

Mark Hoff



Eco Green Group of Silicon Valley
Magnetic Levitation

Thursday, March 23, 2017

Today's Presentation

- What is Magnetic Levitation (Mag Lev)
- The Math Involved OR Theorem, Theorem, Who's Got The Theorem
- Magnetic Levitation: Two Short Tutorials
- Mag Lev Trains
- The Future of Magnetic Levitation
- Discussion



Magnetic Levitation

What is Magnetic Levitation (Mag Lev)

[Wikipedia Link - Magnetic Levitation](#)

- Magnetic levitation, MagLev, or magnetic suspension is a method by which an object is suspended with no support other than magnetic fields.
- Magnetic force is used to counteract the effects of the gravitational acceleration and any other accelerations.
- The two primary issues involved in magnetic levitation are
 - lifting forces: providing an upward force sufficient to counteract gravity
 - stability: ensuring that the system does not spontaneously slide or flip into a configuration where the lift is neutralized.
- Magnetic levitation is used for MagLev trains, contactless melting, magnetic bearings, and for product display purposes.

[Wikipedia Link - MagLev](#)

- MagLev (derived from magnetic levitation) is a transport method that uses magnetic levitation to move vehicles without making contact with the ground.
- With MagLev, a vehicle travels along a guideway using magnets to create both lift and propulsion, thereby reducing friction by a great extent and allowing very high speeds.
- In itself, MagLev technology includes no moving parts.
- MagLev trains move more smoothly and more quietly than wheeled mass transit systems.
- The power needed for levitation is typically not a large percentage of its overall energy consumption; most goes to overcome drag, as with other high-speed transport.
- MagLev trains hold the speed record for trains.

Mark Hoff



Eco Green Group of Silicon Valley

Thursday, March 23, 2017

Magnetic Levitation

The Math Involved OR Theorem, Theorem, Who's Got The Theorem

Wikipedia is a great resource for research. By reading the following articles, you will get a clear picture of magnetism and how it can be used. There are other related pages, feel free to read them too. Each article has references at the end, should you desire even more information.

[Wikipedia Link - magnetic field](#)

[Wikipedia Link - magnetic pressure](#)

[Wikipedia Link - railgun](#)

[Wikipedia Link - magnetic dipole](#)

[Wikipedia Link - diamagnetic](#)

[Wikipedia Link - paramagnetic](#)

[Wikipedia Link - ferromagnetic](#)

[Wikipedia Link - superconductors](#)

[Wikipedia Link - Earnshaw's theorem](#)

[Wikipedia Link - Lenz's law](#)

[Wikipedia Link - Halbach array](#)

Mark Hoff



Eco Green Group of Silicon Valley

Thursday, March 23, 2017

Magnetic Levitation

Magnetic Levitation: Two Short Tutorials

[Watch YouTube Video - magnetic suspension](#)

Magnetic Suspension, Levitation, and Propulsion: Matthew Thomas Sturm at TEDxYouth@SeaburyHall 2014

Published on May 12, 2014

Time: 10 min 3 sec

Levitation, many think it to be impossible. But Matthew Thomas Sturm demonstrates how it is not only possible, but achievable. By using his model of a Maglev Train, Sturm makes a complicated idea understandable and entertaining, all the while illustrating its importance.

[Watch YouTube Video - Quadcopter](#)

Electromagnetic Levitation Quadcopter

Published on Jan 30, 2017

Time: 6 min 18 sec

Obviously this "quadcopter" is a demonstration device, showing how moving magnets over a conducting surface can generate levitation. It has not been optimized to minimize losses or be an efficient mode of transport. I still think it's pretty cool. I'm used to seeing light things levitated by induced currents but not a 100+ lb machine.

Mark Hoff



Eco Green Group of Silicon Valley

Thursday, March 23, 2017

Magnetic Levitation

Mag Lev Trains

[Wikipedia Link - Maglev train](#)

- MagLev trains travel along a guideway using magnets to create both lift and propulsion.
- In itself, MagLev technology includes no moving parts.
- The highest recorded MagLev speed is 603 km/h (375 mph), achieved in Japan by JR Central's L0 superconducting Maglev on 21 April 2015.
- MagLev transport systems are in operation in just three countries (Japan, Korea and China)
- Future systems are planned in many countries: Australia - Italy - United Kingdom - United States – Germany - Switzerland - China - India - Malaysia - Iran - Taiwan - Hong Kong

Mark Hoff



Eco Green Group of Silicon Valley

Thursday, March 23, 2017

Magnetic Levitation

The Future of Magnetic Levitation

[Wikipedia Link - Hyperloop](#)

Hyperloop is a proposed mode of passenger and freight transportation that would propel a pod-like vehicle through a near-vacuum tube at more than airline speed.

(please refer to last week's presentation)

[Watch YouTube Video - SciFi Hoverboard](#)

Sci-fi 'hoverboard' becomes reality

Published on Nov 16, 2014

Time: 2 min 12 sec

Ever since Marty McFly rode on one in 'Back to the Future Part II', fans have dreamed of having their own 'hoverboard'. That wish has now been granted, as engineers in Northern California have made the futuristic device a reality.

[Watch YouTube Video - Arxpax Demo Reel](#)

Arx Pax Labs

Published on Mar 1, 2016

Time: 6 min 46 sec

{no YouTube description} Demonstration of the Hendo Hoverboard, including placing what appears to be 800 pounds of weight on one as it hovers, and skateboard legend Tony Hawk riding one at their Los Gatos headquarters (near Vasona Park). Trendy music too.



Magnetic Levitation

[Web Site Link - Arxpax Labs](#)

A one-of-a-kind concept - MFA Technology

MFA is a new tool that can be used in the markets above and many more.

MFA enables lift, propulsion, control — and it is a much more cost effective, and simpler solution than traditional Maglev systems.

It's imaginative and inventive.

And the way it uses magnetic fields is transformative.

How Hover Technology Works

MFA is simply the design of more useful magnetic fields.

By combining relatively weak magnetic fields in the correct way, the magnetic flux can be organized to reinforce and align itself to do more work.

Depending on the application, MFA can begin either with electromagnets or permanent magnets.

When their respective fields are properly combined, new field patterns can be created for specific uses.

The MFA hover engine generates a primary magnetic field, which induces electrical currents in the conductive surface.

These eddy currents then create a secondary magnetic field which repels the primary field.

In other words, the hover engines create opposing electromagnets in the surface material which provide lift.

What MFA Can Do

Motion and Control

- ◆ Objects powered by MFA technology are capable of omnidirectional motion, propulsion, braking, and rotation without touching the surface.
- ◆ MFA allows for extremely complex movements without use of articulation or robotic motion.
- ◆ Systems enabled with MFA are able to rotate 360 degrees with no turning radius.

Lift and Isolation

- ◆ Merely having a levitated object allows external ("passive") control of motion with negligible friction.
- ◆ Levitation allows vibration isolation between the levitated object and its conductive base.
- ◆ MFA overcomes Earnshaw's Theorem to allow a stable levitation paradigm.

Energy Transmission

- ◆ Systems, such as inductive charging systems, can be simply deployed with limited re-design and expense.
- ◆ Efficiency gains could be used to build inductive charging systems with larger air gaps and less stringent positional accuracy.

Non-Touch Coupling

- ◆ Technology would allow for concepts such as a magnetic "clutch."
- ◆ End effectors that pick up objects without touching them.
- ◆ Able to move objects through non-conductive walls.

Mark Hoff



Eco Green Group of Silicon Valley
Magnetic Levitation

Thursday, March 23, 2017

Discussion