the general science journal

Older and contemporary attempts for inertial propulsion

Christopher G. Provatidis, PhD

Abstract

In this paper we review and critically present the state-of-the-art of inertial propulsion means, which may cause motion of the object to which they are attached. At the same time, we indirectly overview some other advanced propulsion systems by direct reference to the main bibliography. First we refer to the rotation of two synchronized masses that move along a circular path (Dean-drive). We prove that they can conditionally cause motion of the object and temporal lift. We also present some of our previous results concerning masses moving along a figure-eight-shaped path on the surface of a hemisphere, which also rotates around the axis of symmetry. We give particular attention to the proper synchronization that may instantly cause loss of weight or create such instability so as the object can be easily displaced by external means. Since the rotation is the key to the inertial propulsion, we discuss the role of the rotation in gyros as well as the possibility of the existence of an aetherometric mesh or the possible influence of time dilation, as claimed by others. This work is an extension of a one-hour presentation at the conference SPESIF-2011 (March 15-17, 2011, at University of Maryland, USA).

1. Introduction

The tendency of man to conquer the air and space is recorded in the Greek mythology in the legend of Daedalus (Greek demigod engineer) and Icarus (Daedalus's son). However, it was 1909 when the U.S. Government bought its first airplane, a Wright Brothers biplane, on July 30. Around the same time, chronologically the first thoughts for rockets were of the Russian mathematician Konstantin Eduardovich Tsiolkovsky (1857 – 1935), the American professor, physicist and inventor Robert Goddard (1882-1945), the Austro-Hungarian-born German physicist and engineer Hermann Oberth (1894-1989) and the German Wernher Von Braun (1912-1977) who lived in the United States after the World War II. Despite many remarkable achievements in advanced space propulsion systems [1], due to the high costs required to cause propulsion in the spacecraft, during the last decade many minds are currently working on alternative methods [2-4]. Only a few of these methods are based on the idea of inertial propulsion using rotating parts. The interested reader may find much information in the internet; for example, we cite two interesting demonstrations for terrestrial applications and two more from the animal kingdom [5].

The first on record application of rotating eccentric masses in order to achieve the so-called inertial propulsion are probably the dumbbells (halteres; in Greek: ἁλτῆρες) that have been used in athletic games such as long jump in ancient Greece [6, p.153] (see also: http://en.wikipedia.org/wiki/Dumbbell). Focusing on Fig.1 and Fig.2, we guess that dumbbells work as follows. The jumper holds the dumbbells in his hands, and then he rotates them on the vertical plane.

Fig.1: Young boy holding a discus at the palaestra. Near him, a pick to prepare the landing ground for the long jump and a pair of dumbbells (halteres) used to maintain equilibrium during the jump. Interior of an Ancient Greek Attic red-figure kylix, 510–500 BC, Louvre Museum, Paris.

Fig.2: Dumbbells (halteres) used in athletic games in ancient Greece, National Archaeological Museum, Athens.

When the jumper lifts off the ground, the dumbbells are either at the ultimate or at the lower point thus directed parallel to the athlete's motion; therefore their linear momentum is a vector towards the direction of long jump. When the jumper touches the ground, the dumbbells should be at 90 degrees ahead, therefore the horizontal component of the linear momentum becomes zero. In this way, the change of linear momentum of the dumbbells increases the momentum of athlete's body thus giving him the capability to increase the distance jumped.

Twenty five centuries later, in mid-1950s, a USA citizen named Norman Dean (a civil service employee residing in Washington DC) proposed the use of two contra-rotating eccentric masses in order to convert rotary motion to unidirectional motion [7]; see also: http://en.wikipedia.org/wiki/Dean_drive. He claimed that in this way one could achieve thrust thus producing motion of the object to which this system was attached. Since then, Dean's mechanism was internationally named as 'Dean drive' or 'Dean space drive'. This subject attracted the attention of many scientists, science fiction writers and philosophers [8-13]. In the pure scientific domain, from the book of the reputable Russian academician Prof. I.I. Blekhman, which was translated into English ten years ago [14], we learn that the applicability of Dean's drive to air or space propulsion has been discussed within two works in the Russian language [15,16]. Also, five years ago NASA published a technical report [17] and a paper [18], both of wider interest.

A brief explanation on the incapability of Dean's drive could be as follows. At every time, every rotating mass passes through a point at a certain velocity; exactly after a whole period of 360 degrees, the same mass passes through the same point at exactly the same velocity. As a result, the change of linear momentum is zero. Therefore, since no other external force is exerted, the net impulse per period vanishes thus inertia propulsion is not possible. From a different point of view, when the mass draws the upper half of the circle the corresponding impulse is positive, while when it draws the lower half it becomes negative (both of equal absolute value). This topic has been thoroughly studied by the author during the last three years [19-21], while he has recently cooperated to extend it to its electromagnetic equivalent [22].

The aim of this paper is to review the several attempts that have been made towards the development of mechanical and other non-mechanical antigravity systems.

2. Alternative propulsion

A useful book concerning the several antigravity systems is due to LaViolette [23]. Moreover, based on additional information collected for the purposes of this paper, among others a crude classification in chronological sequence could be as follows:

