

# Construction of Magnetic Levitating Devices and their Future Prospects

Sanjeet Ray (sanjeetray74@gmail.com)

Sourish Datta ([sourishdatta95@gmail.com](mailto:sourishdatta95@gmail.com))

N. Arun (arun.n@ktr.srmuniv.ac.in)

## Abstract

The following paper deals with the construction of magnetic levitation devices and their behaviour in different conditions. It explores the principle behind anti-gravity systems and also addresses as to how they can be brought to life.. Further it encompasses the future prospects of such technology when combined with other upcoming technologies in different areas of life. The paper then explains how they can be used and why it can bring a difference in our basic technology. It also seeks on the option of anti-gravity devices based on the earth's magnetic field.

**Keywords:** *Magnetic Levitation, Anti-Gravity, Earth's Magnetic Field,*

## 1. Introduction

The basis for electromagnetic levitation devices comes from the objective of studying ideal systems. For long, friction and weight of an object has caused hindrances in the studying systems as well as they have caused reduction in efficiency of a system. Therefore to obtain maximum efficiency in any system it is desirable to exclude gravity. This feat can be achieved by keeping the system to be studied to be in a free falling or suspended state. To suspend objects in space the concept of electromagnetic induction can be used. Such devices have been constructed in large scale and can be seen in Maglev Trains, however a small scale device which can be used by people according to their necessities. These devices utilize rotating magnetic fields to levitate.

## 2. Construction

The construction of such devices are simple quite cost-effective. The device as seen in Fig (1) shows the four BLDC motors being attached to a frame. This frame supports both the motors and acts as an attachment for load carrying purposes. Having these four motors, stabilizes the device. In a system having a single motor would eventually start spinning in the opposite direction as a consequence of the reaction force. Similarly with two motors the system would

produce a torque. However with four motors rotating in which two are adjacent spinning in opposite direction with respect to other allows the device to stay stable in its position.

These BLDC motors are attached to magnets which are constantly spinning with the motor. Therefore when these rotating magnetic fields come in contact with any paramagnetic conducting surface, it exhibits a repulsion force on the surface of the material to push itself forward in a direction away from the plate.

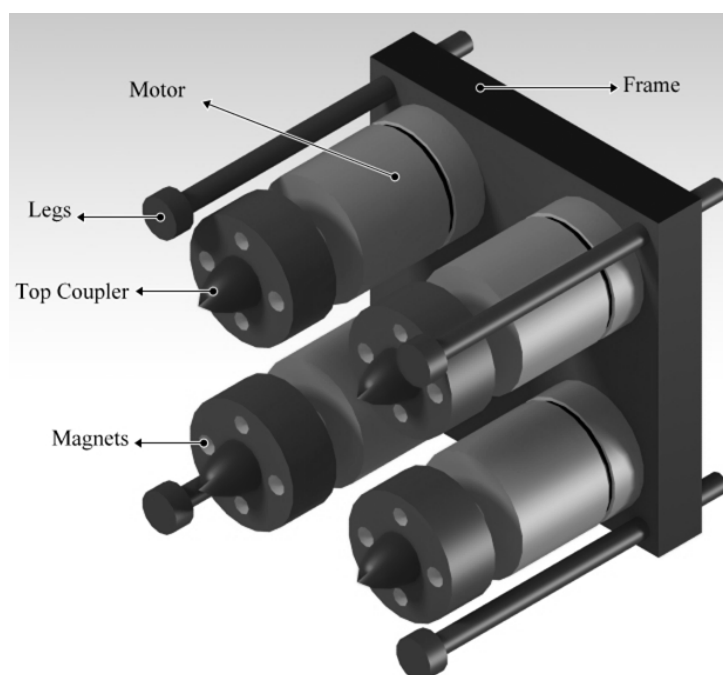


Fig (1)

### 3. Hall Bach Array

As we know that magnets cannot have a monopole. It divides itself into two poles, however, by arranging a group of magnets in a particular repetitive or cyclic pattern enables us to get a higher field line density on one side of the arranged with respect to the other side. Following such arrangements helps the field to be localised to a direction and hence providing us with the maximum efficiency from a rotating magnetic field inducing a paramagnetic plate.

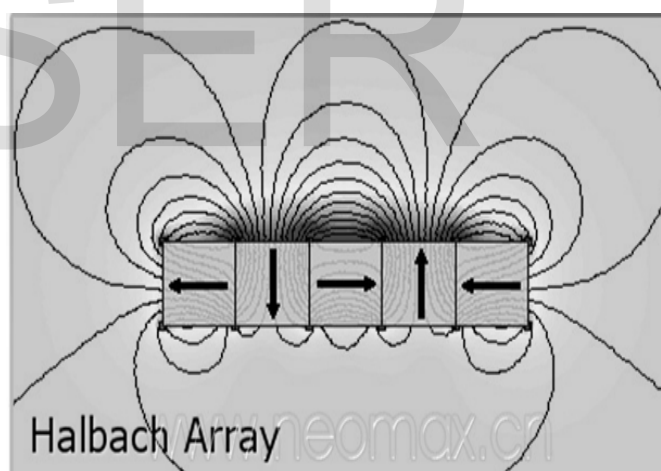


Fig (2)

