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Injection Optimization via Reinforcement Learning: From Simulation to Real-World Application

Tuesday, 21 May 2024 16:00 (2 hours)

This research presents a framework for the application of Reinforcement Learning (RL) to optimize the injection process at particle accelerator facilities. By utilizing a tailored and enhanced RL agent, we demonstrate its capability to dynamically optimize the beam's cross-section to meet predefined targets effectively at the Cooler Synchrotron COSY facility in Jülich, Germany. The agent, trained exclusively in a simulated environment, successfully applied its learned strategies during live operations, achieving optimization accuracy comparable to that of a human operator but in a notable less time. An empirical analysis of the architecture components—dense layers, observation noise, history, and domain randomization—demonstrates their individual and collective importance in preparing the agent for real-world applications. The findings highlight the potential of RL to enhance the efficiency of operations in particle accelerators.

Footnotes

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