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Optimal operating condition for a type parabolic trough collector with low-cost components using inverse neural network and solved by genetic algorithm

E.D. Reyes-Téllez[a], R.A. Conde-Gutiérrez[a,*], J.A. Hernández[b,*], E. Cardoso[a], S. Silva-Martínez[b], F. Z. Sierra[b], O. Cortés-Aburto[c]

[a]*Posgrado del Centro de Investigación en Ingeniería y Ciencias Aplicadas (CIICAp) de la Universidad Autónoma del Estado de Morelos. Av. Universidad No. 1001, Col Chamilpa, CP. 62209, Cuernavaca, Morelos, México, email: roberto.conde@uaem.mx (R.A. Conde-Gutiérrez)*
[b]*Centro de Investigación en Ingeniería y Ciencias Aplicadas (CIICAp), Universidad Autónoma del Estado de Morelos (UAEM). Av. Universidad No. 1001, Col Chamilpa, CP. 62209, Cuernavaca, Morelos, México, Tel. +52 01 777 3297084 email: alfredo@uaem.mx (J.A. Hernández)*
[c]*Universidad Politécnica de Puebla, Tercer Carril del Ejido "Serrano" s/n, San Mateo Cuanalá, Juan C. Bonilla, Puebla, C.P. 72640*

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ABSTRACT

The parabolic trough collectors (PTC) are able to concentrate the solar radiation and in turn transferred heat along a tube. In this paper, the PTC uses copper tube to heat water in residential use, which reduced costs in the system. An artificial neural network (ANN) model was developed to predict the hot-water outlet temperature of PTC with low-cost components, and its inverse (ANNi) was used to optimize the system's performance. The best fitting training data was acquired with the architecture of 9-9-1 considering a hyperbolic tangent sigmoid transfer-function in the hidden layer and a linear transfer-function in the output. Comparing the predicted and experimental data it was observed a satisfactory agreement ($R^2 > 0.9854$, RMSE > 0.8055 and MAE ~0.0586). Furthermore, from this ANN model, a strategy was applied for optimize the feeding tank temperature, in order to increase the water outlet temperature of the PTC, using inverse artificial neural networks (ANNi) and solved by the method of genetic algorithms (GAs). These results showed that the highest outlet temperature reached by the PTC was 49°C. Consequently a good prediction of the ANN model, as well as the optimized data using ANNi-GAs, makes it possible to control on-line the operation of the system and improve performance.

Keywords: Parabolic trough collector with low-cost components; Increase of water temperature; Inverse artificial neural network; Genetic algorithms; Optimal values

*Corresponding author.

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