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A surrogate model to optimize injection efficiency in PSI muEDM Experiment

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A dedicated experimental search for a muon electric dipole moment (EDM) is being set up in PSI. This experiment will search for a muon EDM signal with a final precision of \SI{6e-23}{e \cdot cm} using the frozen-spin technique. This will be the most stringent test of the muon EDM to date, improving the current experimental limit by 3 orders of magnitude. A crucial component of the experiment is the off-axis injection of the muons into a 3T solenoid, where it will be stored with the aid of a weakly focusing magnetic field. To achieve the precision objective, it is important to maximize the muon injection efficiency. However, the injection efficiency is a function of multiple design parameters which makes simple Monte Carlo simulation techniques computationally demanding. Thus, we employ a Surrogate Model based on Polynomial Chaos Expansion (PCE) to optimize the injection efficiency as a function of the experimental design parameters and asses the model performance by utilizing regression based techniques. In this talk, we report findings from our simulation studies using PCE-based surrogate model and discuss the merits of this technique over alternative AI-based optimization methods.

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