Anti-gravitational motor,

MYTH OR REALITY?

Introduction

A prototype of an anti-gravitational motor based on a rotating system capable of producing a centrifugal force differential at a given angle is presented. This differential if it occurs in the opposite direction to the gravitational force can produce levitation.

The centrifugal force differential (ΔFc) is produced by a change of radius/mass synchronized with the rotation of the system itself, producing a novel propulsion phenomenon that does not depend on the atmosphere.

This system brings many dreams closer to reality: floating vehicles, space elevators etc.

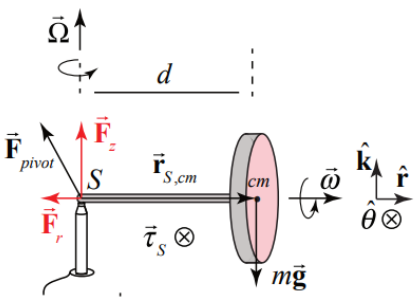
Inspiration

No doubt there are multiple videos that explicitlyexplain, how a inertial wheel can look like it floats in space.

https://www.youtube.com/watch?v=GeyDf4ooPdo

https://www.youtube.com/watch?v=tLMpdBjA2SU

If we analyze briefly the physical formulation on which its behavior is based.



The reason the disk is kept floating is because the support of its axis equalizes the forces.

Fz−m*g=0

It is relevant and inspiring as the inertial force closely related to the centrifugal force is able to counteract the gravitational force, although in this case, what is counteracted is the torque of the arm that supports it, since the weight of the system is supported by the central axis

Basic Physical Principle

In the orbit of the planets there is a known balance of centrifugal and gravitational forces. The inertial force also contributes to the balance and stability of the system.

It does not get in deep math, but if the basic idea is exposed:

"to get something floating or away from the earth's surface this rule has to be got"

$$\boldsymbol{Fc(centrifugal) \geq Fg(gravitational)}$$

$$Fcentrifugal(Newton) = Kg * \frac{rad}{sg} * metro = \boldsymbol{m_1} * \omega^2 * \boldsymbol{r}$$

$$Fgravitational(Newton) = \frac{kg}{m} = M\,m * \frac{G}{d^2} = 9{,}8 * \boldsymbol{m_2}$$

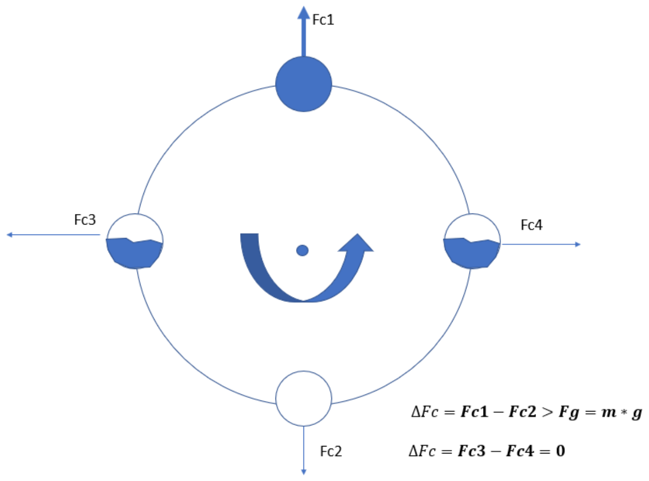
Note that in the approach that is made in this system $\boldsymbol{m_1}$ or "r" will be parameters that will vary depending on the angle of rotation and that will produce this centrifugal force differential(ΔFc)

$$\boldsymbol{m_1}(Kg) = inertial\ mass$$
$$\boldsymbol{m_2}(Kg) = overall\ system\ mass$$

$$\boldsymbol{m_2 > m_1}$$

Well, in a simple way the hypothesis is raised of having a system formed by 2 objects (or a greater number called N) of placed symmetrically to avoid eccentricities when rotating on an axis.$\boldsymbol{m_1}$

The idea is that it changes its mass depending on the angle of rotation, that is, to achieve a greater mass at the top (example: full of water) and that it is empty in the $\boldsymbol{m_1}$ lowerposition.



