497e Simplifying PEM Fuel Cell Models without Compromising on Accuracy

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First-principles models based on transport phenomena and electrochemical principles have been used by various researchers to model, simulate, analyze and design PEM fuel cells. These models are typically governed by coupled nonlinear partial differential equations in multiple domains. Though these models predict the expected behavior, these are not ideal for case studies, parameter estimation, process analysis/control with other systems, hybrid analysis, optimization studies etc.

Empirical or approximate models cannot be used for PEM fuel cells, as they do not predict the expected behavior. In this paper, we show how the physics based rigorous models can be simplified for a wide range of operating conditions. Simplification of these models involves a combination of numerical/experimental observation, our novel hybrid numerical techniques, dimensional analysis etc.