Contribution ID: **561** Contribution code: **SUP072** Type: **Poster Presentation**

Surrogate Model for Third-integer Resonance Extraction at the Fermilab Delivery Ring

Sunday 10 August 2025 15:00 (3 hours)

We present an ongoing work in which a surrogate model is being developed to reproduce the response dynamics of the third-integer resonant extraction process in the Delivery Ring (DR) at Fermilab. This is in pursuit of smoothly extracting circulating beam to the Mu2e Experiment's production target, whereby the goal is to extract a uniform slice of the circulating 1e12 protons in the DR over 25,000 turns (43 ms). The DR contains 3 harmonic sextupoles that excite a third-integer resonance and three fast, tune-ramping quadrupole magnets that drive the horizontal tune towards the 29/3 resonance. In our initial work, the surrogate model trains on a semi-analytical simulation provided in the same format as live data. Using Reinforcement Learning (and other potential ML methods), the trained surrogate acts as the "environment"in which a simple ML control agent could learn to dynamically adjust the quadrupole ramp at 430 break points within the 43 microsecond spill window. The controller will be hosted on a dedicated Arria 10 FPGA. In this work, we report the accuracy and fidelity of the surrogate model in comparison to the response dynamics of the physics simulator.

Please consider my poster for contributed oral presentation

Yes

Would you like to submit this poster in student poster session on Sunday (August 10th)

Yes

Footnotes

Funding Agency

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I have read and accept the Privacy Policy Statement

Yes

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