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(U*) AI-driven beamline tuning at the TRIUMF Off-Line Ion Sources (OLIS) facility

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The Off-Line Ion Sources (OLIS) facility is part of TRIUMF's world-class Isotope Separator and Accelerator (ISAC) complex, specializing in nuclear and particle physics research. Delivery of stable beams from OLIS and rare isotope beams from ISAC and eventually ARIEL (the Advanced Rare Isotope Laboratory) to various experiments with desired intensity and quality requires a complex tune of many independent parameters, over a lengthy, manual procedure.

Here we present first results of tuning the OLIS beamline using Bayesian optimization, a state-of-the-art machine learning algorithm to maximize black-box functions. It takes advantage of probabilistic modeling using Gaussian processes with an iterative method (an acquisition function) of selecting sample points to search for the best solution. We have shown that the working model performs as well as human operators in minimizing beam loss over a section of beamline.

Our AI-driven method has far-reaching implications for automated tuning of the entire ISAC-I/II and ARIEL beamline complexes for rare and stable isotope beam transport.

Keyword-1

machine learning

Keyword-2

Bayesian optimization

Keyword-3

accelerator tuning

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