Multiobjective Optimization Methods for the LCLS-II Photoinjector

Scientific Achievement

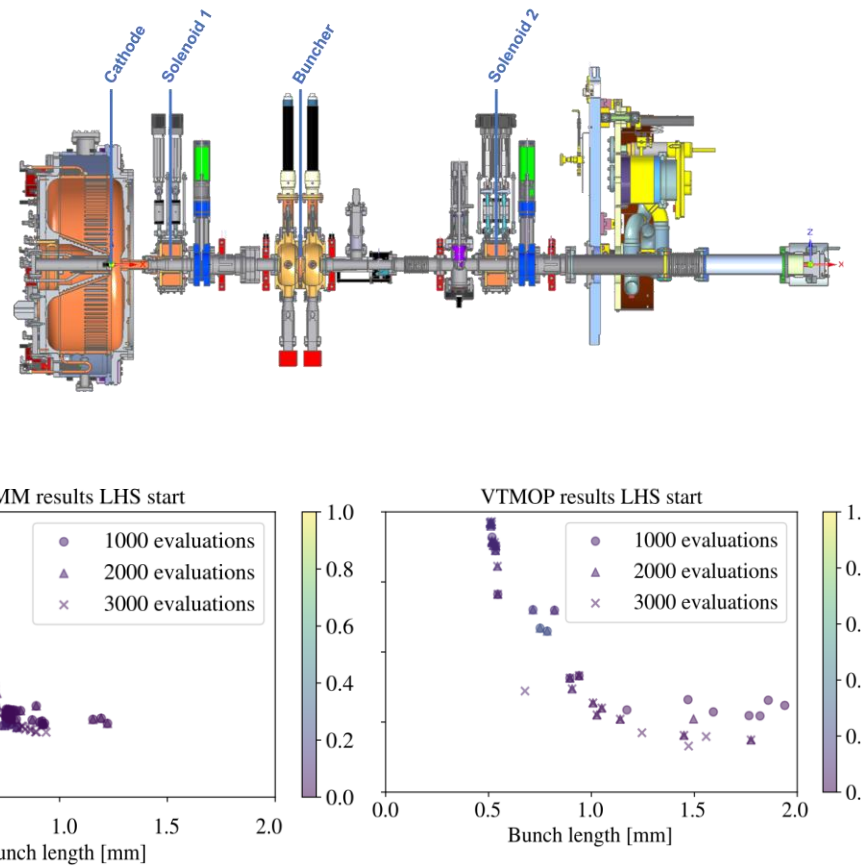
Implement and compare three optimization algorithms for tuning the upgraded Linac Coherent Light Source (LCLS-II) at SLAC. Our modeling techniques improve performance by an order of magnitude across all algorithms, allowing for optimization to be carried out in a dramatically shorter time.

Significance and Impact

- Tuning particle accelerators is a complex process requiring considerable HPC simulation resources
- Our improvements to problem formulations and solution methodologies greatly reduce computing costs over previous studies

Technical Approach

- We propose a novel multiobjective penalty function to handle simulation failures that greatly accelerates convergence
- We show that Latin hypercube sampling reduces computing needs
- We show optimization algorithms performance on restrictive compute budgets



(Top) LCLS-II diagram to be optimized including laser parameters, gun phase, and solenoid strength for the rf gun. (Bottom) Results of the optimization study for two optimization algorithms developed at Argonne.

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