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Comparison of multi-objective Bayesian optimization and the reduction of resonance driving terms in the optimization of the dynamic aperture of the BESSY III MBA lattice

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HZB is currently designing the lattice for BESSY III, the successor of the 1.7 GeV electron storage ring running in Berlin since 1998. HZB follows a deterministic lattice design strategy, where the natural substructures of a non-hybrid MBA lattice are optimized separately. The substructures consist of only a few parameters, that can be derived from the strategic goals of the project. In the next step, the focusing and de-focusing sextupole families are split up, to optimize the longitudinal and the transverse apertures. The paper compares two approaches to select the optimal sextupole strengths. The first one is multi-objective Bayesian optimization, where the dynamic aperture volume from tracking simulations is used as an objective to be maximized. The second approach does not involve tracking and minimizes the geometric and chromatic resonance driving terms. The comparison of the two results includes their quality in terms of the size of the achievable 3D dynamic aperture and the computational effort involved.

Footnotes

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