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Performance optimization design of photocathode injector based on multi-objective genetic algorithm

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Generating beam with nC-level charge is of great significance for particle colliders. In order to achieve lower emittance and length of bunch, based on the photocathode injector, we designed a L-band gun and L-band accelerating tube. However, with many coupled parameters, it is difficult to optimize its performance to the limit when optimizing them separately. Therefore, we employed a multi-objective genetic algorithm for searching in the multi-dimensional parameter space and utilized a deep Gaussian process as a surrogate model to solve the high-dimensional parameter optimization problem. Through optimization, we successfully obtained the normalized transverse emittance of $3.4 \pi \text{ mm} \cdot \text{mrad}$ and the bunch length of 1.0 mm for a fixed charge of 5 nC. This indicates that our method can effectively improve the performance of the photocathode injector.

Footnotes

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