- 1920: Townsend Brown's Technology of Electrogravitics
- 1929: Viktor Schauberger
- 1959: Dean drive (US Patent 2,886,976)
- 1969: Searle effect generator (http://en.wikipedia.org/wiki/John_Searl, http://searleffect.com/)
- 1980: Cook, Device for Conversion of Centrifugal Force to Linear Force and Motion, US Patent 4,238,968.
- 1992: Eugene Podkletnov (superconductive materials)
- 1999: Laithwaite & Dawson, “Propulsion System”, US Patent 5,860,317 (grant Jan.1999)
- 2000: Roshchin & Godin, “An experimental investigation of the physical effects in a dynamic magnetic system”, Technical Physical Letters, Vol. 26,(12), pp.70-75
- 2001: Robertson, Propulsion method and apparatus utilizing centrifugal force”, World Intellectual Property Organization (WIPO), Number WO 01/46584 A3, 28 June 2001.
- 2003: Chung, Internal propulsion apparatus of closed system using a Coriolis force, International Patent WO 03/087574 A1, 23 (Publication date: 23 October 2003)
- 2005: Volfson, (inflationary vacuum state), US Patent 6,960,975.
- 2005: Franklin S. Felber, ‘Antigravity’ propulsion and relativistic hyperdrive; Exact relativistic ‘antigravity’ propulsion, arXiv:gr-qc/0505099 v2 6 Jun 2005
- 2005: Hoshino, Propulsion apparatus using centrifugal force, US Patent 20050139022.
- 2007: Hauser & Dröscher, Gravitation space propulsion, AIAA Conferences
- 2007: Tanner, Resonant Maglev Centrifugal Propulsion, US Patent application US 2007/0079663 A1
- 2008: Robertson, Murad, and Davis: A review paper (Reference [3])
- 2010: Martin Tajmar, Homopolar artificial gravity generator based on frame-dragging (Reference [44])
- 2011: A.A. Martins, M.J. Pinheiro: On the nature of the propulsive force of asymmetric capacitors in the atmosphere, and in a vacuum, Physics Procedia, 2011, Volume 20, Pages: pp.103-111 & pp.112-119.
- 2011: Benjamin T. Solomon: *Phys. Essays* 24, 327 (2011) (Reference [59])

According to an internet website (www.americangravity.com), there are about 21 principles to “achieve” antigravity, as follows:

1. Mach’s Principle
2. ELF-Grav Shielding
3. Mass-Fluctuation
4. Biefield-Brown
5. Superconductive Gav-Shield
6. Superconductive HFGW
7. Bismuth/Element 115
8. Gyroscopic-Precession
9. Lenz-Law

10. GeoMagnetic Levitation
11. Rotating Magnetic Field Device
12. Hutchinson-Effect
13. Poynting Vector Propulsion
14. Einstein's UFT Effect
15. Casimir Force & ZP
16. Torsion Field
17. Electromagnetic Plenum Effect
18. Coanda-Effect Levitatio
19. Alt-Energy System
20. Boundary Layer Reduction & Stealth
21. Relativity Theory

An edited book and a review paper with collected information until 2010 is due to Millis [24,25]. In brief, he divides the relevant technologies in three main categories as follows: (i) Propellantless propulsion approaches (26 methods), (ii) Faster-than-light approaches (4 methods), and (iii) Energy conversion approaches (9 methods).

3. The role of rotation

From our childhood we all know and are impressed by the processing top that seems to "violate" the physical laws, as it does not fall down like the usual non-rotating objects. Of course, this occurs due to its axial angular momentum **L**, of which the change equals to the torque of top's weight, whereas the ground reaction is cancelled by this weight. Moreover, from the smallest atom up to the biggest planet motion, the rotation dominates and achieves a permanent repeated motion in dynamic equilibrium. Furthermore, within the context of biology and human behavior, it is worth-mentioning that if someone is going to fall down a cliff, instinctively rotates his hands to keep balance and avoid the downfall.

Rotation has been a matter of inspiration and research. There is a diffused feeling that physical laws may be somehow "violated" in rotating systems, and in any case even simple laws are a matter of interest [26]. There has been some work on relativistic rotating masses by Browne [60]. The gyroscopes are also a source of inspiration [27,57,58] although their capability has been disputed [17,18]. Also, in all drawings of flying saucers made by Viktor Schauberger (Fig.3) or those created by science fiction people, the rotation dominates (Fig.4) [28,29].

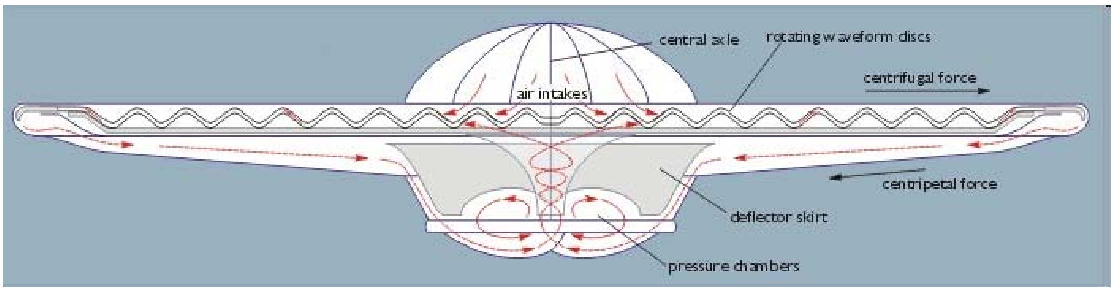


Fig.3: A typical flying saucer (Viktor Schauberger)

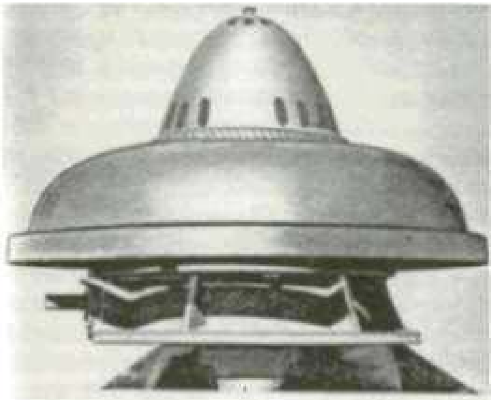
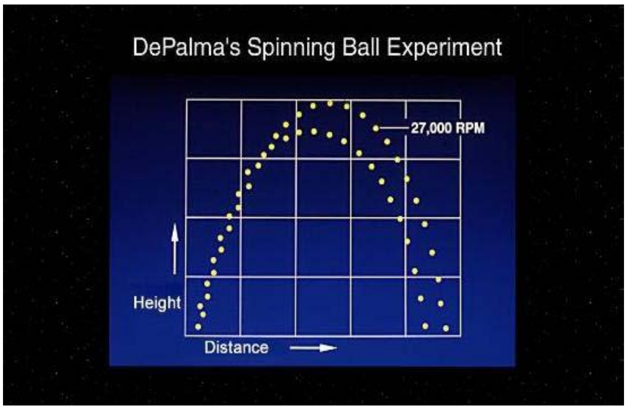


