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Investigation of Design Considerations for an Electromagnetic Induction Coilgun System

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An electromagnetic induction coilgun system accelerates a projectile in the axial direction which is a non-periodic moving. In addition, since the electromagnetic coilgun system converts the electrical energy to mechanical energy, the interactions between variables are very complex. Therefore, during a design process of the coilgun system, the design considerations are much more complicated and difficult to analyze compared to others electro-mechanic systems. Some of the design considerations have been published in previous researches, but some others are still deficient in study. A thorough study of the design considerations is necessary to design the coilgun system. This paper investigates the design considerations of an electromagnetic induction coilgun system and suggests reasonable parameters of the system to achieve high energy efficiency. Some common design considerations such as capacitance, voltage level, length of the barrel, switching time, initial position and output velocity of the armature will be evaluated and then their influences on operation and energy efficiency will be assessed from the evaluated data. Some others which still are lacking in researches such as wire size, resistance, air gap, and distance between stator coils will be investigated and explained. A mathematical model of the coilgun is used to study the impact of the design considerations. Finally, the recent achievements, challenges, and trend of the coilgun system will be addressed briefly. We believe that the summary and study on the design considerations are useful and essential to design the coilgun system and largely contribute to its development.

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