If this mechanism existed, an increase in centrifugal force could be achieved that Δfc could compensate/exceed the force of gravity of the system.

$$\Delta Fc = \boldsymbol{\Delta m_1} * \omega^2 * \boldsymbol{r}$$

$$\Delta Fc \geq Fg$$

Note that before a system in which **r** is a constant, it has an amplifying (quadratic) effect on our equation. That is to say, although the variation of mass is small, the speed of rotation $\boldsymbol{\omega^2}$will allow us to increase the ΔFc and approach to weightlessness.

A system can also be considered in which it is constant and what is varied is, it is maintained that it has an amplifying effect (quadratic) in our equation. That is $\boldsymbol{\Delta r}$ o say, as before, although the variation in mass is small, the speed of rotation $\boldsymbol{\omega^2}$ will allow us to approach to weightlessness.

Also increasing by **N** the number of devices that change their mass will help us to this end

$$\Delta Fc = \boldsymbol{N} * \boldsymbol{\Delta m_1} * \omega^2 * r$$

$$\Delta Fc = \boldsymbol{N} * \boldsymbol{\Delta r} * \omega^2 * m_1$$

Synchronized mass variation

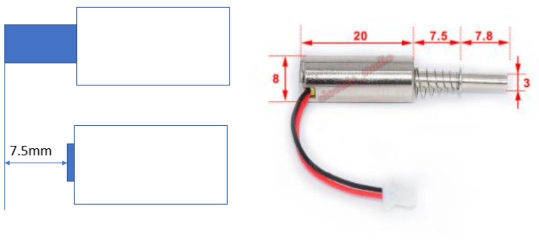
Based on this idea, the different prototypes implemented in this study are raised, as well as the limitations of some of them.

It has been in this evolution of prototypes and analysis of their different limitations that allows and confirms the practical viability of this idea.

Prototype 1: Electromagnetic plunger system activated by electric impulse

This system is based on a plunger (metal part) that produces a magnetic displacement of linear mass produced by an electromagnet. This system will produce a and in principle meets the needs raised.$\boldsymbol{\Delta r}$

For this prototype it has been used in the calculations $\boldsymbol{\Delta r = 7.5mm}$



It is remembered the purpose of ΔFc achieving as high as possible and in this case $\boldsymbol{m_1}$, $\boldsymbol{(r_2 - r_1) = 7.5mm}$. A priori with these parameters so small it does not seem that any result of interest will be achieved

$$\boldsymbol{\Delta Fc = m_1 * \omega^2 * (r_2 - r_1)}$$

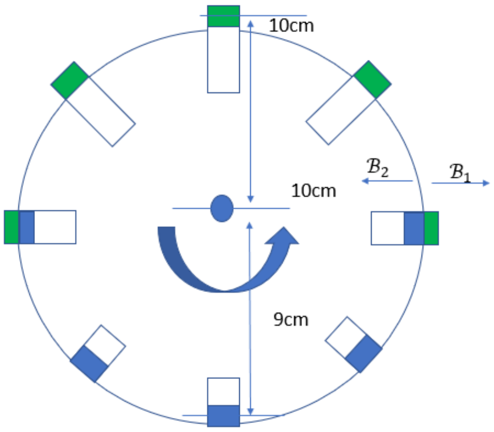
It exists however as a multiplier factor, $\boldsymbol{\omega^2}$ if we rotate this system very fast, we will amplify in a quadratic way ΔFc

For example, with speed of 1800 rpm (30 turns by second) and we estimate a total weight of the system of 400 grams (including batteries etc ...)

$$\boldsymbol{\Delta Fc} = 0.002 * \left(\frac{1800}{60} * 2\pi\right)^2 * 0.0075 = \mathbf{0.53\ N}$$
$$\boldsymbol{Fg} = 9.8 * 0.4 = \mathbf{3.92\ N}$$

You can increase the result with 8 plungers located symmetrically with what we would have achieved our first anti-gravitational motor when the weight of the system is exceeded

