An Analysis of the Feasibility of a Superconducting Maglev Launch System Based on the Meissner Effect

Lee, Chan

The purpose of this study was to analyze a superconducting maglev launch system for its feasibility to minimize the loss of launch energy and to efficiently propel a projectile using the Meissner effect. A scale model consisting of a superconducting disk, magnetic track, electromagnetic accelerator, and power supply, was constructed. Different cooling conditions of the superconductor, including zero field-cooling and field-cooling, were tested to determine the most effective method of providing stable levitation. For each test, the superconductorwas released from the top of an inclined magnetic track, and its final velocity when reached at the bottom was measured using a Venier Photogate. By measuring the conservation of energy, the energy lost and damping force of the levitating superconductor were calculated. The collected data were analyzed through a two sample t-test, (p-value = 4.06E-09, alpha = 0.05) and the research hypothesis: “If the energy losses of a zero field-cooled superconductor and a field-cooled superconductor on a magnetic track were measured and compared, then the field-cooled superconductor would have less energy loss” was supported. Efficiency of the electromagnetic accelerator was tested by measuring the thrust generated by different current inputs. Results suggested that the field-cooling method is most effective at preventing energy loss of the levitating superconductor, while the accelerator is not practical due to its inability to provide sufficient thrust. The cause of the inefficiency of the accelerator was identified as self-inductance of the coil. However, by substituting a superconducting coil, an increase in the efficiency is predicted.

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