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Response Matrix Identification and Slow Feedback Controller Design for XFEL Using SINDy, LQR, and Kalman Filtering

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This work presents a structured approach to response matrix identification and slow feedback controller design for European XFEL . The response matrix is identified using the Sparse Identification of Nonlinear Dynamical Systems (SINDy) algorithm, integrating prior knowledge of its zero elements to enhance accuracy. The system is transformed from static to dynamic by introducing an inherent delay, modelling real-world behaviour. The controller is designed using a Linear Quadratic Regulator (LQR) and is implemented on a model obtained from open-loop data, ensuring applicability to experimentally observed system behaviour. To further improve robustness, a Kalman filter is utilised to mitigate the effects of modelling uncertainties and sensor noise, enabling reliable state estimation.

Summary

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