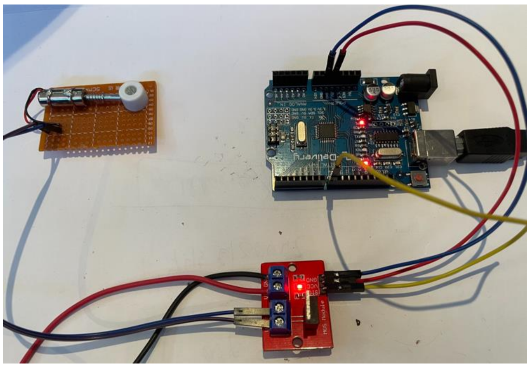
$8 * \Delta Fc = \mathbf{4.24\ N} > Fg = \mathbf{3.92N}$



While the system is theoretically viable, it turns out that at a practical level it is not. The speed of 1800 rpm (30 Hz) is not possible for a full stroke, the inertia of piston and the elongation of the spring prevent it, (for example, try operating a subwoofer at 1 kHz)

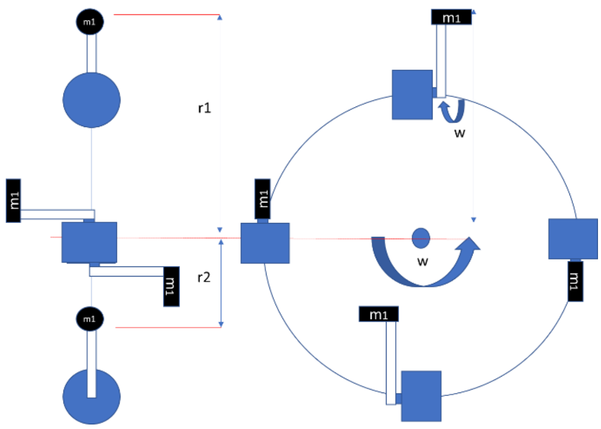
This limitation makes this prototype unfeasible, since it is essential that the movement of the piston has to be synchronized with the rotation of the system.

In addition, an additional problem arises as the plunger is based on an electromagnet, the heating of the solenoid and the high energy consumption also invalidate this solution.



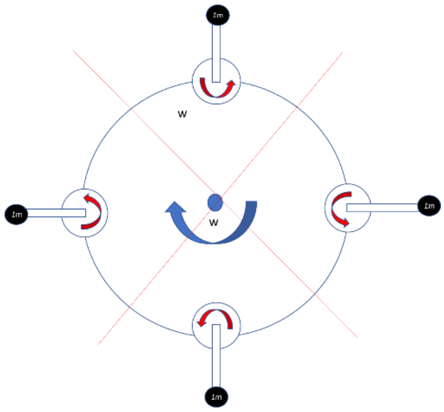
Prototype 2: System with step motors

The idea of this new prototype has been to replace the piston with a step motor (**inertial** motor) that rotates synchronously to the traction **motor** and produces the effect of changing the radius depending on its angular position. This idea eliminates the $\boldsymbol{\Delta r}$ inertial drawbacks of the piston since the displacement is based on a rotating system.

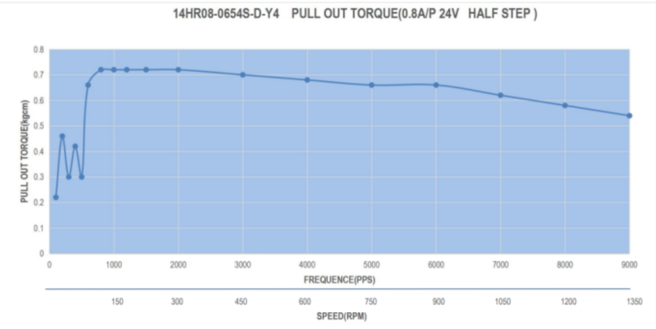


In this case the idea is that the "inertial" motor rotates at the same speed of the system, both can be adjusted. $\boldsymbol{\omega^2}$

Something that has been applied logically is to place the motors orthogonally to the rotation of the system instead of same plane to avoid the influence of the additional forces of the inertial motor's own rotation.



In this system can be adjusted "r" and "$\boldsymbol{m_1}$", without losing sight of the fact that the torque of the engine must allow it. A limitation to keep in mind is that in step motors the torque of rotation decreases with speed. $\boldsymbol{\omega^2}$



The first challenge to achieve the viability of the system is to find light step motors to decrease as much as $\boldsymbol{m_2}$ possible.

