

Real-Time Ion Beam Orbit Correction in the RAON LEBT Section Using Surrogate Modeling and Reinforcement Learning

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Precision orbit correction is critical for maintaining beam stability and transmission efficiency in low-energy beam transport (LEBT) systems, particularly under the influence of nonlinear field effects and strong space-charge forces. Traditional correction techniques often struggle to cope with such complexities, especially when real-time responsiveness is required.

In this work, we present a machine learning-based framework that combines surrogate modeling with reinforcement learning to enable accurate and adaptive orbit correction in RAON's LEBT section. The approach demonstrates strong potential for improving correction performance beyond conventional methods, while offering generalizability to varying beam conditions. Moreover, this study highlights how AI-driven control techniques can be integrated into modern accelerator operations, paving the way toward intelligent and autonomous beam tuning systems.

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