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Feedback stabilisation of longitudinal quadrupole coupled-bunch oscillations in the CERN PS

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Longitudinal coupled-bunch oscillations are observed with LHC-type beams in the CERN Proton Synchrotron (PS). They cause degradation of the longitudinal beam quality and beam loss. A dedicated feedback system with a wide-band Finemet cavity as a longitudinal kicker suppresses all dipolar oscillations. The existing feedback has been upgraded and extended to also damp quadrupolar modes. The additional signal processing operates in parallel to the dipole-mode feedback and involves a hybrid time- and frequency-domain scheme. A bunch-by-bunch peak detection filter is applied to the longitudinal beam signal before its down-conversion to baseband to reject dipole-mode oscillations, and the output signal is modulated such that zero kick is applied to the centre of each bunch. This technique allows the system to retain the advantages of a frequency-domain approach without incurring long delays associated with narrowband filters. Having developed and verified the new scheme in longitudinal beam dynamics simulations, experimental damping of quadrupole coupled-bunch oscillations has been successfully demonstrated with beam in the PS.

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