The **28BYJ-48** is unipolar step motor of excellent torque and very light, but with a major drawback the maximum speed is 17rpm (one lap every 4 seconds), insufficient to compensate compensation of Fg

28BYJ-48 – 5V Stepper

Rated voltage :	5VDC
Number of Phase	4
Speed Variation Ratio	1/64
Stride Angle	5.625°/64
Frequency	100Hz
DC resistance	50Ω±7%(25℃)
Idle In-traction Frequency	> 600Hz
Idle Out-traction Frequency	> 1000Hz
In-traction Torque	>34.3mN.m(120Hz)
Self-positioning Torque	>34.3mN.m
Friction torque	600-1200 gf.cm
Pull in torque	300 gf.cm
Insulated resistance	>10MΩ(500V)
Insulated electricity power	600VAC/1mA/1s
Insulation grade	A
Rise in Temperature	<40K(120Hz)
Noise	<35dB(120Hz,No load,10cm)
Model	28BYJ-48 – 5V

Even so, it is decided to continue with this engine, the kit comes with the ULN2003 driver, which facilitates the rapid implementation, in this way it will be possible to advance in the design of the structure and the control software.

Performing some initial calculations the motor will allow speeds of **w = 17 rpm** , but will support moving with an arm of 4.5 cm producing a = $\boldsymbol{m_1 = 9\ gr\ \Delta r = (r_2 - r_1)}$ **=9 cm,**the total mass of the system will be that includes the E $\boldsymbol{m_2 = 600\ gr}$ formed by Esp32 and a battery of 7.2v/ 3000mAh lithium (2 cell)

$$\boldsymbol{\Delta Fc} = 0.009 * \left(\frac{17}{60} * 2\pi\right)^2 * 0.09 = \boldsymbol{0.0026\ N}$$
$$\boldsymbol{Fg} = 9.8 * 0.6 = \boldsymbol{5.88\ N}$$

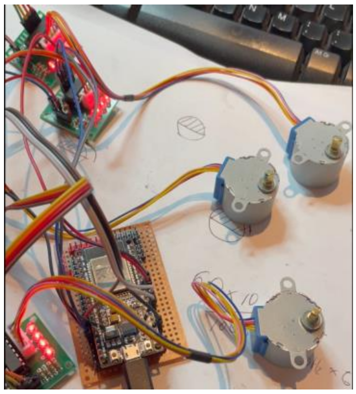
Even in the best case putting 4 engines will not achieve the balance of forces.

$$\boldsymbol{4 * \Delta Fc} = 4 * 0.002 = \boldsymbol{0.008N\ < 7.84\ N}$$

The system is unfeasible due to its low speed, this motor is designed to be used in robotic arms, has low speed, high precision and a torque of (300g / cm), which is achieved with reduction of rotation by gears 1/64.

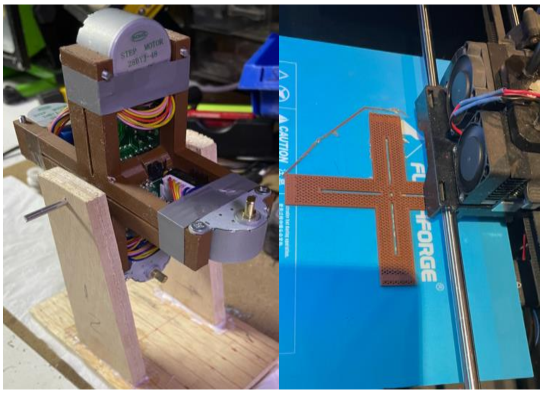
Even if it is not viable, it is of interest to make the prototype and explore other possible design problems. The control system must be part of the turning system:

- Diver electronics (Rx), Esp32 processor (with wifi capabilities)
- Control electronics(Tx), Esp32 processor (with wifi capabilities)
- 7.5v/3000mAh lithium battery
- drivers of the 4 step motors



