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Implementation and evaluation of bunch-by-bunch feedback systems at PLS-II for coupled-bunch instability mitigation

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In synchrotron light sources, coupled-bunch instabilities driven by resonant wakefields in the vacuum chamber pose significant challenges to beam stability and quality. This study presents the implementation and evaluation of a bunch-by-bunch feedback system at the Pohang Light Source-II (PLS-II). Utilizing state-of-the-art feedback technologies, including Dimtel iGp12 baseband processors and advanced BPM hybrid networks, the system was configured to address both transverse and longitudinal instabilities. Key demonstrations include real-time grow/damp measurements, fast tune tracking, and bunch cleaning to suppress unstable modes effectively. Comparative analysis with the SPring-8 feedback system highlights performance improvements and system tuning strategies tailored to PLS-II's operational parameters. Results from horizontal and vertical plane modal amplitudes demonstrate robust damping capabilities, maintaining beam stability even at high currents and narrow insertion device gaps. These advancements contribute to enhanced operational efficiency and higher quality photon output at PLS-II.

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