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Bayesian optimization of laser-plasma accelerators assisted by reduced physical models

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High-fidelity particle-in-cell simulations are an essential tool for the modeling and optimization of laser-plasma accelerators. However, the high computational cost associated with them severely limits the possibility of broad parameter exploration. Here, we show that a multitask Bayesian optimization algorithm can be used to mitigate the need for high-fidelity simulations by incorporating information from inexpensive evaluations with reduced physical models. In a proof-of-principle study combining the FBPIC (high fidelity) and Wake-T (reduced model) codes, this algorithm demonstrates an order-of-magnitude speedup when the optimization is assisted by the reduced-model simulations. This opens the way for cost-effective optimization of laser-plasma accelerators in large parameter spaces.

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