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High efficiency multi-objective Bayesian algorithm for APS-U nonlinear dynamics tuning

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The Advanced Photon Source (APS) facility has just completed an upgrade to become one of the world's brightest storage-ring light sources. Machine learning (ML) methods have seen extensive use during commissioning. One important application was multi-objective tuning of dynamic aperture and lifetime, a complex high-dimensionality task intractable with classic optimization methods. In this work we will discuss novel Bayesian optimization (BO) algorithmic and implementation improvements that enabled this use case. Namely, pre-training and uncertainty-aware simulation priors, dynamic parameter space and acquisition function refinement, and an adaptive wall-time convergence criteria. We will also show results of optimization runs from 10 to 24 dimensions, benchmarking scaling and efficiency as compared to standard MOGA and MGGPO. Given the promising performance, work is proceeding on tighter BO integration into the control room.

Footnotes

Paper preparation format

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