CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)

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Project Number

S0809

Project Title

Magnetic Levitation: The Effects of Fluid Damping and Control Distance in a Position Feedback Magnetic Levitation System

Abstract

Objectives/Goals

The purpose of this project was to determine the effects of dampening due to fluid viscosity (using water, air, and motor oil as test fluids) and distance from an electromagnet in a position feedback magnetic levitation system.

Methods/Materials

The materials used in this science fair project were an annealed soft iron screw, bolt, DC power supply, coil of copper wire, laser pointer, photodiode, wood with which the experiment was built, a control loop (constructed from electronic devices (detailed below)), a data acquisition unit (NI USB-6009), laptop, a metal test object, sail (Constructed from a plastic sheet), a tank for the fluid, water, and motor oil.

Results

For the tests done in water, as distance increased, the mean current in the solenoid also increased. In addition, the frequency of oscillation decreased. The amount of time the object was held remained fairly constant and then dropped off abruptly. For the tests done in oil, the findings followed a pattern similar to water (in terms of increases and decreases) for held time and mean current, however , it did not oscillate, instead, it simply levitated in place with minute changes in position, or the test object fell. This means that the standard deviation was always very low and the frequency measurements were irrelevant for oil. For tests done in air, increases in distance from the solenoid resulted in increased mean current, while frequency, standard deviation, and time held decreased as distance from the solenoid increased.

Conclusions/Discussion

The hypothesis was supported by the data. The results of this experiment give a fairly accurate representation of the limits of a position feedback electromagnetic levitation system. Further research should be done on a variety of other variables in the system, as is discussed in the conclusion of this experiment.

Summary Statement

Air and water resulted in quasi-stable, chaotic in levitation displacements, while the viscous oil resulted stable levitation, for this distance feedback system, and, for all fluids, stability decreased when control distance increased.

Help Received

Consulted father about control circuit design.