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Improvement of the Slow Longitudinal Feedback System at the European XFEL

For the operation of free-electron lasers (FEL), the electron bunches provided from the gun are accelerated to almost the speed of light in various accelerator modules and compressed in bunch compressors to enable the shortest possible pulse with high current intensity for the subsequent SASE process.
The Slow Longitudinal Feedback System consists of multiple different control loops to compensate for drifts in the bunch length and in timing jitter, e.g., of the high-frequency supply of the accelerator modules. Up to now, a response matrix with the values of all actuators and monitors has been inverted by singular value decomposition (SVD) in order to form an inverse response matrix that is intended to keep the system stable. Currently, only the values of the main diagonals are used for control.
The aim of this work is to investigate the influence of individual components outside the main diagonal on the control, i.e. considering the individual control loops as a coupled system. Furthermore, the response matrix is to be obtained from a physical model, by means of machine learning approaches or system identification on the accelerator itself.

Group

M-MSK

Project Category

B3. Research on Accelerators

Special Qualifications

Programming Skills (Matlab or Python)

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