Data-driven modeling of a polymer electrolyte membrane fuel cell stack

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We present two data-driven modeling methods, partial least square (PLS) and artificial neural network (ANN), to predict the major operating and performance variables of a polymer electrolyte membrane (PEM) fuel cell stack. PLS and ANN models were constructed using the experimental data obtained from the testing of a 30 kW-class PEM fuel cell stack, and then were compared with each other in terms of their prediction and computational performances. To reduce the complexity of the models, we combined a variables importance on PLS projection (VIP) as a variable selection method into the modeling procedure. The modeling results showed that the ANN models outperformed the PLS models in predicting the average cell voltage and cathode outlet temperature. However, the PLS models also offered satisfactory prediction performances although they can only capture linear correlations between the predictor and output variables. Depending on the degree of modeling accuracy and speed, both ANN and PLS models can be employed for performance predictions, offline and online optimizations, controls, and fault diagnoses in the field of PEM fuel cell designs and operations.