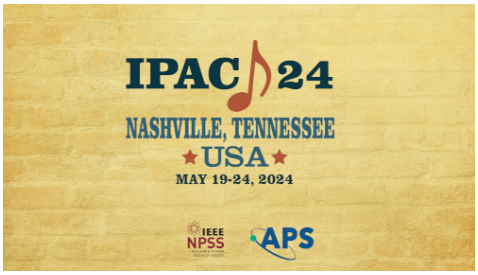

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Enhanced harmonic stability in magnet resonant power supplies via multi-harmonic closed-loop control and current feedforward

Thursday 23 May 2024 16:00 (2 hours)

As the China Spallation Neutron Source (CSNS) Phase II project upgrades beam power to 500 kW, maintaining horizontal beam orbit stability necessitates more precise output current from the main magnet power supplies. The existing control strategy, suited for 100 kW extraction power, falls short of the higher precision requirements for the output current, characterized by a quasi-sinusoidal waveform with 25 Hz and its higher-order harmonics. Moreover, this strategy is highly sensitive to environmental temperature, causing significant fluctuations in the amplitude and phase of the high-order harmonics, thereby adversely affecting the power supplies' performance.

This paper proposes a new control scheme that merges high-order harmonic current compensation with double PI closed-loop control, enabling up to sixth harmonic control in the main magnet power supplies. Leveraging the existing Digital Power Supply Control Module (DPSCM) controller in the power supply system, this approach achieves precise and efficient control of the 50 Hz harmonic current output which was previously the source of the largest ripple error.

The study confirms that the new control scheme effectively mitigates temperature drift issues and reduces the output ripple of the entire 50 Hz reference current waveform. As a result, the performance of the main magnet resonant power supplies in Rapid Cycle Synchrotron is significantly enhanced, leading to a marked reduction in the variation of beam orbit deviation.

Footnotes

Funding Agency

Paper preparation format

Region represented

Asia

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