Fig.4: Flying saucers of Viktor Schauberger (http://en.wikipedia.org/wiki/Viktor_Schauberger)



(a)

(b)

Fig.5: Alleged similarities between (a) DePalma's experiment and (b) the supposed deviation of Explore 1 (1958) (Source: http://www.brucedepalma.com/n-machine/spinning-ball-experiment/)

In the public domain, the first scientific attempt to study rotating gyroscopes is probably due to Bruce Eldridge De Palma (1935-1997), who was working at MIT as a lecturer in Photographic Science in the Laboratory of Dr. Harold Edgerton and directed 3-D color photographic research for Dr. Edwin Land of Polaroid Corporation. Based on photographic experiments he claimed to have measured a delay in a falling gyro or an increase of its upper level in an oblique shoot [30]. Although an elderly American professor of physics, who had relationships with Wernher von Braun's team, assured the author (in March 2011) that there is nothing strange happened during the launch of Explorer 1 (1958), for the sake of completeness we should mention that there are several people who relate the antigravity behavior in the upper level rise of experimental ball (in DePalma's experiment) with the alleged deviation of the satellite, as shown in Fig.5.

Thirteen years later, Hayasaka and Takeuchi measured a weight reduction of gyros when rotating in the right direction (spin vector pointing downward) [31]; he showed that the higher the gyro revolutions per minute the higher the weight loss. This finding was disputed by many others [32-38]. However, it is not perhaps widely known that Hayasaka insisted to his findings and eight years later he cooperated with three other coworkers and presented again similar measurements when the rotating gyro falls from a height [39] (unfortunately, the volume in which this paper belongs has been excluded from the electronic version of the Journal; so the interested reader has to ask for a hard copy in a library. Interestingly, the next year the Journal ceased). In contrast, Luo et al. [61] report that the differential acceleration between a rotating mechanical gyroscope and a nonrotating one was directly measured by using a double free-fall interferometer, and no apparent differential acceleration has been observed at the relative level of 2×10^{-6}. It means that the equivalence principle is still valid for rotating extended bodies, i.e., the spin-gravity interaction between the extended bodies has not been observed at this level. Also, to the limit of our experimental sensitivity, there is no observed asymmetrical effect or antigravity of the rotating gyroscopes as reported by Hayasaka et al.[31].

The latest paper concerning gyroscopes, and particular Laithwaite's experiments is probably due to Wayte [40] who reported a weight loss of 8 percent (it is noted that the aforementioned loss has been calculated as a time integral of measured impulse of the reaction force).

In their monograph, Correas [41] comment of the controversial findings by some of the abovementioned researchers [32-38], underlying that all relevant experiments were conducted at quite different angular velocities (Hayasaka's first series of experiments [31] were between 3,000-13,000 rpm and focused in 12,000-13,000 RPM while those of Quinn & Picard [36] were performed at 8,000 RPM, and those of Faller [33] at 6,000 RPM). In reference [41,p.58], Correas claim that "Hayasaka's results were well within the standard error of their measurements, and thus provided a much higher degree of accuracy of measurement than the results of the other/abovementioned groups". The explanation which Correas present is related to the significant role played by the magnitude of the angular velocity of the gyro. Based on their theory, they calculated that "*the gravitational oscillations of the electron are expressed in double swings as per Reich's equation:* $s_e = \sqrt{K_{kr} 5/l_e}$ *= 13,716.1 double swings per minute-org (DSPMO), which is equivalent to 12,858.8 RPM ≅ 13,000 RPM, very near to Hayasaka and Takeuchi [31] for observation of the maximal effect*". Also, "*the gravitational frequency of the electron is* $\Psi_e = \sqrt{K_{kr} 5/l_e}\,/4^3$ *= 214.3 DSPS, which is half the aetherometric frequency* f_e *of the electron-graviton, whose actual value is 426.95 sec-1, thus leading to 12.808.59 RPM)*".

Within this framework, the author wonders whether it is an accident that the rotations reported by DePalma [30] were 27,000 RPM, which are almost double of the critical value of 13,000 RPM. On the other point of view, the second Hayasaka's experiment (free fall: ref.[39]) was performed at 18,000 RPM, which is not directly related to the abovementioned 13,000 RPM in an apparent way.

Moreover, after a 12-years research Solomon [59] concluded that time dilation can be the source of gravitation effects. He has also presented the hypothesis that time dilation causes a shift in the center of mass.

For the completeness of the text it is worth-mentioning that in the field of relativistic physics based on rotation, the first clear reference to antigravity was made by Forward [42] in 1963, although he uses findings by Thirring-Lense in 1918-1921 that were translated in English by Mashhoon et al. [43]. Clearly, when a horizontal ring rotates around its vertical axis of symmetry, not only centrifugal force but also axial relativistic force appears; the latter is the antigravity force. In this context, one of the most recent papers is due to Tajmar [44].

