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Influence of Solenoid Configuration on Electromagnetic Acceleration of Plunger

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Abstract : Utilizing the Lorentz force to propel an electrically conductive plunger through a solenoid represents a fundamental application in electromagnetism. The parameters of the solenoid significantly influence the force exerted on the plunger, impacting its response. A parametric study has been done to understand the effect of these parameters on the force acting on the plunger. This study is done to determine the most optimal combination of parameters to obtain the fast response. Analysis has been carried out using an algorithm capable of simulating the scenario of a plunger undergoing acceleration within a solenoid. Authors have conducted an analysis focusing on several key configuration parameters of the solenoid. These parameters include the inter-layer gap (in the case of a multi-turn solenoid), different conductor diameters, varying numbers of turns, and diverse numbers of layers. Primary objective of this paper is to discern how alterations in these parameters affect the force applied to the plunger. Through extensive numerical simulations, a dataset has been generated and utilized to construct informative plots. These plots provide visual representations of the relationships between the solenoid configuration parameters and the resulting force exerted on the plunger, which can further be used to deduce scaling laws. This research endeavors to offer valuable insights into optimizing solenoid configurations for enhanced electromagnetic acceleration, thereby contributing to advancements in electromagnetic propulsion technology.

Keywords : Lorentz force, solenoid configuration, electromagnetic acceleration, parametric analysis, simulation
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