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Reinforcement Learning in Particle Accelerators

Thursday 5 June 2025 11:00 (30 minutes)

Reinforcement learning (RL) is a unique learning paradigm inspired by basic principles of animal and human behavior, where the learning happens from the interaction with the environment. This interaction involves exploring and assessing the effectiveness of various strategies under different conditions. RL is particularly well-suited for addressing control problems in large environments, managing delayed consequences, and, through advanced techniques, learning from experiences without needing a model of the problem's dynamics. Such capabilities render RL methods highly promising for applications within particle accelerators, where the dynamic conditions of both the particle beam and accelerator systems necessitate continuous adaptation. Although the particle accelerator community has only recently begun to explore the potential of RL, yielding promising outcomes, the widespread application of these methods remains constrained. Challenges include formulating the control problem in a meaningful manner and deploying solutions in real-world systems. This presentation should provide an overview of RL applications in the context of particle accelerators, highlighting the current challenges the community faces and exploring promising directions for future research.

Footnotes

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