4. A critical analysis of Dean drive

Concerning Dean Space drive, the results obtained in previous works [19-21] are summarized as follows. Two contra-rotating lumped masses, of eccentricity *r*, compose a mechanical system that has a certain amount of kinetic energy (Fig.6). If the motion takes place on the *xz*-plane, the *x*- and *z*-components of their linear momentum are harmonic and may be given in vector form by the formulas:

$$\vec{\mathbf{p}}_{right} = m\omega r \cdot \{-\sin\phi, \cos\phi\}^T \quad \text{and} \quad \vec{\mathbf{p}}_{left} = m\omega r \cdot \{\sin\phi, \cos\phi\}^T \tag{1}$$

for the right and the left mass, respectively. The polar angle is given by $\phi = \phi_0 + \omega t$, where ϕ_0 represents its initial value, ω is the constant angular velocity, and *t* is the elapsed time.

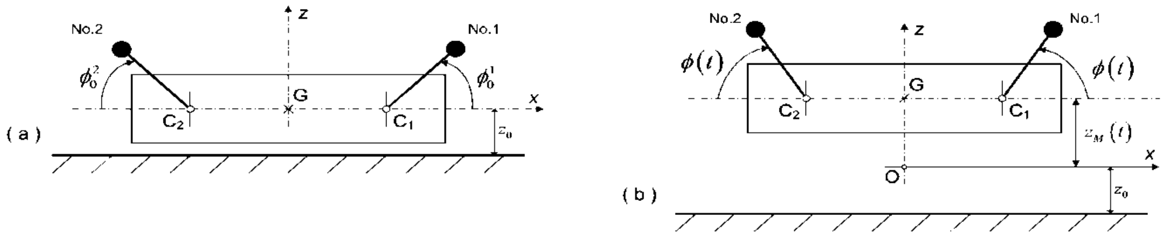


Fig.6: The concept of Dean's space drive. (a) Initial position at $t = 0$, (b) Current position at every time $t > 0$.

Therefore, the total sum of both linear momentums will be:

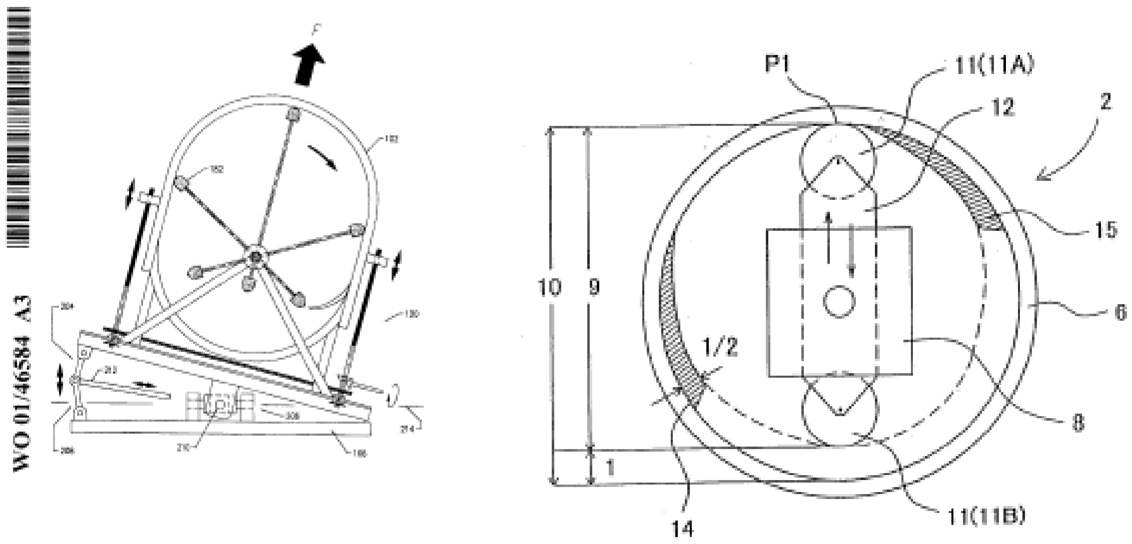
$$\vec{\mathbf{p}}_{total} = m\omega r \cdot \{0, 2\cos\phi\}^T \quad \text{(in the } z\text{-direction only)}, \tag{2}$$

whereas the total angular momentum vanishes ($\vec{\mathbf{L}}_{total} = \vec{\mathbf{0}}$) thus not introducing gyroscopic phenomena. Based on these elementary mechanics, the result of attaching the aforementioned couple of rotating masses to an object is a matter primarily dependent on the initial value ϕ_0 at which the object is left free to fall down. In more details, if $\phi_0 = 0$ (horizontal rods moving upwards) the initial linear momentum is maximum thus making it possible to transfer a large portion of it to the object after 90 degrees of rotation. In this way, it is possible the object to move upwards like a projectile in a vertical upward shoot and then fall down. In [20,21] analytical formulas have been obtained for the time needed to reach its upper position and to return from it to the ground. It should be clarified that by raising the body to the distal point several rotations of the arms may be performed.

5. Variations of Dean drive

As was previously mentioned, the circular path on which the eccentric masses move causes positive and negative vertical impulses when the mass moves above or below the horizontal level through the center, respectively. The latter prevent the system to produce a thrust. Therefore, in order to be released from the lower part, many attempts have been made as follows.

One of them is to force the mass to move along a shorter radius in the lower part [45,46] but the reduction of it through an external shell causes undesired reaction forces, which cancel the supposed benefit (Fig.7).



(a) (b)

Fig.7: Two ways to modify the lower radius in the path of the eccentric masses. (a) from Ref.[45], and (b) from Ref.[46]

The second attempt was to vary the angular velocity in the upper and lower circular parts but the problem is that every 360 degrees the mass passes again through the same point and therefore the change in linear momentum is zero; even an exponential variation does not lead to positive results [19,20]. Nevertheless, it has been previously found that during the rotation of a mass, if the beginning of time measurement is a little after the lower dead point (the mass goes upwards), it is possible to increase the angular velocity and achieve the object to which the propulsive unit is attached to hover for a while, being entirely immobile. However, when the mass tends to approach the upper dead point the angular velocity tends to infinity thus not allowing continuing hovering [20]. The formula obtained for the variation of the angular velocity is as follows:

$$\omega(t)=\frac{\left[-\left(\dfrac{g}{\mu}\right)t+\left(\omega_0\cos\phi_0\right)\right]}{\sqrt{1-\left[-\left(\dfrac{g}{2\mu}\right)t^2+\left(\omega_0\cos\phi_0\right)t+\sin\phi_0\right]^2}},\quad -\frac{\pi}{2}<\phi(t)<\frac{\pi}{2} \qquad (3)$$

with

$$\mu=\frac{2mr}{\left(2m+M\right)} \qquad (4)$$

whereas ω_0 denotes the initial angular velocity, ϕ_0 is the initial polar angle at time $t=0$, *m* is the eccentric mass at radius *r* and *M* is the mass of the object.

