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Modeling nonlinear heat exchanger dynamics with convolutional recurrent networks

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Abstract

Deep learning for system identification has enabled fast and accurate predictions in applications where physics-informed models are either absent or are too complex to be used efficiently for analysis and control. In this paper, we propose a deep state-space modeling framework that combines the feature extraction capabilities of convolutional neural networks (CNNs) with the efficient sequence prediction properties of gated recurrent units (GRUs); we refer to the neural state-space model as CNN-GRU SSM. We compare this model to other state-of-the-art deep state-space modeling tools and demonstrate that our proposed method often outperforms contemporary algorithms on benchmark dynamical system data. We validate the CNN-GRU SSM on a real-world application of predicting multi-input, multi-output, coupled, and nonlinear heat-exchanger dynamics observed in vapor compression cycles.

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