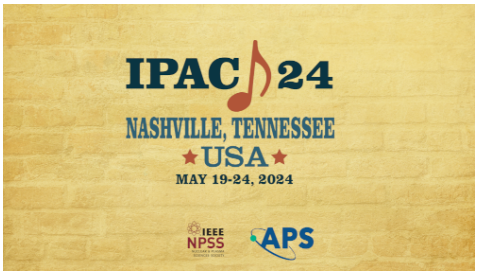

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Data-driven model predictive control for automated optimization of injection into the SIS18 synchrotron

Tuesday, 21 May 2024 16:00 (2 hours)

In accelerator labs like GSI/FAIR, automating complex systems is key for maximizing physics experiment time. This study explores the application of a data-driven model predictive control (MPC) to refine the multi-turn injection (MTI) process into the SIS18 synchrotron, departing from conventional numerical optimization methods. MPC is distinguished by its reduced number of optimization steps and superior ability to control performance criteria, effectively addressing issues like delayed outcomes and safety concerns, including septum protection.
The study focuses on a highly sample-efficient MPC approach based on Gaussian processes, which lies at the intersection of model-based reinforcement learning and control theory. This approach merges the strengths of both fields, offering a unified and optimized solution and yielding a safe and fast state-based optimization approach beyond classical reinforcement learning and Bayesian optimization.
Our study lays the groundwork for enabling safe online training for the SS18 MTI issue, showing great potential for applying data-driven control in similar scenarios.

Footnotes

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