Again, while short-time hovering is possible the singular denominator of the form $\sqrt{1-(\ldots)^2}$ does not allow it for more than half a cycle. I guess someone will be able to comment on the nature of the denominator, which is reminiscent of relativity theory, although it is probably irrelevant.

6. “Breaking” the circle and the symmetry by a synchronized spinning

The idea was inspired by nature as follows. In America, there is a kind of birds, called *hummingbirds*, which possess an extraordinary capability. In order to hover, a hummingbird’s wings move back and forth horizontally drawing a narrow but elegant figure-eight in the air with each full stroke. The stroke is continuous –like a Möbius strip– which is the symbol of infinity. The hummingbird can hover for 50 minutes, while moving their wings 53 times per second (approx. 3000 rounds per minute) [47,48]. The interested reader may consult many internet videos such as those in [5].

The above idea was the source of inspiration to construct a differential mechanism, a device to reproduce the figure-eight shape. Later, we accidentally found that an inventor from Canada had developed an apparatus to simulate wing movement for ornithopters [54].

Moreover, we have followed the abovementioned idea of the figure-eight path, by transforming the circumference of a circle (on which an eccentric mass moves) as follows.

This is achieved by deforming the ‘circle’ in two successive ways. First the ‘circle’ is folded by rotating its lower part around the vertical axis of symmetry thus producing a crossed figure-eight-shape, which entirely lies on the vertical plane. Second the latter planar path is further bent in such a way that it perfectly lies over the surface of a hemisphere, the latter having a center ‘O’ and a radius r . These two successive deformation steps lead to a new, fully three-dimensional, curvilinear path that lies entirely above or entirely below the center of the hemisphere; henceforth it is called ‘figure-eight-shaped’ path. It is clarified that in this final configuration of the mechanism, the immobile end of every connecting bar is pinned to the centre of the hemisphere while the second end carries the corresponding mass. Consequently, one could say that –in this way– the proposed procedure achieves to create a new path on which only the upper, or only the lower half of the initially considered circular path, operate. Despite this fact, it has been theoretically verified that the maximum upward force is equal and opposite to the maximum downward force thus net propulsion is still impossible [49]. The mechanical device capable of producing the aforementioned figure-eight-shaped path has been presented in [49-53] and for the completeness of the text it is shown in Fig.8.

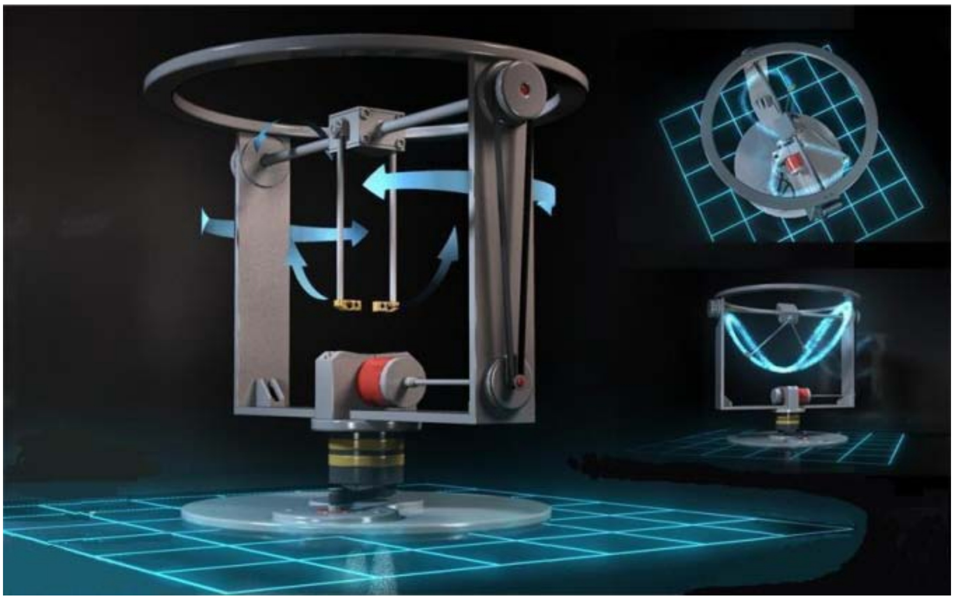


Fig.8: The prototype mechanism. In the left part the arrows show the directions of the two simultaneous rotations, while in the right part the figure-eight-shaped path is clearly illustrated for two different views.

In more details, the rotating masses are those two yellow ones at the end of the two rods (Fig.8). When only the red electric motor operates, the two masses move uninterruptedly along the figure-eight-shaped illustrated path so as the lower part (beyond the center of the sphere) vanishes. But even in this case, we cannot avoid the rotating mass not to pass through the same point every 360 degrees. Therefore, as a mechanical solution to overcome the aforementioned shortcoming**,** we propose the breakdown of the path symmetry through spinning. In more details, we impose a second rotation about the vertical axis of symmetry. Therefore, if the second rotation is characterized by an angular velocity that primarily is not an integer multiple of the first one, a *non-rational* ratio of the two aforementioned rotations ensures that the mass should never pass through the same point in the 3D Cartesian space; illustrative simulations for several ratios may be found in reference [52].

