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Two-stage constrained Bayesian optimization for particle accelerator tuning

Monday 11 August 2025 16:00 (2 hours)

Particle accelerators are highly complex, non-linear systems that require rapid tuning during operation to meet requirements on beam qualities for applications in different scientific disciplines. Multi-objective Bayesian Optimization (MOBO) has been recently demonstrated at SLAC MeV-UED facility for speeding up online electron beam tunings and obtaining Pareto Fronts giving trade-offs between key beam properties of interest. One challenge in algorithm- based tuning is the alignments of beam through the collimators, screens and timing diagnostics under different system working points. This usually requires trial-and-error based hand tunings and strongly limits the data taking efficiency. Here, we utilize two-stage constrained Bayesian optimizations (CBE-MOBO) for beam tunings at MeV-UED. Instead of directly optimizing objectives of interest, beam property constraints are first modeled in the tuning-measurement joint domain using constrained Bayesian exploration. Based on the information learned, MOBO is then used to efficiently search the parameter space and resulted in dramatically improved valid data efficiency. Our results show potential of CBE-MOBO for autonomous tunings of particle accelerators.

Please consider my poster for contributed oral presentation

No

Would you like to submit this poster in student poster session on Sunday (August 10th)

No

Footnotes

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Yes

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