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Triggering Strategy of Railgun Power Supply for the Accurate Control of the Armature Muzzle Velocity

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As a new kind of kinetic-energy weapon system, electromagnetic railgun possesses one major advantage of high muzzle velocity which can be controlled artificially and accurately. Since the muzzle velocity error has a great influence on the hit rate, accurate velocity control is of importance. However, existing literatures focus more on the maximization (or promotion) of the muzzle velocity, rather than the accurate control. In other words, studies on muzzle velocity control are still inadequate.

The paper proposes a solution to this problem, namely a triggering strategy of the PFUs (Pulsed Forming Unit) of the pulsed power supplies. In this strategy, the armature acceleration process is equivalent to the uniform acceleration motion. And several velocity detecting devices are equidistantly placed along the barrel. The triggering time of each PFU group is the moment when the armature passes by each velocity detecting device. The unit number of each PFU group is selected, based on the principle of minimizing the error between the actual velocity and the ideal velocity (uniform acceleration) at the next velocity detecting device. In this way, the actual armature velocity waveform can coincide quite well with that of the ideal uniform acceleration process, thus the armature muzzle velocity can be controlled quite accurately. Simulations show that, with 0.15-kg armature mass and 6-m barrel length, if the target velocity is between 1.5 km/s to 2 km/s, the control precision of the muzzle velocity is within 0.5%.

Moreover, optimization on the positions of the velocity detecting devices is conducted, in order to further decrease the muzzle velocity error. Simulations show that, with the optimal device positions, the control precision can be improved, within 0.05%.

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