7. Figure-eight-shaped paths

Somehow related, the figure-eight shape hardly appears in the flexible gyroscope manufactured by Eric Laithwaite [55-58]. In his construction one can notice the existence of two electric motors of which the combination leads to the aforementioned figure-eight in the deformed beams of the gyroscope [55]. In our case, we have practically done the *opposite*. I am sure that if Laithwaite (1921–1997) did not leave us at the age of 76, he would have discovered this point.

Again, we have intentionally created a large figure-eight track (Fig. 8) and due to the second rotation in conjunction with the variable elasticity, as the figure-eight-shaped path tends to straighten we achieve to create forces in the system. In more details, let us consider the particular case in which every rod moves always in the lower hemisphere (below the center of the sphere). Then, when the rods are found in the lower position they have their minimum radial force (smallest tensile elongation) whereas when they are horizontal they have their maximum one (largest tensile elongation). Although a crude mathematical analysis has led to elegant closed form expressions of the impulse I_z that suggest weight loss [52]:

$$I_z = I_{z,rigid} + I_{z,tension} \tag{5}$$

where

$$I_{z,rigid} = 2m\omega r \sin 2\theta \tag{6}$$

and

$$I_{z,tension} = c_0\theta + c_2 \sin 2\theta + c_4 \sin 4\theta + c_6 \sin 6\theta \, , \tag{7}$$

the violation in the conservation of linear momentum in the vertical direction is something that has to be further explored. Despite the mathematics, the question "*how it is possible to develop thrust using internal forces?*" is reasonable. An answer could be possibly based on Solomon's theory [59], according to which time dilation can be the source of gravitational effects.

8. Discussion

The replacement of rockets by other advanced means is an ongoing procedure [4]. The application of purely mechanical means is against the known physical laws. The rotation plays an important role, which is under investigation. In a few words, we would like to develop centrifugal forces to support a rotating device in the same way that nearly horizontal radial strings can hold an object still (thanks to the elastic deformation of the strings). The application of hybrid mechanical-electromagnetic systems is also under investigation.

As physics is primarily an experimental science, despite the fact that is usually standardized in the form of mathematical laws, nobody can entirely reject a new idea.

To give an example about the difficulty with which the mankind conquers the knowledge, even Lord Kelvin in 1895 said the famous phrase "*Heavier-than-air flying machines are impossible*". Below we highlight some interesting points/stations in the technological evolution of propulsion during the last century.

Although all experts were expecting that it would be Samuel Langley (Smithsonian Institution Secretary) who would achieve to fly an airplane, this was finally done by Wright Brothers, two simple people involved in bicycle business. But in 1901, at Kill Devil Hills, North Carolina, the Wright Brothers flew the largest glider ever flown, with a 22-foot wingspan, a weight of nearly 100 pounds and skids for landing. However, many problems occurred: the wings did not have enough lifting power; forward elevator was not effective in controlling the pitch; and the wing-warping mechanism occasionally caused the airplane to spin out of control. In their disappointment, they predicted that *man will probably not fly in their lifetime*. In 1903, the New York Times (newspaper) wrote: maybe in *1 million to 10 million years* they might be able to make a plane that would fly. Despite these reverses, in 1909 the U.S. Government bought its first airplane, a Wright Brothers biplane, on July 30; the airplane sold for $25,000 plus a bonus of $5,000 because it exceeded 40 mph.

In 1903, H.G. Wells, a famous science fiction writer, anticipated *gravitational propulsion* methods when he described gravity repelling "cavorite" (*The First Men in the Moon*) (Source: http://en.wikipedia.org/wiki/H._G._Wells, and some patents). Today, many writers such as [62] are inspired by similar topics.

In 1926, Robert Hutchings Goddard successfully launched a rocket in USA; it is reminded that he started in 1907. It is worth-mentioning that in 1927, the German Rocket Society was formed, and the German Army began a rocket program in 1931 (the German government paid much more attention to Goddard's work than the US government did).

In 1957, the first man-made vehicle purpose built to reach space was Sputnik 1 launched on an R-7 rocket by the USSR. Also, in 1958: Explorer 1 was the first satellite launched by the United States when it was sent into space on January 31, (http://www.nasa.gov/mission_pages/explorer/). Since then, rockets are the main characteristic of all subsequent space vehicles.

Today, in November 2011, an Internet search reveals a few millions of references on the term advanced propulsion or 'antigravity'. Over 200 US patents related to antigravity propulsion devices (although they are entitled a different word) have been granted to date. Many others have been granted from EPO, WIPO and others. Gyroscopes, Ion/Hall thrusters , superconductive materials as well as electromagnetics constitute an alternative type of advanced propulsion. Many Institutes have been founded (IASSPES, Tau Zero Foundation, MorningStar, et cetera).

In conclusion, the death of Rocket Science is only a matter of time.

References

[1] Martin Tajmar, *Advanced space propulsion systems*, Springer-Verlag, Wien-New York, 2003.

[2] Claudio Bruno, and Antonio G. Accettura (Eds.), *Advanced propulsion systems and technologies: Today to 2020*, Volume 223 Progress in Astronautics and Aeronautics

