



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 5, May 2023

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.423

# Electromagnetic Railgun

Ishan Mulani, Aryan Mandaviya, Kaif Khan, Anirudh Kashyap, Mr. Sudhir Thakre

Department of Mechanical Engineering of Thakur Polytechnic, Mumbai, India

**ABSTRACT:** The electromagnetic railgun is a promising technology has the potential to revolutionise the field of projectile propulsion. This paper provides an overview of the electromagnetic railgun and discuss the principal of operation, design consideration and potential applications. The paper also reviews some of the recent research and development efforts in this area.

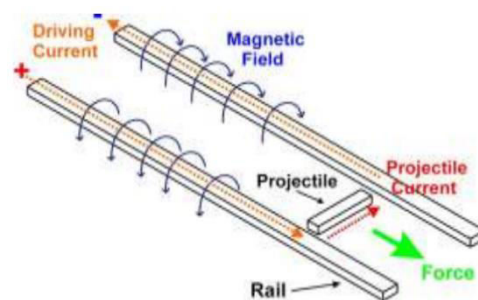
**KEYWORDS:** projectile propulsion, electromagnetic force, magnetic field, weapon, high velocity

## I. INTRODUCTION

The electromagnetic railgun is a device 36 electromagnetic forces to accelerate a gunshot into high rapidity. This principle of operation of the railgun is grounded on the commerce between 2 resembling conductive rails and the conductive amateur when a large current is passed through the rails or glamorous field is generated which interacts along with the glamorous field which is generated by the architecture. This commerce results in Lorentz force which accelerates the architecture and the gunshot attached to it.

A railgun (or a spelled rail gun) is a direct motor device, which can be designed as an armament that uses electromagnetic force to launch shells at high haste. The gunshot typically doesn't contain snares, rather counting on the gunshot's high kinetic energy to induce damage. The railgun uses a brace of resembling operators (rails), along with which a sliding architecture can be accelerated by the electromagnetic goods of a current which flows down one rail, into the architecture and also back along the other rail. It's grounded on the principle analogous to those of the homopolar motor.

The railgun is different from a traditional electric motor in which no use of fresh field windings is made (or endless attractions). This introductory configuration is formed by a single circle of current and therefore requires high currents (on the order of one million amperes) to produce sufficient accelerations (and nib rapidity). The railgun walks by using a high power electrical palpitation to induce a glamorous field that accelerates the gunshot along the rails. The force generated by the glamorous field propels the gunshot out of the Regan at extremely high pets, potentially reaching hypersonic rapidity



The railgun walks by using a high power electrical pulse to generate a magnetic field that accelerates the projectile along the rails. The force generated by the magnetic field propels the projectile out of the Regan at extremely high speeds, potentially reaching hypersonic velocities.

## II. LITERATURE REVIEW

[1]An electromagnetic railgun accelerator system, for accelerating shells by a tube bow, introduces a breakdown inhibiting gas into the railgun chamber behind the accelerating gunshot. The breakdown inhibiting gas, which absorbs electrons, is a halide or a halide emulsion similar as fluorine or SF (sub 6). The gas is introduced between the railgun rails after the gunshot has passed through coves in the rails or the gunshot; by sheeting the rails or the gunshot with a material which releases the gas after the gunshot passes over it; by fabricating the rails or the gunshot or insulators out of a material which releases the gas into the portions of the chamber through which the gunshot has travelled. The gunshot may have a depression at its hinder to control the release of ablation products.

**-By Hawke, R.S.**

[2]Processes that accompany the generation of strong shock swells during the acceleration of a free tube piston (PP) in the electromagnetic railgun channel have been experimentally studied. The conformation of shock swells in the railgun channel and the stir of a shock- surge- compressed subcase do (in discrepancy to the case of a classical shock tube) in a rather strong electric field (up to 300 V/ cm). The trials were performed at the original gas pressures in the channel ranging from 25 to 500 Torr. At 25 Torr, the shock- surge Mach figures reached 32 in argon and 16 in helium. At high attention of charged patches behind the shock surge, the electric field causes the passage of a part of the discharge current through the volume of the shock- surge- compressed sub caste, which induces violent gleam similar with that of the PP gleam.

