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# Data-driven models for virtual diagnostics and control

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Machine learning methods have been increasingly used to model complex physical processes that are difficult to address with traditional approaches, especially when these processes exhibit temporal dynamics or require real-time implementation. The linear accelerator (LINAC) at the LANSCE facility is one such system. While a high-resolution simulation tool, HPSim, exists, the complexity and high computational costs of the simulation, combined with the spatiotemporal variability of the LINAC and limited diagnostic measurements, creates challenges for real-time operation. These challenges can be mitigated by developing fast surrogate machine learning models to provide virtual diagnostics and enable control. However, the highly expressive nature of machine learning models often results in opaque representations, complicating their use in control applications. Control design and tuning are significantly simplified when the system dynamics are captured by a more interpretable, parsimonious model. This study seeks to harness the power of machine learning while applying traditional system identification techniques to develop models that are both effective for control and computationally efficient.

## Footnotes

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