

215e A Neural Network-Based, Reduced Order Model for Repetitive and Time-Efficient Prediction of the Behavior of PEM Fuel Cells

Taehoon Oh, Dongil Peter Shin, and Raghunathan Rengaswamy

Proton exchange membrane fuel cells (PEMFC) are considered as one of the most promising sources of distributed electrical power. Detailed modeling of PEMFC has been of considerable interest in predicting the fuel cell performance and also for use in various systems engineering activities. Computational Fluid Dynamics (CFD) models have the promise of providing detailed information about the operation of fuel cells and have been used in fuel cell modeling. While CFD equipment models provide detailed analysis of the performance, they are very time-consuming to develop and run. The computations become quite complex, especially when such models have to be embedded in flowsheet level optimization. Hence, there has been recent interest in building Reduced Order Models (ROMs), based on the result of detailed CFD simulations that can be routinely used in a number of performance studies. Among the many possibilities for building reduced order models, neural networks (NNs) are an attractive choice. NNs have been used in a wide range of engineering applications such as, pattern recognition, behavior prediction and function approximations. In this paper, we will present results on building reduced-order NN models for quickly predicting the flow of reactants in a PEMFC manifold. A feed-forward, back-propagation neural network is used in this work. The data for ANN training is generated from the detailed CFD simulations of the manifold using a half-cell model. The input parameters to the NN are: channel dimension, inlet velocity, inlet gas temperature and initial pressure. The output values are: H₂ consumption, pressure drop and mean velocity in the channels. The ability of the proposed NN-based ROM to quickly predict detailed flow behaviors in the manifold is discussed.