**-By Bobashev, S. V.; Zhukov, B. G.; Kurakin, R. O.; Ponyaev, S. A.; Reznikov, B. I.**

[3]Descriptions are given of the following railgun systems the fast- capacitor/ inductor system, the slow- capacitor/ inductance system, the homopolar creator/ inductor system, the distributed energy store system, and the flux compressor powered railgun. Attention is also given to the inverse railgun flux compressor, where the piston is driven between the rails along which the reversed badge architecture slides. The development of the railgun since World War II is surveyed. It's noted that the most burning need at present is for cheaper, simpler energy stores to couple to the railguns.

**-By Marshall, R. A.**

[4]Electromagnetic acceleration of projectiles has the potential to achieve high velocities than achieved by any other means. A railgun is the simplest form of electromagnetic macro particle accelerator and can generate the highest sustained accelerating force. The practical length of conventional railguns is limited by the impedance of the rails because current must be carried along the entire length of the rails. A railgun and power force system called the distributed energy store railgun was proposed as a result to this limitation. A distributed energy storehouse railgun was constructed and successfully operated. In addition to this demonstration of the distributed energy store railgun principle, a theoretical model of the system was also constructed. A simple simulation of the railgun system grounded on this model, but ignoring frictional drag, was compared with the experimental results. During the process of comparing results from the simulation and the trial, the effect of significant frictional drag of the gunshot on the sidewalls of the drag was observed.

**-By Holland, L. D.**

[5] **DRDO Electromagnetic Railgun** :- The Future Weapon of Indian Navy : Rail gun is a weapon, which has the capability of launching projectile without the usage of explosives or propellants, but, are launched at extremely high speeds, Mach 7 (at sea level) or even more. Capability of launching projectiles at velocities Higher than guns and cannons makes rail gun hit targets at greater ranges capable of hitting the target with extreme speed and accuracy thus nullifying the escape factor of the enemy platform or an approaching projectile. With the usage of rail gun the hazards of usage of explosives and chemical propellants are evaded as well.

[6]**Raghav Sharma. Jitendrasingh Chauhdary**, "To launch satellites into the low earth orbit, railgun can be used National Institute of Technology, Jalandhar, Punjab.



[7]**Volodymyr T. Chemerys**, “Key Problems of Railgun: New Concept for their Resolution National Aviation University of Ukraine, Build.1,Cosmonaut Komarov Ave., Kyiv 03680, Ukraine

[8]**Yu-tao LOU , Hai-yuan LI, Bao-ming LI**, “Research on proximity effect in railgun” National Key Laboratory of Transient Physics, Nanjing University of Science and Technology, Nanjing 210094, Jiangsu, China

[9]**Bao-ming LI**, “Analysis and discussion on launching mechanism and tactical electromagnetic railgun technology “National Key Laboratory of Transient Physics, Nanjing University of Science and Technology, Nanjing 210094, Jiangsu, China

[10] **Ian R.McNab**, “Use electromagnetic railgun to launch in space” Senior Member, IEEE.

[11]**Lizhong Xu**, Yanbo Geng, “Forces of rails for Electromagnetic railgun”, Mechanical Engineering Institute, Yanshan University,

### III.BACKGROUND

The conception of the electromagnetic railgun dates back to the early 1900s, with the development of the first prototype in the 1930’s. The technology remained largely experimental until the 1980’s when the US Navy begin probing railgun for use in military operation. The conception of the railgun was first introduced by French innovator André Louis Octave Fauchon- Villeplée, who created a small working model in 1917 with the help of the Société anonyme des accumulateurs Tudor (now Tudor Batteries).

One of the crucial advantages of railguns over the traditional gunpowder grounded armament system eventuality for high rapidity and lesser delicacy. Rail ordnance use glamorous fields to accelerate shells in hypersonic pets, making them potentially useful for long range and perfection attacks.

In recent times there has been significant interest in railgun technology from military associations around the world. The US cortege in particular has invested heavily in railgun exploration and development with the thing of creating a practical and effective railgun system for use in boat grounded armament system.

### IV.DESIGN & DEVELOPMENT

The design of an electromagnetic railgun depends on colourful factors similar as asked haste of the gunshot, the mass of the gunshot and the strength of the glamorous field. The rails and the architecture must be made of high conductivity accoutrements similar as bobbyor aluminium to minimise the resistive losses. The architecture must also be designed to repel the high force generated during acceleration.

