Magnetic Levitation Train

Functional Description

By:

Dusty Funk

&

Kyle Getsla

Project Advisor:

Dr. Anakwa

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Introduction

The Magnetic Levitation Train (MAGLEV) project uses the concepts of electromagnetism and electrical machinery to levitate and propel a train along a track. The previous work of Paul Friend on this topic includes the development of a laboratory scale model of an Inductrack on a rotating wheel and a train containing permanent magnets. Using his previous work as a starting point, MAGLEV will be divided into three phases. Phase I will prove that levitation is possible using Paul Friend's design. Phase II will involve redesigning the train to contain two sets of permanent magnets – one for levitation and one for propulsion. The third and final phase will consist of constructing an oval track to demonstrate the practical use of this project. The final highest level system block diagram is illustrated in Figure 1.1. Using only AC power from a standard wall socket, both the height and velocity of the train will be controlled with the MAGLEV system.

Figure 1.1 Highest Level System Block Diagram

Phase I

The goal of Phase I is to use Paul Friend's physical design of the of the magnetic levitation train to prove that levitation is possible. Figures 1.2 and 1.3 show the Inductrack and train that he constructed.

Figure 1.2 Paul Friend's Circular Inductrack

Figure 1.3 Paul Friend's Constructed Train

The track shown in Figure 1.2 will need to be rotated by a motor that can spin the track above the required speed for levitation.

Phase II

The goal of Phase II is to redesign the train to include permanent, propulsion magnets. The permanent magnets currently on the train are arranged to form a Halbach array. Two rows of the Halbach magnet arrays will be centered on the levitation coils, while two more rows will be centered on the stator coils for propulsion. The magnetic field lines created by Halbach arrays are illustrated in Figure 2.1. From this figure, the magnetic fields created above the magnets cancel, while the fields created below the magnets combine. These combined fields create the lift force for levitation.

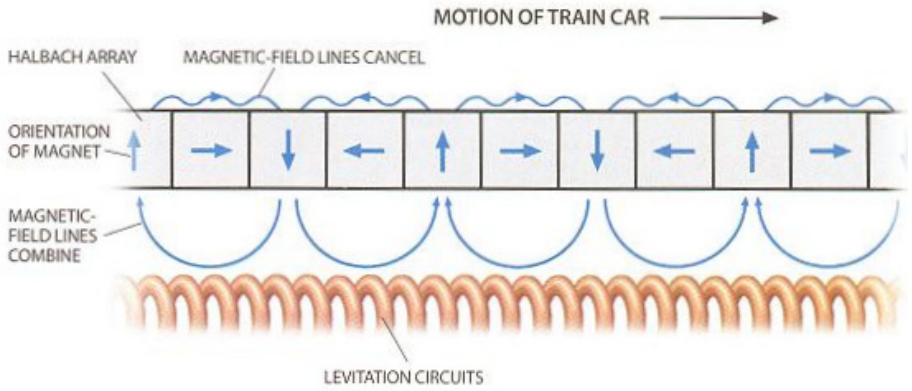

Figure 2.1 Magnetic Fields of a Halbach Array

Phase III

In phase III, an oval track will be designed to simulate an infinite track in a practical fashion. This will introduce issues in guiding a levitating train along a specific path. In this phase, the train will move along the track. This concept may require redesign of the propulsion system (designed in phase II) to accommodate the oval track. The 3⌀ power input to control levitation height and velocity will also be implemented in this phase.