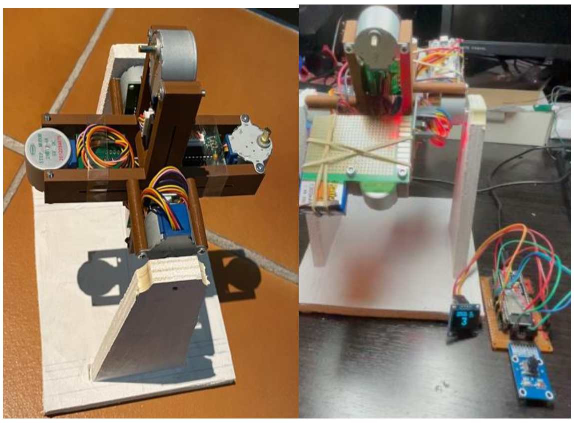
It is therefore necessary to connect the step motors in slave mode so that they all rotate synchronously. The tests connecting in parallel the control signals (In1, In2, In3, In4) that leave the ESP32 to the drivers of the 4 engines give satisfactory results.

ULN2003

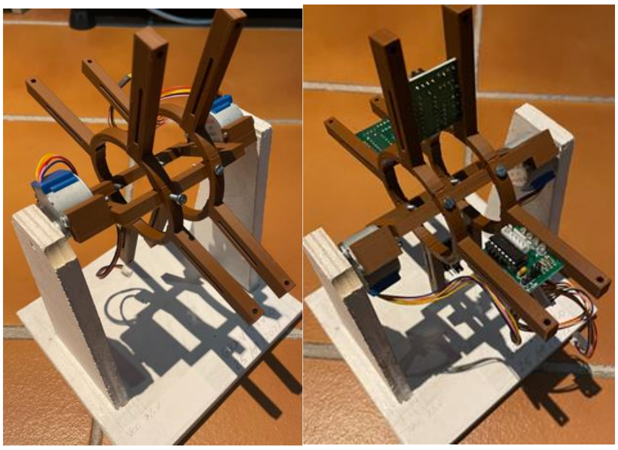


Initially it is proposed for this prototype that the system rotates with an external engine, but it would cease to fulfill the premise of being autonomous. Thus, a new design is created in which two additional motors can be placed in the system that provide the main turn.

It is added with this new approach the weight of 2 new engines and 2 new drivers that will also rotate next to the system



At the time of this new implementation a serious design error is discovered, the battery(200gr) must have a location in the center of rotation of the system so that there are no eccentricities that harm the rotation of the main system.



Once the new physical structure that solves the aforementioned problems is completed, it is necessary to achieve reliable speed control, based on an external remote control (Tx)that allows to control the speed of the system (Rx).

For this control software, the Arduino platform has been used with the FreeTOS functionality that allows to use two parallel processes in real time without delays:

- receive commands from Tx
- give movement instructions to the engine, which we remember must be synchronous. Varies by speed, but signal may be required every 100 usg

Prototype 3: System with higher speed step motors

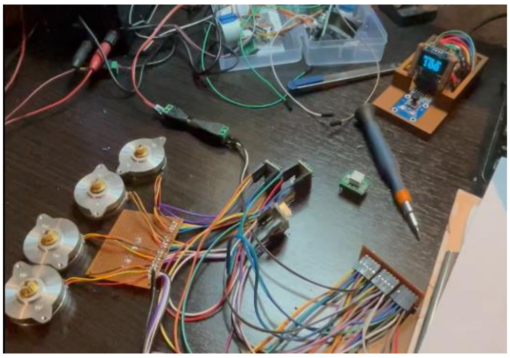
In this new prototype it is proposed to reach a viable system with a higher speed but light engine (52gr), the bipolar engine YK**36BYG12** announces speeds close to 500rpm seems to be a good candidate.

Especificación:

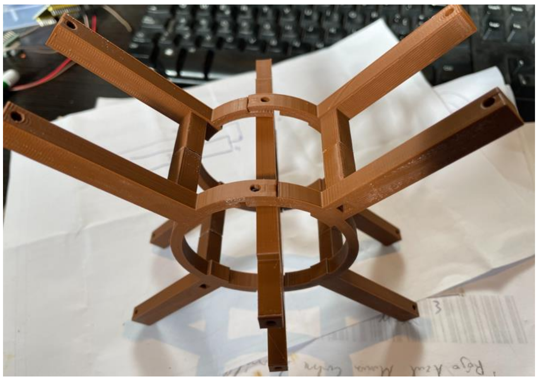
1. Diámetro del Motor: 36,27mm
2. Altura del Motor: 13,4mm
3. Diámetro del eje de salida: 3,5mm
4. Longitud del eje de salida: 9mm
5. Engranaje de cobre: 9,8mm * 5mm
6. Dientes del engranaje: 12 dientes
7. Ángulo de paso: 0,9 grados
8. Resistencia de fase: 20 ohmios
9. Peso: 52g