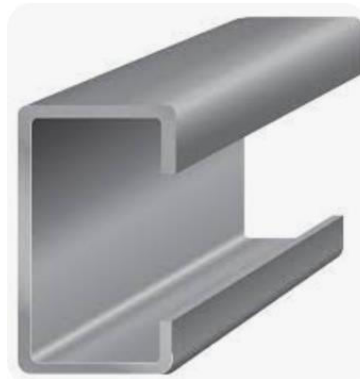
A railgun consists of two resembling essence rails (hence the name). At one end, these rails are connected to an electrical power force, to form the end of the gun. When a conductive gunshot is passes between the rails (e.g. by insertion into the pants) also it completes the circuit. Electrons flow from the negative outstation of the power force up the negative rail, across the gunshot, and down the positive rail, back to the power force.

For making the railgun, we used the following components:

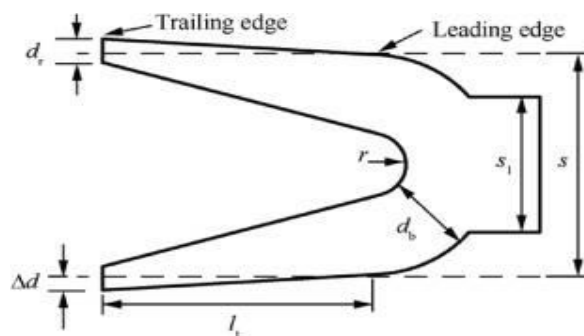
- a. **Power supply:** It is simply a source of large electric current.



- b. **Rails:** A brace of resembling conductive essence, similar as aluminium, bobbyis used for rails. They can range from about 4 to 30 bases in length.



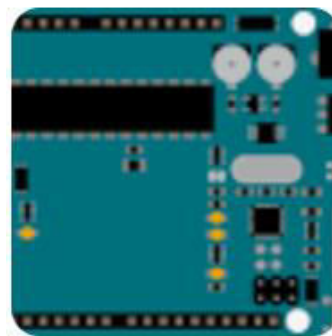
- c. **The armature:** It is used to bridge the gap between the two rails. It can be a solid piece of conductive essence or a carrier that houses an outrage or other gunshot.



**d. Resistors:** Resistors are required in the circuit of the targeting system.



**e. Arduino Uno:** Arduino UNO is a low- cost, flexible, and easy- to- use programmable open- source microcontroller board which can be used to integrate a variety of electronic systems. This board can be connived with other Arduino boards, Arduino securities, and jeer Pi boards and it can also control relays, LEDs, servos, and motors as an affair.



**f. N CHANNEL MOSFET:**In the circuit arrangement, an improvement- mode N- channel MOSFET is used to switch a simple beacon “ON” or “OFF.” The main function the mosfet is to switch ON or OFF. Shells the gunshot which has to be fired through the railgun should be extremely small, largely conductive and largely toast resistant.



**g. Projectiles:** The projectile which has to be fired through the railgun should be extremely small, highly conductive and highly heat resistant.



- h. And numerous similar small factors like 10k resistor, attraction neodymium, camera, s3 battery, 1n4007 diode, etc.

### V. CHALLENGES

The main challenges faced for the construction of the railgun are:

1. **High Current and Magnetic Fields:** One of the primary challenges in the design of electromagnetic railguns is generating the high currents and magnetic fields necessary for the device to operate. The power supply must be able to deliver a high current for a short period of time to produce the necessary magnetic fields. Generating these high currents and magnetic fields without causing damage to the device or the surrounding environment is a significant challenge.
2. **Rail and Armature Design:** The design of the rails and armature is critical to the performance and reliability of the railgun. The rails and armature must be designed to withstand the high forces and stresses generated during acceleration. The design must also minimize resistive losses and ensure optimal contact between the rails and the armature.
3. **Projectile Design:** The design of the projectile is also critical to the performance and reliability of the railgun. The projectile must be designed to withstand the high forces and stresses generated during acceleration. The projectile's shape, mass, and materials can all impact its performance and must be carefully selected.
4. **Control and Triggering:** The railgun requires a control system to ensure proper timing and sequencing of the firing sequence. The control system must be able to manage the high voltages and currents that are present during operation. Ensuring that the control system is reliable and operates within safe limits is a significant challenge.
5. **Heat Dissipation:** The high currents and magnetic fields generated during operation can cause significant heat build-up in the rails and armature. Ensuring that the heat is dissipated effectively and does not cause damage to the device is a significant challenge.
6. **Material Selection:** The selection of materials for the rails, armature, and other components of the railgun is critical to its performance and reliability. The materials must be able to withstand the high forces, stresses, and temperatures generated during operation. The selection of materials that can meet these requirements while also being cost-effective is a significant challenge.

