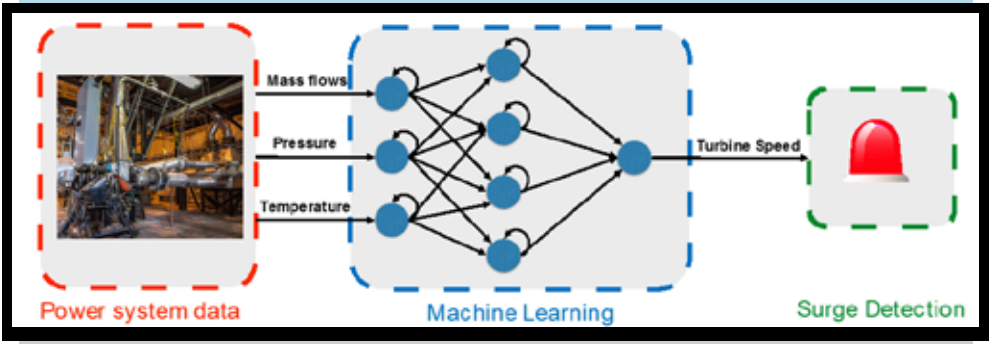
Machine Learning Tools for Detecting Compressor Instabilities

This project's goal is to detect and predict abnormal conditions in gas turbine systems such as compressor surge and stall, one of the most critical problems that occurs in gas turbine cycles during startup and transient operation. Stall occurs when the airflow is separated from the compressor blades. When this phenomenon is propagated to the full compressor stage, a surge event occurs. This effect pushes the airflow backwards causing serious instabilities in the compressor, and potential failures are propagated to the turbine.



We examined using supervised and unsupervised machine learning techniques to detect and predict abnormal conditions (such as compressor surge and stall) of a 100 kW laboratory scale gas turbine power system. Both models were trained with historical data based on the dynamic response of thirty sensors. When the historical data did not present enough failures, an unsupervised learning approach provided better performance than a supervised approach, but this approach required a control logic that expands the output from the validation process to detect the failures. In both cases the machine learning model was able to predict a surge and stall event 15 time steps before it occurred.

In future work the prediction tool will be implemented on a 100 kW laboratory scale gas turbine power system to determine the effectiveness of early intervention on stall reduction at the time scale detected. Additional datasets, including supplementary sensors or valves in the training data, and predicting parameters will also be used.

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