It is necessary to use a new type of drivers A4988 exclusive to bipolar engines. This driver has great advantages such as the use of logical levels of 3v3 that makes it compatible with the Esp32. It also supports wide control voltage range although in this prototype it is limited by the battery voltage at 7.5v

Modelo	A4988
Color	Verde o Rojo
Intensidad máxima	2A
Tensión máxima	35V
Microsteps	16
Rs típico	0.05, 0.1 o 0.2
Fórmulas	I_max = Vref / (8 * Rs)
	Vref = I_max * 8 * Rs



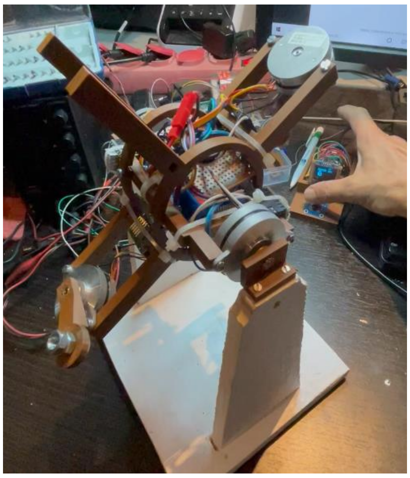
After practical implementation it is determined that it will allow speeds of w=250 rpm with the necessary torque to move a weight of 9 gr, and $m_1 = 9\ gr$ $\Delta r = (r_2 - r_1)$=9 cm, $m_2 = 800\ gr$



Despite the increase in speed, calculations show that it will be insufficient to achieve weightlessness even with 4 inertial motors

$$\boldsymbol{\Delta Fc} = 0.009 * \left(\frac{250}{60} * 2\pi\right)^2 * 0.09 = 0.55\ N$$
$$\boldsymbol{Fg} = 9.8 * 0.8 = 7.84\ N$$

$$\mathbf{4} * \boldsymbol{\Delta Fc} = 4 * 0.55 = \mathbf{2.22N}\ < \mathbf{7.84\ N}$$



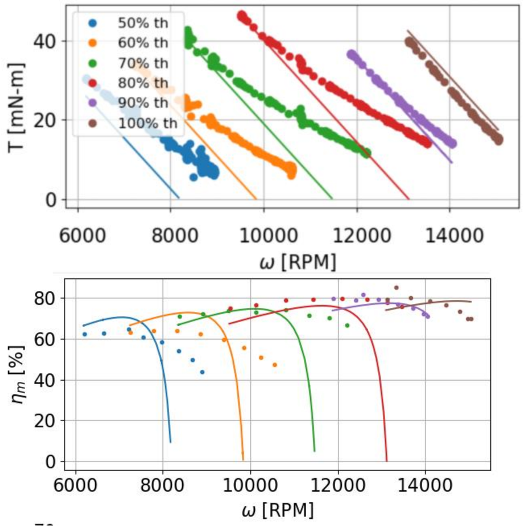
It is calculated and determined that it would be enough to double that speed to w=500rpm, to achieve weightlessness.

$$\boldsymbol{\Delta Fc} = 0.009 * \left(\frac{500}{60} * 2\pi\right)^2 * 0.09 = 2.22\ N$$
$$\boldsymbol{Fg} = 9.8 * 0.8 = 7.84\ N$$

$$\mathbf{4} * \boldsymbol{\Delta Fc} = 4 * 2.22 = \mathbf{8.88\ N}\ > \mathbf{7.84\ N}$$

Approaches to improving this system

Moving to higher speed brushless motors presents as the main problem the impossibility of synchronization. In addition, there is the same problem that the torque is also reduced when the speed is increased.



Conclusions

The technological challenge is on the table, the physics shows that the system is viable, it is however necessary to achieve step motors light of greater speed and that the torque will be maintained.

The ultimate goal of this analysis is to motivate IEEE members to improve the systemby following this basic idea. I know that together we will get it!

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