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Identification of magnetic field errors in synchrotrons based on deep lie map networks

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Magnetic field errors pose a limitation in the performance of circular accelerators, as they excite non-systematic resonances, reduce dynamic aperture and may result in beam loss. Their effect can be compensated assuming knowledge of their location and strength. Procedures based on orbit response matrices or resonance driving terms build a field error model sequentially for different accelerator sections, whereas a method detecting field errors in parallel yields the potential to save valuable beamtime. We introduce deep Lie map networks, which enable construction of an accelerator model including multipole components for the magnetic field errors by linking charged particle dynamics with machine learning methodology in a data-driven approach. Based on simulated beam-position- monitor readings for the example case of SIS18 at GSI, we demonstrate inference of location and strengths of quadrupole and sextupole errors for all accelerator sections in parallel. The obtained refined accelerator model may support set up of corrector magnets in operations to allow precise control over tunes, chromaticities and resonance compensation.

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Footnotes

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Yes

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