The magnets as labelled in Fig (1) follow the array and hence have a magnetic field concentrated downwards towards the ground. A pictorial depiction of the array is given in Fig (2). Here you can notice that the North Pole is shown with an up arrow and the South Pole with a down arrow. However, magnets do not understand poles. They work on the concept of magnetic spins which is later discussed in the fourth section of the paper. Further we will discuss the Faraday's Paradox and how the third law of motion replicated in Lenz is' Law. Understanding these will help us give hint towards the

#### 4. Working

The device spins the magnets attached to the motor, hence changing the magnetic field over the area of the material beneath the magnet. In such a scenario the change of flux leads to the formation of an electric current on base plate which in return produces a repulsive force. However as told earlier, the two adjacent motors should spin in the opposite direction so that the device experiences net zero force and doesn't start spinning in the opposite direction.

This device when supplied with load of a given quantity decreases the height of the system from the ground. Therefore a specific load will have a specific height for a given RPM of the motors. This leads us to understand that by increasing the RPM would lead to more weight carrying capacity.

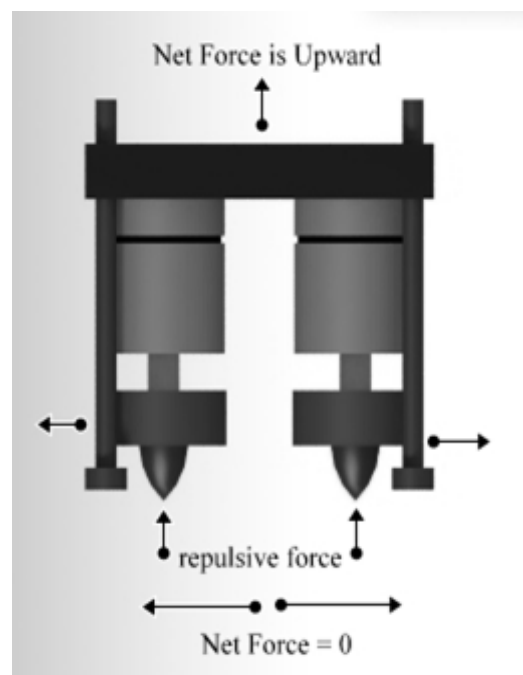
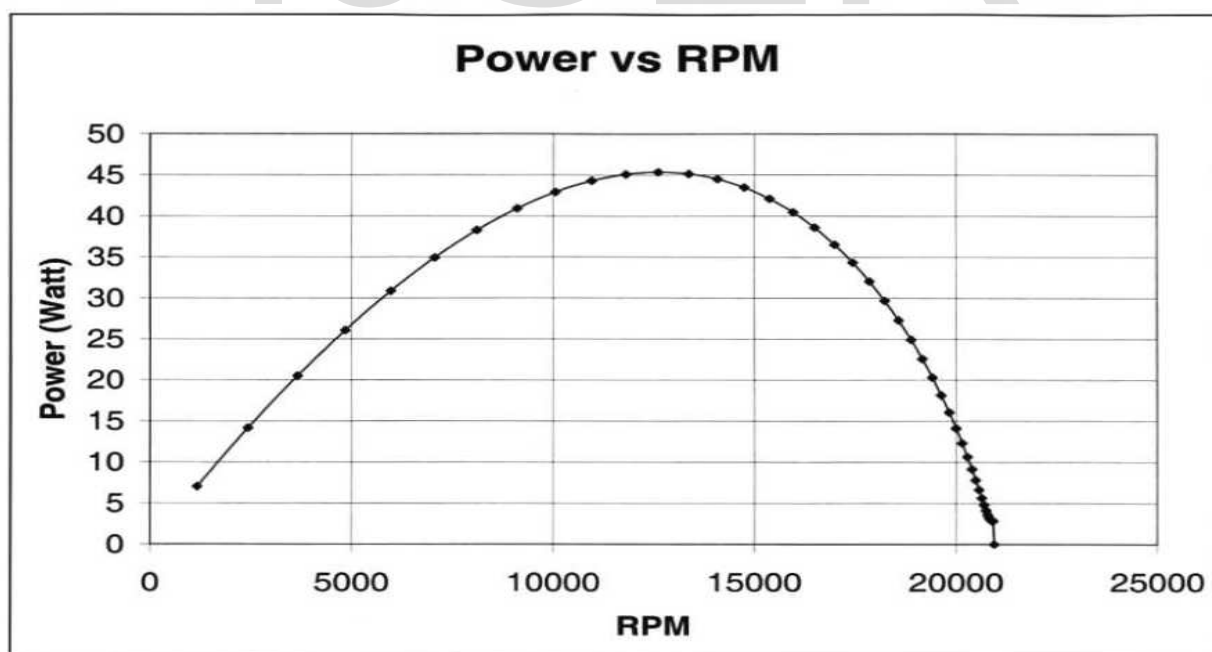


Fig (3)

Hence electrical energy is directly converted to mechanical energy. The power of the system increases with the RPM, however after a peak value for Power, even when the RPM increases constantly the power starts to deteriorate. This happens due to the heat dissipation of the system. This can be observed in the graph given below.



