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Development of a beam commissioning tool based on Bayesian optimization in CSNS

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This study explores the use of Bayesian optimization in reducing CSNS RCS beam loss. Bayesian optimization is a global optimization framework ideal for complex, black-box functions. By building a probabilistic model of the objective function, often a Gaussian process, it selects new sampling points based on predicted uncertainty, efficiently finding the optimum with limited resources. It has proven more effective than grid and random searches in hyperparameter tuning and has been successfully applied in fields like laser processing and materials design. In RCS beam loss optimization, its versatility allows for the selection of various key beam physics quantities to construct suitable target functions, effectively cutting beam loss and boosting accelerator efficiency. Experimental results show it can swiftly converge to optimal solutions with minimal computational resources, highlighting its adaptability and scalability. This research offers new insights into accelerator beam optimization and underscores the broad application potential of Bayesian optimization in complex system optimization.

Footnotes

Funding Agency

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Yes

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