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Design and structural analysis of induction type coilgun system

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A multi-stage induction type coilgun system is one of the most important research items. Especially, the capacitor driven induction coilgun, which is almost free from physical contact between the barrels and projectile, has a longer gun lifetime compared to other electromagnetic launchers. Accurate analysis of multi-stage induction coilgun is usually necessary to establish full-size finite element model. Full-size finite element model is accurate and comprehensive, but the model is complex, poor general, computing time increases with the coil from the geometric progression in multiples of increase cannot solve the problem quickly. It is necessary to find a way to ensure both accuracy as well as rapid calculation. In this paper we present design and structural analysis of multi-stage induction type coil-gun system with pulse power module using FEM programs. The fundamental specifications of the induction type coil-gun system were investigated via mathematical analysis model using MATLAB considering pulse power module. The voltage, current, force, velocity, acceleration, efficiency of the multi-stage coil-gun system was analyzed using electromagnetic analysis. Based on the electromagnetic analysis results of the coil-gun system, the structure of the coil-gun system, including the stator (Driving) coil, armature coil, and supporter parts, was defined. The electromagnetic analysis results were compared with mathematical analysis results to confirm the reliability of the FEM simulation model. As the results, voltage, current, force, velocity, and acceleration of the multi-stage coil-gun system were very similar to mathematical analysis results, and the designed coil-gun system has higher efficiency. The stress of the coil structure was less than the allowable stress of the materials, and the increasing temperature was within the permissible range. We therefore recognize that the designed the induction type coil-gun has high efficiency and safe from the force and temperature of the coils.

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