Research on Discharge Timing Control of Multi-Parameter Pulse Forming Network

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A timing trigger control system with a PID controller was designed to solve the complicated timing control process caused by the mixed-use of multi-generation pulse power sources in the system.

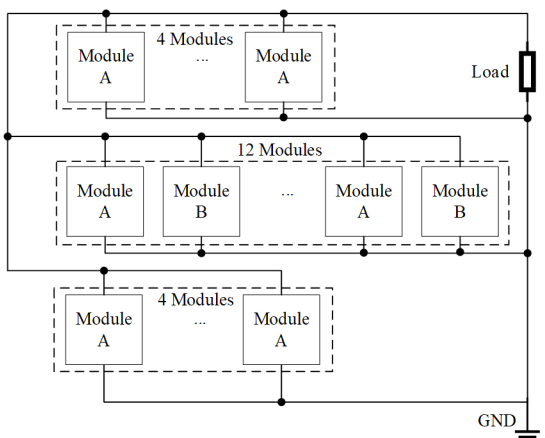


Figure 1. Schematic diagram of the pulse forming network

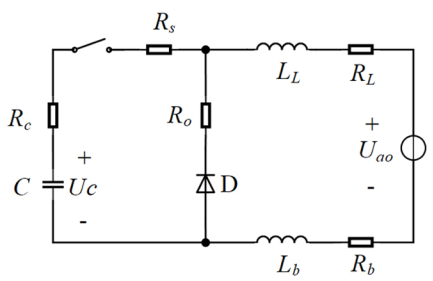


Figure 2. Circuit model of pulse power supply
R_L and L_L are the resistance and inductance of the wave modulation inductance, R_c, U_c, and C are the storage capacitor resistance, voltage, and capacitance, R_b and L_b are the resistance and inductance of the cable, R_s is the resistance of the SCR, R_o is the resistance value of the freewheeling diode and U_{ao} is the voltage value across the rail.

Figure 1 is a schematic diagram of the PFN of the multi-parameter power modules used in this experiment. The capacity of the type A module is higher than the type B module. Group A contains only type A modules, which work in a synchronized trigger state. Group B is made up of type A and type B modules arranged alternately, and the group of modules works in the sequential triggering state. Group C is the remaining pulse power source modules. Modules connect to the load in parallel.

Figure 2 shows the circuit model of a single pulse power source module.

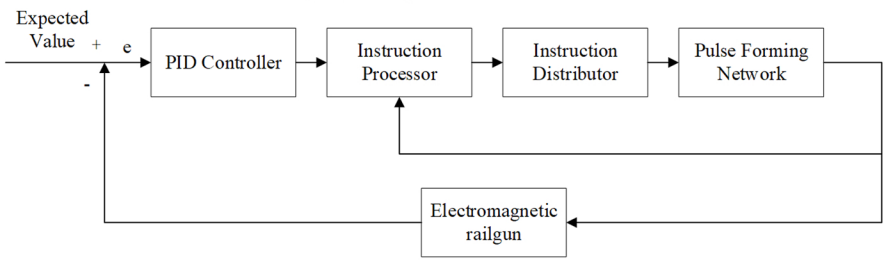
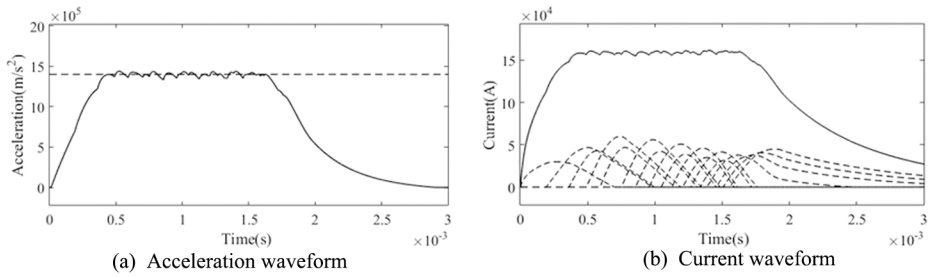


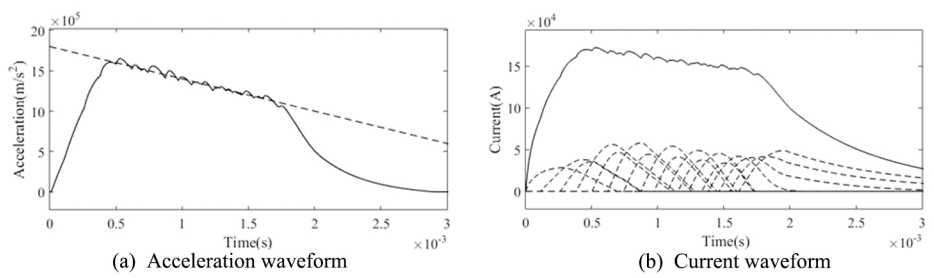
Figure 3. Schematic diagram of the PID control system of an electromagnetic rail gun

Figure 3 is a closed-loop control system of an electromagnetic rail gun based on the PID controller. The instruction processor is responsible for determining the type of pulse power source according to the system states and the output of the PID controller. The instruction processor is based on a fuzzy logic controller. The instruction distributor is used to find the next pulse power source and handle various exceptional situations.



(a) Acceleration waveform (b) Current waveform

Figure 4. Acceleration and current waveform at constant acceleration



(a) Acceleration waveform (b) Current waveform

Figure 5. Acceleration and current waveform at constant acceleration

It can be seen from figure 7-8 that the control system proposed in this paper can accurately control the trigger sequence of the power module to make the armature acceleration track the set value.