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Demonstration of Beam Emittance Optimization using Reinforcement Learning

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In Particle accelerators, commissioning of a complex beam line requires extensive use of computer models. When the as-built beam line cannot be exactly modeled by the simulation (due for example to mechanical errors or to the extensive usage of the non-linear focusing forces), the solution found in the simulations needs to be adjusted. Thus, it is often required to modify the settings by exploring different parameters ranges on the real accelerator. Given the high parameter space, this is a demanding task both in term of beam time and in term of required expertise. Furthermore, there is no guarantee to reach the optimal solution. This paper proposes a Reinforcement Learning approach to develop a model able to efficiently explore the parameter space of a beam line and iteratively move towards the optimal solution. The approach is first applied for the ADIGE Medium Resolution Mass Separator (MRMS) at INFN Legnaro National Laboratories (LNL), where the potentials of an electrostatic multipole must be correctly tuned to minimize the output beam emittance after the separation stage.

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Footnotes

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Yes

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