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RESEARCH ON THE ARMATURE VELOCITY CONTROL BASED ON COMPLICATED DYNAMIC MODEL

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The energy of the electromagnetic railgun comes from the pulse power which has ability to adjust parameters, furthermore, it can adjust the armature velocity in bore.
The electromagnetic force of the traditional railgun is easy to be obtained by relying on the relationship between the inductance gradient and the current, however, the electromagnetic force of the augmented railgun is not able to be accurately described in this way. Based on the consideration of the skin effect and proximity effect, through calculating the electromagnetic force from the inner and the outer rail respectively, mathematic model of the accurate electromagnetic force is obtained. In the meantime, by analyzing the armature velocity curve, the motion process can be divided into static model and dynamic model. Extreme physical processes such as ablation, plasma and planning, are analyzed as dynamic models. After that, the complicated dynamic model of the armature motion is established.
Based on the actual test and simulation test, we divide the armature motion into two stages: low velocity and high velocity. During the low velocity stage, a number of kinds of electric and thermal effects lead to the complicated dynamic model of armature. During the high velocity stage, the sliding friction has little change and the armature acceleration decreases. The discharge time of the last PFN is given by the velocity feedback and the intelligent algorithm.
In conclusion, the rise time of current is similar to that of static friction force, and the complicated dynamic model of armature leads to the difficult velocity control in the low velocity stage. Meanwhile, the dynamic model of the augmented electromagnetic railgun is established, and the relationship between the discharge sequence and the muzzle velocity is obtained. The intelligent algorithm can be carried out in the high velocity stage.

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