(Frank K. Lu, Editor-in-Chief), American Institute of Aeronautics and Astronautics, Virginia, 2008.
[3] Glen A. Robertson, P.A. Murad and Eric Davis, New Frontiers in Space Propulsion Sciences. *Energy and Conversion Management*, 49 (2008), pp. 436–452.
[4] Glen A. Robertson, Darryl W. Webb, The Death of Rocket Science in the 21st Century, *Physics Procedia*, Volume 20, 2011, Pages 319-330 (Space, Propulsion & Energy Sciences International Forum).
[5] Inertial propulsion: http://www.youtube.com/watch?v=EfuIJcZX3jc
Gyroscope: http://www.youtube.com/watch?v=0cjleOJueqE&feature=related
Flying snake (National Geographic): http://www.youtube.com/watch?v=iwDAsJCB2Pg
Hummingbird: (i) http://www.youtube.com/watch?v=hjnc1kHMDDo&feature=player_embedded
(ii) http://www.jcmdi.com
[6] Edward Norman Gardiner, *Athletics in the ancient world*. Dover, New York (2002)
[7] Norman L. Dean, "System for converting rotary motion into unidirectional motion," US Patent 2,886,976, May 19, 1959; also: US Patent 3,182,517, May 11, 1965; http://deanspacedrive.org
[8] John Campbell, Jr., The Space Drive Problem, *Astounding Science Fact and Fiction*, June 1960, page 98.
[9] Richard F. Dempewolff, Engine with Built-in Wings, *Popular Mechanics*, Sept. 1961, pp. 131-134 & pp. 264-266.
[10] William O. Davis, Ph.D., The Fourth Law of Motion, *Analog*, May, 1962., pg 103
[11] Gaston Burridge, Toward Antigravity, *Rosicrucian Digest*, Vol. XL, No.4, April 1962, pp. 136-139.
[12] G. Harry Stine, Detesters, Phasers and Dean Drives, *Analog*, June 1976, page 75.
[13] Steven M. Hampton, *From Dean Drives and Davis Mechanics*: *Inertial Propulsion and the Manipulation of Time in Symmetrical Systems* ©, Ebook, Apple Communications, London Mills, Illinois, 2007, 2011 (ISBN 518 373).
[14] Ilia. I. Blekhman, "*Vibrational Mechanics: Nonlinear dynamic effects, General approach*, *Applications*", World Scientific, Singapore, 2000 (p.15 and p.19).
[15] G. Yu. Stepanov, "Why is it impossible to have 'Dean's Apparatus'?," *Jour. Priroda*, vol. 7, 1963, pp. 85-91 (in Russian).
[16] I.F. Goncharevich, *Dynamics of vibrational transportation*. Nauka, Moscow (1972); p. 244 [in Russian]
[17] Marc G. Millis and N. E. Thomas, "*Responding to Mechanical Antigravity*," NASA/TM-2006-214390, AIAA-2006-4913, December 2006. Available at: http://gltrs.grc.nasa.gov/reports/2006/TM-2006-214390.pdf
[18] Marc G. Millis, "Assessing Potential Propulsion Breakthroughs," In: E. Belbruno, Ed., Issue 'New Trends in Astrodynamics and Applications', New York, *Annals of the New York Academy of Sciences*, vol. 1065, Dec. 2005, pp. 441–461.
[19] Christopher Gabriel Provatidis, Some issues on mechanical antigravity mechanisms using two contra-rotating masses, *Proceedings 3rd International Conference on Experiments/Process/System Modeling/Simulation & Optimization* (3rd IC-EpsMsO), Athens, 8-11 July, 2009.
[20] C. G. Provatidis "Some issues on inertia propulsion mechanisms using two contra-rotating masses," *Theory of Mechanisms and Machines*, vol. 8, no. 1, Apr. 2010, pp. 34-41.
[21] C. G. Provatidis, A Study of the Mechanics of an Oscillating Mechanism, *International Journal of Mechanics*, Volume 5, Issue 4, 2011, pp. 263-274.
[22] C. G. Provatidis, M. Gamble, Support forces in a synchronized rotating spring-mass system and its electromagnetic equivalent**,** *Technical Report*, *Released by Boeing Co.*

(BOE063011-447), 31 August 2011.
[23] Paul A. LaViolette, *Secrets of Antigravity Propulsion*: Tesla, UFOs, and Classified Aerospace Technology, Bear & Company, Rochester, Vermont, 2008.
[24] Marc G. Millis, Progress in revolutionary propulsion physics, Paper IAC-10-C4.8.7. In: *Proceedings 61st International Astronautical Congress*, Prague CZ, 2010.
[25] Marc G. Millis and Eric W. Davis , Frontiers of Propulsion Science, *Progress in Astronautics and Aeronautics Series*, 227, Published by AIAA, © 2009, 740 pages, Hardback
[26] Kern E. Kenyon, Newton's Third Law for Rotary Motion Derived, *Physics Essays*, volume 18, number 2, 2005, pp. 174-176.
[27] Eric Lathwaite, *An inventor in the Garden of Eden*, Cambridge University Press, 1994.
[28] Renato Vesco, and David Hatcher Childress, *Man-made UFOs 1944-1994: 50 years of suppression*. Adventures Unlimited Press, Stelle, Illinois, 1994. ISBN 0932813232.
[29] Jack Follett, *Special Report 2011: Hitler's secret UFO weapons in War II and beyond*, Huebner Marketing & Consulation Associates, Norderstedt, 2011.
[30] Bruce dePalma, The Tuning Fork Experiment, In: R.L. Dione, 1976 (ISBN 553-02723-150); see also: http://www.brucedepalma.com/n-machine/spinning-ball-experiment/
[31] H. Hayasaka, S. Takeuchi, Anomalous weight reduction on a gyroscope's right rotations around the vertical axis on the earth. *Physical Review Letters* 63 (25), 2701-2704 (1989)
[32] E.G. Adelberger, Science correspondence on paper by Hayasaka & Takeuchi. *Nature* 345:121 (1990)
[33] J. E. Faller, W. J. Hollander, P. G. Nelson, and M. P. McHugh, Gyroscope-weighing experiment with a null result. *Phys Rev Lett* 64:825–826 (1990)
[34] M. MacCallum, Does a spinning mass really lose weight? *New Scientist* N1704:30 (1990)
[35] Nitschke JM, Wilmarth PA, Null result for the weight change of a spinning gyroscope. *Phys Rev Lett* 64: 2115–2116 (1990)
[36] T.J. Quinn, A. Picard, The mass of spinning rotors: no dependence on speed or sense of rotation. *Nature* 343, 732-735 (1990)
[37] S.H. Salter, Good vibrations for physics. *Nature* 343:509–510 (1990)
[38] Akira Imanishi, Koichi Maruyama, Shoichi Midorikawa and Teruhisa Morimoto, Observation against the weight-reduction of spinning gyroscopes. *J Phys Soc Japan* 60:1150–1152 (1991)
[39] H. Hayasaka, H. Tanaka, T. Hashida, T. Chubachi, T. Sugiyama, Possibility for the existence of anti-gravity: evidence from a free-fall experiment using a spinning gyro. *Speculations in Science and Technology* 20, 173-181 (1997)
[40] Richard Wayte, The phenomenon of weight-reduction of a spinning wheel. *Meccanica* 42:359-364 (2007)
[41] P. & A. Correa, Gravitational Aetherometry, Monograph AS3-II.10, 2002, 2006.
[42] Robert L. Forward, Guidelines to Antigravity, *American Journal of Physics* 31(3), 166-170 (1963)
[43] Bahram Mashhoon, Friedrich W. Hehl, Dietmar S. Theiss, On the Gravitational Effects of Rotating Masses: The Thirring-Lense Papers, *General Relativity and Gravitation* 16(8), 711-750 (1984)
[44] M. Tajmar (2010), Homopolar artificial gravity generator based on frame-dragging, *Acta Astronautica*, 66(9-10), 1297-1301 (2010)
[45] D.B. Robertson, Propulsion method and apparatus utilizing centrifugal force, WO 01/46584 A3, 28 June 2001.
[46] M. Hoshino, U.S. Patent for "Propulsion apparatus using centrifugal force," No. 20050139022 (Filed 7 Jan. 2004; Published: 30 June 2005)

