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Momentum aperture optimization of a nonlinear lattice for transverse resonance island buckets

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In a circular accelerator, the nonlinear behavior near a horizontal resonance line ($n\nu_x$) usually involves the appearance of stable fixed points (SFPs) in the horizontal phase space, also referred to as transverse resonance island ''buckets" (TRIBs). Specific conditions are required for TRIBs formation. At the Cornell Electron Storage Ring, a new method is developed to improve the dynamic aperture (DA) and momentum aperture (MA) in a 6-GeV lattice as well as to preserve the conditions for TRIBs formation. This method reduces the dimension of variables from 76 sextupoles to 8 group variables and then utilizes different algorithms in the direct DA optimization. The robust conjugate direction search method, commonly used for online optimization, proved effective for offline optimization of the DA/MA of our TRIBs lattice. The experimental results demonstrate that the optimized sextupole distribution yields an improved DA/MA.

Footnotes

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Author: WANG, Suntao (Cornell University (CLASSE))

Co-author: KHACHATRYAN, Vardan (Cornell University (CLASSE))

Presenter: WANG, Suntao (Cornell University (CLASSE))

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