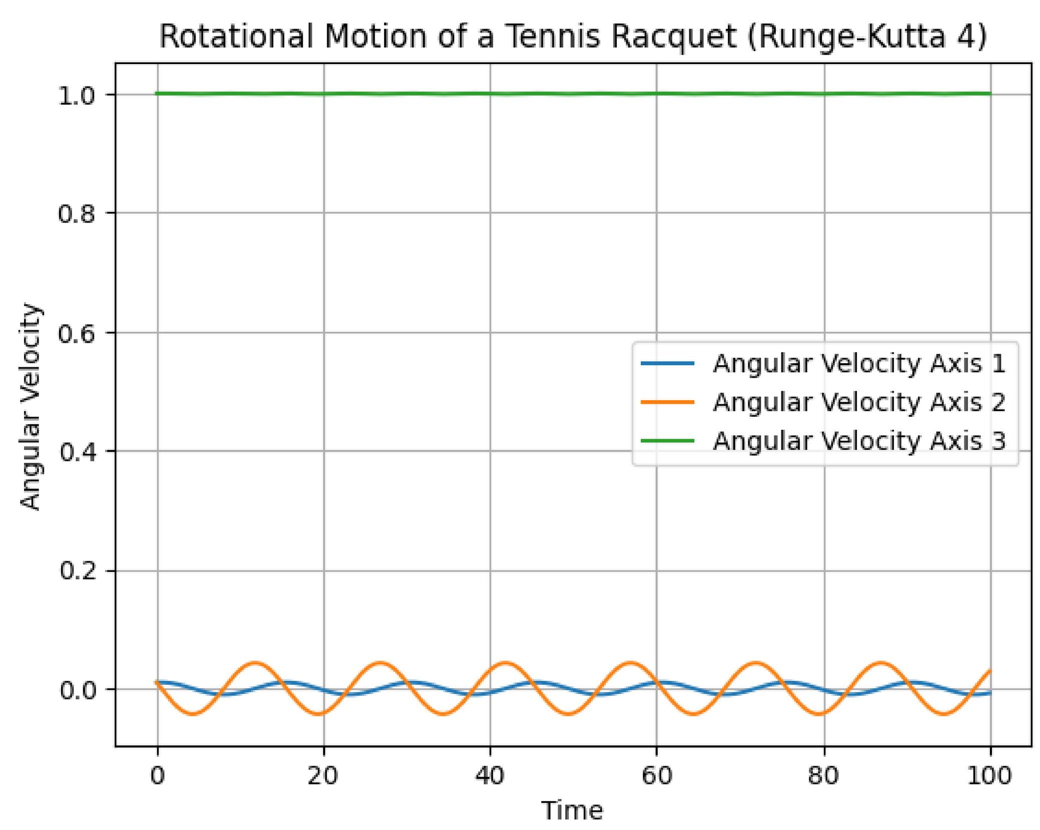
$\ddot{\omega}21$ = (positive quantity) $\omega1$

This means that ω1 is not opposed, it will **increase**. Even a small disturbance about the other axis can make the object "flip".

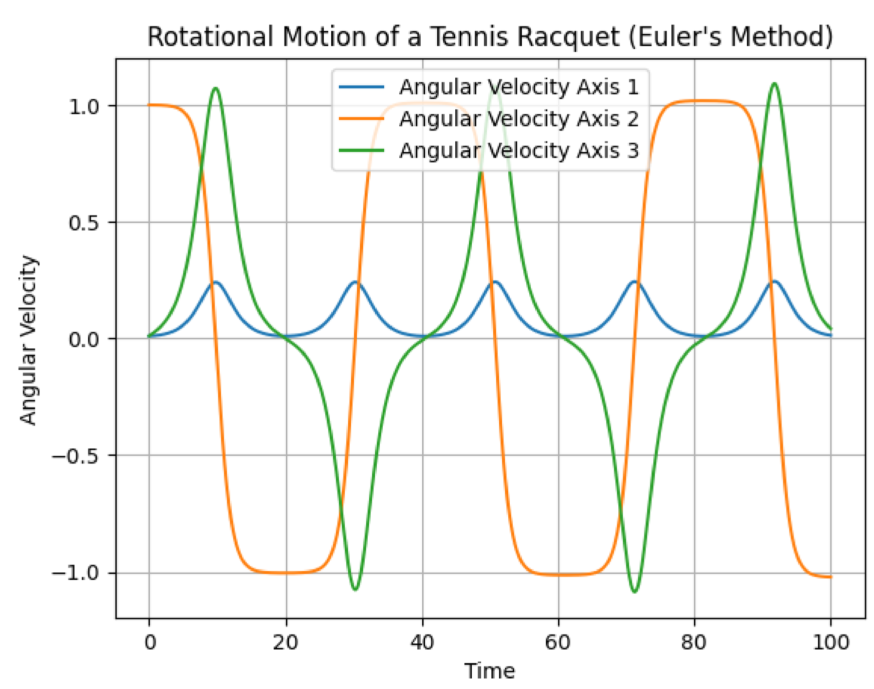
Results

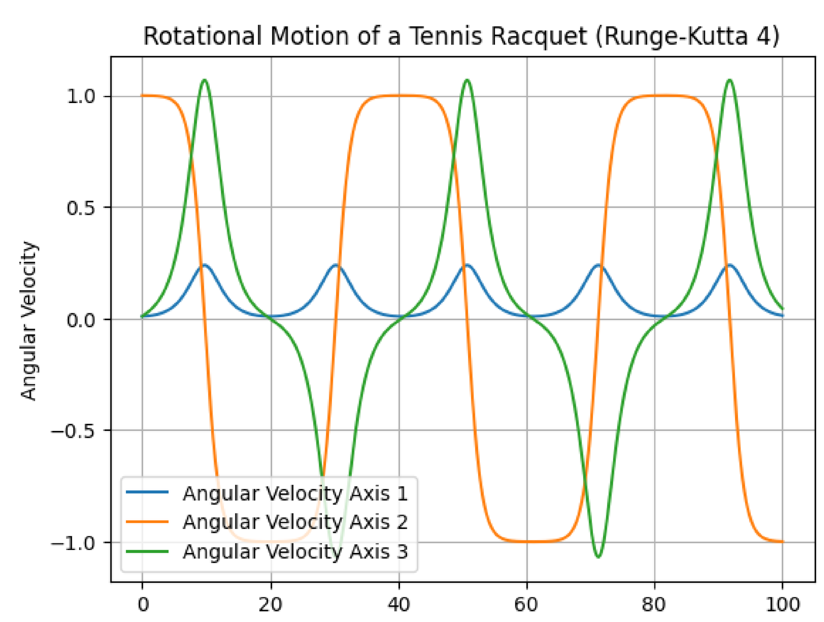
The following results were obtained when we rotated the object about I3.





But, what happens when rotated about I2?





Object will Flip!