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RF Feedbacks

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Feedback systems are commonly applied to stabilise charged particle beams in accelerators. In the longitudinal plane radio-frequency (RF) feedback reduces the beam induced voltage in an RF system, or it allows to damp bunch oscillations. While local feedback decreases the cavity impedance at the origin, global feedback cures the consequence when the source driving the instability is not identified or cannot be removed. The general stability criterion for bandwidth-limited RF feedback is derived and defines the maximum gain due to loop delay. Profiting from the periodicity of bunches passing through an RF system in a circular accelerator, this electrical stability limit can be overcome with 1-turn delay or narrow-band multi-harmonic feedback. For a multi-bunch beam in a synchrotron, global feedback systems can either stabilise the beam bunch-by-bunch in the time domain, or mode-by-mode in the frequency domain. Examples for RF feedback implementations are compared, and criteria to choose the appropriate architecture for a given application are established.

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