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Efficient Accelerator Operation with Artificial Intelligence Based Optimization Methods

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Tuning injectors is a challenging task for the operation of accelerator facilities and synchrotron light sources, particularly during the commissioning phase. Efficient tuning of the transfer line is essential for ensuring optimal beam transport and injection efficiency. This process is further complicated by challenges such as beam misalignment in quadrupole magnets, which can degrade beam quality and disrupt operations. Traditional
tuning methods are often time-consuming and insufficient for addressing the complexities of highdimensional parameter spaces.
In this work, we explore the use of advanced AI methods, including Bayesian optimization, to automate and improve the tuning process. Initial results, demonstrated on the transfer line of KARA (Karlsruhe Research Accelerator) at KIT (Karlsruhe Institute of Technology), show promising improvements in beam alignment and transport efficiency, representing first steps toward more efficient and reliable accelerator operation.
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Summary

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