Investigation of Various Data-Driven Modeling Techniques for an Industrial Heat Exchanger

| Conference paper | First Online: 23 July 2024

| pp 563–580 | Cite this conference paper

Data Management, Analytics and Innovation

(ICDMAI 2024)

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Part of the book series: Lecture Notes in Networks and Systems ((LNNS,volume 997))

Included in the following conference series:
International Conference on Data Management, Analytics & Innovation

Abstract

Measurement data acquired from an industrial heat exchanger (HE) can provide a reliable inference on its dynamics and performance. Harnessing the information available on the acquired data, the data-driven modeling technique can create a dynamic model of an HE without any expert knowledge or complex mathematical analysis. Motivated by these factors, data-driven modeling techniques are investigated to model an industrial Naphtha cooler HE in this work. Model describing the HE dynamics is a primary requirement to simulate control strategies and enhance operational efficiency. Naphtha cooler is an industrial shell and tube HE, where the temperature of Naphtha available at the shell side is controlled using the cooling water flow rate at the tube side. Hence, the HE is modeled as a Multi-input Multi-output (MIMO) process with four inputs and two outputs. Three different data-driven modeling approaches namely, traditional, polynomial, and non-linear are investigated. A total of eight model structures are considered and the fit percentage is used as performance metrics to determine the accurate model. Experimental results illustrate that the ARMAX model exhibits a significant 88.2% fit on average.