MATTER AND TECHNOLOGIES

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Learning-based Optimisation of Particle Accelerators Under Partial Observability Without Real-World Training

Reinforcement learning (RL) has enabled the development of intelligent controllers for complex tasks that previously required human intuition to solve. In the context of particle accelerators, there exist many such tasks and solving them with conventional methods takes away from scarce experiment time and limits the operability of accelerators. We demonstrate how to successfully apply RL to the optimisation of part of a linear particle accelerator under highly limited partial observability and without requiring expensive beam time for training on the real machine. Our method outperforms conventional optimisation algorithms in both the achieved result and time taken, and achieves close to human-level performance. In the future, RL-based controllers like ours will enable more challenging beam configurations and significantly reduce the time required to attain them, thereby increasing both quality and quantity of experimental output of accelerator facilities and consequently enable scientific advances in the research fields served by these machines.

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