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A 50 T high-stability flat-top pulsed magnetic field energized by a 100 MW pulsed generator-rectifier power supply with parameters self-adjusting model predictive control

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High-stability flat-top pulsed magnetic field, which combines the advantages of pulsed high magnetic field and steady high magnetic field, is an important tool of scientific experiments in the fields of physics, biology, and chemistry. The pulsed generator-rectifier power supply, with controllable output voltage, is commonly used to power multi-coil magnet to generate synthetic flat-top magnetic field with high parameters. However, the coupling characteristics of coil current and the disturbance factors in the power supply side (such as the voltage amplitude fluctuation and the phase fluctuation) bring challenges to generate a high-stability flat-top pulsed magnetic field. Based on the 100 MW generator-rectifier power supply and the 50 T dual-coil magnet in WHMFC, this paper firstly propose a coupling transformer to decouple the dual-coil magnet. The mutual inductance of coupling transformer and dual-coil magnet are the same in value and opposite in direction, so the adverse effects, caused by the coupling characteristics between the coil current, can be eliminated. Then we propose a control method of high-stability flat-top pulsed magnetic field based on the parameters self-adjusting model predictive control. A prediction model of rectifier trigger angle is established by using characteristic equations of the rectifier and coupling equations between resistance of the magnet and output voltage of the rectifier. Considering the errors caused by equivalent model, PI close-loop control is used to automatically adjust the parameters of the model predictive control method. A simulation model is built by MATLAB/Simulink to simulate the discharge process, and a 50 T/470 ppm flat-top pulsed magnetic field is generated. The final experiment is expected to be completed in the spring of 2018. Acknowledgements: The National key research and development program of China (2016YFA0401702) and the Program for New Century Excellent Talents in University.

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