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Reinforcement control for LEBT and RFQ of linear accelerators

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As a scientific system with many subsystems, particle accelerator system is getting more complex, due to rising demands on accelerator performance. Meanwhile, it is increasingly difficult to study such complex systems using traditional research methods based on physical models. At present, machine learning (ML) is mature enough to be applied in accelerator science such as beam diagnostics and equipment control. Compared with traditional research methods, machine learning has strong generality and high computational efficiency. However, problems such as incomplete database or insufficient test time often hinder the application of ML in accelerator operation control and optimization.
To further explore the application of ML in accelerator science, in this paper, we demonstrate the feasibility of reinforcement learning in accelerator control using: 1) replacement model of linear accelerator components based on neural network; and 2) reinforcement control and fast matching of the LEBT and RFQ of the linear accelerator, which is based on reinforcement learning. These methods will be experimentally verified on a linear accelerator.

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