### VI. FUTURE SCOPE

The future of electromagnetic railguns is promising, with potential applications in both military and civilian settings. Here are some potential future scope for electromagnetic railguns:



1. **Military Applications:** One of the primary applications of electromagnetic railguns is in military settings, where they could be used as powerful long-range weapons. The high velocity and accuracy of the railgun could make it an effective tool for defence against aerial and ground-based threats.
2. **Space Exploration:** Another potential application for electromagnetic railguns is in space exploration. The railgun's ability to accelerate objects to high velocities could be useful in launching payloads into space more efficiently and cost-effectively.
3. **Transportation:** Electromagnetic railguns could also have applications in transportation. The high velocity and acceleration of the railgun could potentially be used to propel vehicles, such as trains or ships, at high speeds over long distances, reducing travel times and costs.
4. **Industrial Manufacturing:** Electromagnetic railguns could be used in industrial manufacturing settings to accelerate materials and particles for manufacturing and processing purposes. This could lead to improvements in manufacturing efficiency and product quality.
5. **Energy Storage:** Electromagnetic railguns could also have applications in energy storage. The high velocity of the projectile could be used to store energy, similar to a flywheel, which could be used to power various devices and systems.

## VII.CONCLUSION

In conclusion, the electromagnetic railgun is a highly promising technology with the potential to revolutionize military weaponry. Its ability to launch projectiles at hypersonic speeds with great accuracy and range offers significant advantages over traditional gunpowder-based weapons.

However, significant challenges must be addressed before electromagnetic railguns can become widely adopted. The need for high-power electrical systems, high-strength materials, and heat dissipation are among the biggest challenges that must be overcome.

Despite these challenges, the potential benefits of electromagnetic railguns for military applications are significant. With continued research and development, it may be possible to create a practical and effective railgun technology that can transform modern warfare.

## VIII.ACKNOWLEDGMENTS

We feel immense pleasure in submitting this report on the topic, '**ELECTROMAGNETIC RAILGUN**'.

While submitting the report, we avail this opportunity to express our gratitude to all those who helped us in completing this task. Heading the list with our honourable Principal Dr. S. M. Ganeshari who is the beginning of our inspiration. We own our deep gratitude and also very thankful to our mentor Mr. Sudhir Thakre and our H.O.D. Mrs. Nehal Muchhala who has proved to be more than just a mere guide to us. This was only possible due to her guidance and co-operation without which this work would never have been completed.

Finally, we wish to express our deep sense of respect and gratitude to each and every staff member who has helped us in many ways and also our parents who have always borne with us in any critical situation and to all the others, sparing their time and helping us for completion of this project in whatever way they could.

## REFERENCES

1. Basic information about electromagnetic railgun <https://en.wikipedia.org/wiki/Railgun>
2. Sample record for earth to space electromagnetic railgun <https://www.science.gov/topicpages/e/earth-to-space+electromagnetic+railgun>
3. Small article <http://ui.adsabs.harvard.edu/abs/1993ITM....29..373B/abstract>





4. The insane plan to shoot rocket from rail guns <https://www.youtube.com/watch?v=YR1OeUb6ZA4>
5. Would it work? Railgun assistant launcher <https://www.youtube.com/watch?v=Rb6sxy3f7VE>
6. Article published by NASA <https://ntrs.nasa.gov/api/citations/20110005535/downloads/20110005535.pdf>
7. Review paper on Electromagnetic Railgun (EMR) <https://www.ijream.org/papers/AMET201927.pdf>
8. WIKIPEDIA
9. <https://en.wikipedia.org/wiki/Railgun#History>



**INNO SPACE**  
SJIF Scientific Journal Impact Factor  
**Impact Factor: 8.423**



**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

9940 572 462 6381 907 438 [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details