Using magnetic field analysis to evaluate the suitability of a magnetic suspension system for lightweight vehicles

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Abstract: A suspension system in a vehicle acts as an isolator that isolates vibrations between the wheel tires and the vehicle body due to road irregularities. Additionally, a suspension system serves as a vehicle stabilizer that stabilizes the vehicle body during unusual driving patterns such as cornering, braking, or accelerating. A controllable suspension system has received significant attention in the automotive world in previous years since it can perform both of the aforementioned tasks without the presence of fluid damper. The study presented in this paper focuses on using magnetic flux density analysis to evaluate a number of parameters of an electromagnetic suspension system (EMS), so that it is suitable for usage in middle-sized passenger vehicles. The proposed EMS utilizes tubular linear actuator with a NdFeB permanent magnet. A number of dimensions of the EMS have been varied to observe their respective effect on force output and magnetic flux density. The purpose of this process was to determine what size of EMS will produce the same force as a standard suspension system, which has a maximum of 2000 N and an average of 800 N, according to quarter vehicle simulation that worked in parallel with this study.

Key words: Electromagnetic suspension, neodymium iron boron, damper, linear actuator

1. Introduction

In general, a suspension system in a vehicle serves as a shock absorber. Its purpose is to absorb vibrations that result from road irregularities and prevent them from reaching the passenger. It also serves as a stabilizer to ensure that the wheel tire is in contact with the road surface at all times, thus increasing vehicle stability during cornering, braking, or accelerating, boosting passenger safety and comfort during travel. The system also prevents damage to parts of the vehicle caused by excessive road vibration.

The difference between an electromagnetic suspension system (EMS) and any other type of suspension system is that it operates using the magnetic field concept. An EMS uses the magnetic field concept to lift or levitate the vehicle body whenever it is supplied by an external power source. The concept of the EMS is based on the interaction of two charged bodies, in which they will repel or attract each other depending on their polarity and magnitude of charge. Based on this concept, the EMS damping force can be controlled by varying external power supply according to road conditions and driving pattern. An EMS can work without externally

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