Chapter 1
Introduction

ABSTRACT

Magnetic levitation systems are receiving increasing attention recently, due to their practical importance in many engineering systems. There are different applications of magnetic levitation in industry such as levitation of models in a wind tunnel, vibration isolation of sensitive machinery, levitation of molten metal in induction furnaces, levitation of metal slabs during manufacture, bio-medical instrumentation, mechatronics, etc. The suspension of objects in air with no visible means of support due to magnetic force is called magnetic levitation. The development of magnetic materials and magnet design has combined with the development of solid-state electronic devices and their ever increasing current carrying and switching capacity to produce controlled magnetic levitation systems capable of supporting heavy payloads. Magnetic levitation is produced in many different ways.

GENERAL

Magnetic levitation systems are receiving increasing attention recently, due to their practical importance in many engineering systems. There are different applications of magnetic levitation in industry such as: levitation of models in a wind tunnel, vibration isolation of sensitive machinery, levitation of molten metal in induction furnaces, levitation of metal slabs during manufacture, bio-medical instrumentation, mechatronics, etc. (Sinha,1987; Jayawant,1988; Rogg,1984; Yamamura,1976). But the most important applications are in the field of active magnetic bearing (AMB) and transportation systems.

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Recently a new transport system has been the object of research in many countries. Its main characteristics lie in the fact that it is magnetically levitated, and has guide and propulsion forces generated magnetically also (Sinha,1987; Jayawant,1988; Bittar & Sales,1998). This maglev system has some advantages when compared to the traditional railway system, like absence of contact eliminates frictional loss and aerodynamic noise, reduced component wear, vibration and maintenance cost.

The suspension of objects in air with no visible means of support due to magnetic force is called magnetic levitation. The development of magnetic materials and magnet design has combined with the development of solid state electronic devices and their ever increasing current carrying and switching capacity to produce controlled magnetic levitation systems capable of supporting heavy payloads. Magnetic levitation is produced in many different ways. The techniques currently used are based on one or more of the following principles:

(i) Levitation due to the induced eddy current when there is relative motion between a magnet and a conducting surface
(ii) Levitation due to repulsion between permanent magnets
(iii) Levitation due to force of attraction between ferromagnetic bodies using tuned RLC circuits and alternation currents
(iv) Levitation due to force of attraction between controlled DC electromagnets and ferromagnetic object

But majority of magnetic levitation systems are based on two different principles: attraction (or electromagnetic attraction) and repulsion (or electrodynamic repulsion).

The electrodynamic levitation system (EDS), actuates through repulsive forces generally uses high speed super-conducting magnets (kept in cryogenic container) mounted on the bottom of the moving vehicle and produces the repulsive force due to eddy currents produced in the aluminum guide ways (Sinha,1987; Moon,1994). The eddy current and hence the repulsive force, thus produced, causes levitation beyond a certain threshold speed. The electrodynamic levitation system is inherently stable, but at high speed it possess stability problem due to negative damping (Moon,1994). So some kind of passive damper is required in elctrodynamically levitated vehicle to maintain stability at high speed.

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