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Neural networks for closed orbit distortion induced by ID gap variation in PETRA III

In recent years, the use of machine learning methods has proved to be capable of considerably speeding up both fundamental and applied research. Accelerator physics applications have also profited from the power of these tools. This implies a wide spectrum of applications from beam measurements to machine performance optimisation.

In this contribution a neural network is used to optimise the orbit control of a simulated PETRA III beam, considering the varying gap sizes of an insertion device. In the ideal case, a perfectly tuned undulator with an antisymmetric magnet structure always has a first field integral equal to zero. But due to inhomogeneities in the magnet material and their nonlinear behaviour, as well as concentration of ambient magnetic fields by undulator poles, field integral changes during gap movements can never be avoided for real-life devices. The traditional approach to compensate these effect is based on lengthy calibration measurements, periodically repeated to create look-up tables used to power up the corrector coils. Here is showed how the application of a model independent neural network allows for closed orbit distortion corrections.

Primary author: VEGLIA, Bianca (MPY (Beschleunigerphysik))

Presenter: VEGLIA, Bianca (MPY (Beschleunigerphysik))

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