Graph (1)

The device works on the basis of the same principle and hence the same formula as the Maglev Trains. However there are two levels of conversion that take place. The first conversion takes place when electrical energy is used to drive the motor and also the magnets. The second conversion takes place with the rotating magnetic field, where mechanical energy is giving rise to electrical energy and finally producing a mechanical output.

In the first step the total current is found which is required to run the motor.

$$I = V / R$$

Where,

I – current, measured in amperes (A);  
V – applied voltage, measured in volts (V);  
R – resistance, measured in ohms ( $\Omega$ ).

The consumed electrical power of the motor is defined by the following formula:

$$P_{in} = I * V$$

Similarly,

$$P_{out} = m.g.h.\omega$$

Where,

‘m’ is the mass of the system

‘g’ is the acceleration due to gravity

‘h’ height from the ground

And ‘ $\omega$ ’ is the angular velocity (in rad/sec) and defined by

$$\omega = \text{rpm} * 2\pi / 60$$

Therefore to find the efficiency we will use

$$E = P_{out} / P_{in}$$

Hence to find the total current requirement depending on the motor’s efficiency is given by,

$$m.g.h = (I * V * E * 60) / (\text{rpm} * 2\pi)$$

## 5. Further Upgrades & Future Prospects

To increase the efficiency and design of the proposed model, the following parameters can be taken into considerations:

1. Asymmetric Magnets should be used; a tilted rotor which can spin will produce higher change in flux.
2. Changing the shape and profile of the magnet that is being spun. Since magnetic field lines curve, therefore having a curved profile will enable a greater range as well as straight ejecting lines from the magnet.

Apart from these minor changes in the design, the advent in the current technology can be used to create the desirable applicative system out of the proposed device. A research conducted by Disney proposes a room which enables charging of all the electrical devices present in the room. The technology is inspired by Nikola Tesla's Wardenclyff Tower. The concept behind the room is based upon electromagnetic induction. This is performed by



Fig (4)

carrying a current carrying coil from the centre of the room which in response induces a current on the walls and hence they produce a constant varying magnetic field. This varying magnetic field causes current to flow in devices.

Such a room can be coupled with the levitation device and hence these systems can be used to perform the following applications:

- Practical simulation in ideal environment.
- Entertainment and Amusement
- Analysis
- Assembly and Manufacturing
- Storage and Maintenance
- Logistics and Transportantion

## Conclusion

From the discussion in the paper we can understand that anti-gravity system using magnets can be built by utilising an existing magnetic field, which is naturally created. This can be the earth's magnetic field. However the earth's magnetic field is not strong enough to support anti-gravity systems. However research in this area to build anti-gravity systems still goes on with these small milestones achieved by different sectors of technology. It is by combining these separate sectors that we will be able to solve the mystery behind anti-gravity systems.

## References

1. Monika Yadav , Nivritti Mehta, "Review of Magnetic Levitation (MAGLEV): A Technology to Propel Vehicles with Magnets" Volume 13 Issue 7 Version 1.0 Year 2013
2. Roth, Daniel L. "The TGV System: A Technical, Commercial Financial, and Socio-Economic Renaissance of the Rail Mode." University of Pennsylvania, 1990.
3. Dai, H. (2005). Dynamic behavior of maglev vehicle/guideway system with control. Ph.D. Thesis, Department of Civil Engineering, Case Western Reserve Uni.
4. EMS systems such as HSST Taking from Wikipedia using internet site.
5. FTA, Office of Research, Demonstration, and Innovation, (2004). Urban maglev technology development program Colorado maglev project
6. Deyle T, Reynolds M. Surface based wireless power transmission and bidirectional communication for autonomous robot swarms. IEEE International Conference on Robotics and Automation, 2008 ICRA 2008. 2008. pp. 1036–1041.
7. Scheible G, Schutz J, Apneseth C. Novel wireless power supply system for wireless communication devices in industrial automation systems. IECON 02 [Industrial Electronics Society, IEEE 2002 28th Annual Conference of the]. 2002. pp. 1358–1363 vol.2.



**Author: Sanjeet Ray** was born and brought up in Kolkata, West Bengal, India. Born on 11<sup>th</sup> of March 1995, he completed his education till the Higher Secondary Section from Birla High School passing the 10<sup>th</sup> class in 2011 and the 12<sup>th</sup> in 2013. He then moved to complete his B.Tech in Mechanical Engineering from Chennai which will be completed by May of 2017.

He currently works in the Mechanical Domain of SRM Mars Rover Team, RUDRA, as the mechanical head and has published papers both in National and International Journals of Robotics and Automation. He has completed an internship in Biloree Cast Pvt. Ltd learning about the centrifugal casting used for manufacturing engine liners. He was also awarded the Silver Medal for his research in Robotics by SRM University.