[47] Ted Andrews, Animal Speak, St. Paul, *Minnesota*, Llewellyn Publications, 1993, p. 157.
[48] B.W. Tobalske, D.R. Warrick, C.J. Clark, D.R. Powers, T.L. Hedrick, G.A. Hyder, A.A. Biewener, (2007). Three-dimensional kinematics of hummingbird flight. *J. Exp.Biol.* 210, 2368-2382.
[49] C. G. Provatidis, “A novel mechanism to produce figure-eight-shaped closed curves in the three-dimensional space,” In: D. Tsahalis, Ed., *Proceedings of Third International Conference on Experiments / Process / System Modeling/Simulation & Optimization*, Athens, July 2009 ([CD-ROM]).
[50] C. G. Provatidis and V. Th. Tsiriggakis, “A new kinematics theory in physics and presentation of a device for gravity studies,” *Proceedings Ninth International Scientific-Practical Conference “Research, Development and Applications of High Technologies in Industry”* (A.P.Kudinov, Ed., ISBN 978-5-7422-2557-7), vol. 1, St. Petersburg, April 2010, pp. 386-393.
[51] C. G. Provatidis and V. Th. Tsiriggakis, “A new concept and design aspects of an ‘antigravity’ propulsion mechanism based on inertial forces,” *Proceedings 46th AIAA/ASME/SAE/ASEE Joint Propulsion Conference & Exhibit*, Nashville, July 2010 (paper AIAA-2010-6684).
[52] C. G. Provatidis, A device that can produce net impulse using rotating masses, *Engineering*, Vol. 2, Number 8 (Aug. 2010), pp. 648-657, http://www.scirp.org/journal/eng/
[53] C.G. Provatidis, Progress in an Antigravity Mechanism using Inertial Masses, Oral Presentation in The Proceedings “*Space, Propulsion & Energy Sciences International Forum (SPESIF-2011)*” [CR-ROM], March 15-17, 2011, University of Maryland, College Park, MD, USA
[54] Clément Therriault, *Wing movement for ornithopters and apparatus of the like*, US Patent No. 6,227,483 B1, May 8, 2001.
[55] Donald Clarke, *How It Works: The illustrated Encyclopedia of Science and Technology*, Marshall Cavendish, USA, 1978, pp. 2194-2197 (Vol. 10, vocabulary entry : “propulsion inertial”, in Greek translation).
[56] Thomas F. Valone, *Eric Laithwaite Report: Gyromagnetic Engineering Genius – Publications, Inventions & News Clips* (IRI PR-02-005), Integrity Research Institute, Beltsville, MD, December, 2006.
[57] Eric Laithwaite, *Engineer Through The Looking-Glass*, British Broadcasting Corporation, London, 1980.
[58] Eric R. Laithwaite, *Propulsion without wheels*, The English Universities Press Ltd, London, 2nd ed., 1970.
[59] Benjamin Thomas Solomon, *An Introduction to Gravity Modification: A Guide to Using Laithwaite's and Podkletnov's Experiments and the Physics of Forces for Empirical Results*, Lightning Source Inc, 2008. Also: Benjamin T. Solomon, Gravitational acceleration without mass and noninertia fields, *Phys. Essays*, vol. 24, 327 (2011); doi:10.4006/1.3595113 (11 pages)
[60] P.F. Browne, Relativity of rotation, *J. Phys. A: Math. Gen*, Vol. 10 (5), 1977.
[61] J. Luo, Y.X. Nie, Y.Z. Zhang, Z.B. Zhou, Null result for violation of the equivalence principle with the free-fall rotating gyroscopes, *Phys. Rev. D*, Vol.65, 042005, 2002.
[62] Rosemary Barnes Bergman Althoff, *The Hot Marble: A Soul’s Warfare*, Createspace, USA, 2011.

Correspondence to: Prof. Christopher G. Provatidis, School of Mechanical Engineering, National Technical University of Athens, 9 Heroes of Polytechnion Avenue, Zografou Campus, 157 80 Athens, Greece.
E-mail: cprovat@central.ntua.gr,
http://users.ntua.gr/cprovat