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Abstract

This study examines modeling and simulation of the transient thermal behavior of a solar collector adsorber tube. The data used for model setup and validation were taken experimentally during the start-up procedure of a solar collector adsorber tube. ANN models are developed based on the nonlinear autoregressive with exogenous input NARX model and are implemented using the MATLAB® tools including the Neural Network Toolbox™. It is considered that the data used for model training and validation are experimental data taken during solar collector operation using standard instrumentation. The neural network predictions agreed well with experimental values with mean squared error which are near 0 and the best fit between outputs and targets (R) are very close to 1. These results showed that NARX models (1–12–1 with $d1 = 10$, $d2 = 9$ and 35 epochs) can successfully be used to predict thermal performance of the adsorber tube.

Refer

ences

- Balzani M. and Reatti A. 2005. Neural network bases model of a PV array for the optimum performance of PV system. Proceeding of IEEE international Conference on

Microelectronics and electronics, 123–126.

- Kalogirou S. A. 2004a. Solar thermal collectors and applications. *Progress in Energy and Combustion Science*, 30(3): 231–295.
- McCulloch W. S. and Pitts W. 1943. A logical calculus of the ideas immanent in nervous activity. *Bulletin of Mathematical Biophysics*, 5: 115–133.
- Kalogirou S. A. 2005. Artificial intelligence in renewable energy application in buildings. *Proceedings of the international conference on the integration of the renewable energy systems (RES) into the building structures*, Patra, Greece, 112–126.
- Toriman M. E. , Juahir H. , Mokhtar M. , Barzani G. M. and Mastura S. A. S. 2009. Predicting for discharge characteristics in Langat River, Malaysia using neural network application model. *Research Journal of Earth Science*, 1: 15–21.
- Yang K. T. 2008. Artificial neural networks (ANNs): a new paradigm for thermal science and engineering. *Journal of Heat Transfer*, 130(9): 19pp. DOI: 10. 1115/1. 2944238
- Lin T. , Horne B. G. , Tino P. and Giles C. L. 1996. Learning long-term dependencies in NARX recurrent neural networks. *IEEE Transactions on Neural Networks*, 7(6): 1329–1351.
- Diaconescu E. 2008. The use of NARX neural networks to predict chaotic time series. *WSEAS transactions on computer research*, Volume 3(3): 182–191.
- Struckmann F. 2008. Analysis of a flat-plate solar collector. Project Report, MVK160 Heat and Mass Transport, Lund, Sweden.
- Hassan H. Z. 2013. A solar powered adsorption freezer: A Case Study for Egypt's Climate. *International Journal of Energy Engineering*, 3(1): 21–29. DOI: 10. 5923/j. ijee. 20130301. 04
- Klein S. A. 1975. Calculation of flat-plate collector loss coefficients. *Solar Energy*, 17: 79–80.
- Duffie J. A. and Beckman W. A. 2006. *Solar engineering of thermal processes*. 3 ed. New York: John Wiley & Sons.
- Saraf G. R. and Hamad F. A. W. 1988. Optimum tilt angle for a flat plate solar collector. *Energy Conversion and Management*, 28(2): 185–191.
- Gao Y. and Joo E. M. 2005. NARMAX time series model prediction: feedforward and recurrent fuzzy neural network approaches. *Fuzzy Sets and Systems*, 150(2): 331–350.
- Siegelmann H. T. , Horne B. G. and Giles C. L. 1997. Computational capabilities of recurrent NARX neural networks. *IEEE transactions on systems, man, and cybernetics. Part B, Cybernetics: a publication of the IEEE Systems, Man, and Cybernetics Society*, 27(2): 208–215.
- Eugen H. 2012. NARX neural networks for sequence processing tasks. Master of Science Thesis Universitat Politècnica de Catalunya – Universitat Rovira i Virgili – Universitat de Barcelona.
- Cybenko G. 1989, Approximation by superpositions of a sigmoidal function. *Mathematics of Control, Signals, and Systems*, 2(4): 303–314.
- Beale M. H. , Hagan M. T. and Demuth H. B. 2014. *Neural Network Toolbox™ User's Guide*, R2014a ed. , Natick, MA: The MathWorks.
- Asgari H. 2014. Modelling, Simulation and control of gas turbines using artificial neural networks. PhD thesis Mechanical Engineering University of Canterbury Christchurch, New Zealand.
- Karlik B. and Olgac A. V. 2010. Performance analysis of various activation functions in generalized MLP architectures of neural networks. *International Journal of Artificial Intelligence*

and Expert Systems (IJAE), 1(4): 111–122.

- Zulkeflee S. A. , Suhairi A. S. and Norashid A. 2011. Nonlinear autoregressive with Exogenous inputs based model predictive control for batch citronellyl laurate esterification reactor, Advanced Model Predictive Control, Dr. Tao ZHENG (Ed.), ISBN: 978-953-307-298-2, InTech. DOI: 10. 5772/16963.

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Index Terms

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Keywords

Solar radiation solar collector adsorber tube temperature neural network