International Journal of Innovative Computing, Information and Control
Volume **5**, Number **4**, April **2009**

ICIC International ©2009 ISSN 1349-4198
pp. 855–864

NOVEL MODELS FOR HOURLY SOLAR RADIATION USING A 2-D APPROACH

Fatih Onur Hocaoglu[1], Ömer Nezíh Gerek[2] and Mehmet Kurban[2]

[1]Afyon Vocational High School
Afyon Kocatepe University
03200, Afyonkarahisar, Turkey
fohocaoglu@anadolu.edu.tr

[2]Department of Electrical and Electronics Eng.
Anadolu University
Iki Eylul Campus, 26555, Eskisehir, Turkey
{ ongerek; mkurban }@anadolu.edu.tr

Received February 2008; revised June 2008

Abstract. *In this work one year hourly solar radiation data are analyzed and modeled using a novel visualization method. Using a 2-D(Dimensional) surface fitting approach, the general behavior of the solar radiation in a year is modeled. By the help of the newly adopted visualization approach, a total of 9 analytical surface models are obtained and compared. The Gaussian surface model with proper model parameters is found to be the most accurate model among the tested analytical models for data characterization purposes. The accuracy of this surface model is tested and compared with a dynamic surface model obtained from a feed-forward Neural Network (NN). Analytical surface models and NN surface model are compared in the sense of Root Mean Square Error (RMSE). It is obtained that the NN surface model gives better results with smaller RMSE values. However, unlike the specificity of the NN surface model, the analytical surface model provides a simple, intuitive and more generalized form that can be suitable for several geographical locations on earth.*

Keywords: Solar radiation, Data modeling, Analytical functions, Neural networks

1. **Introduction.** Solar radiation is the principal energy source for physical, biological and chemical processes on earth. An accurate knowledge and an insightful model of the solar radiation data at a particular geographical location are of vital importance. Such knowledge is a pre-requisite for the simulation and design of solar energy systems. Architects, agriculturalists, air conditioning engineers and energy conscious designers of buildings also require such information. In many cases, the solar energy applications involve tilted surfaces. To compensate for the effect of radiation on tilted surfaces, knowledge of both diffusing and direct components of global radiation falling on a horizontal surface is required [1]. Menges et al [2] reviewed and compared the available solar-radiation models for a region in detail. The majority of the models developed for the prediction of solar radiation are based on existing climatic-parameters, such as sunshine duration, cloud cover, relative humidity, and minimum and maximum temperatures [3, 4, 5]. Unfortunately, for many developing countries, solar-radiation measurements are not easily available because of the expensive measuring equipments and techniques required [6]. Recently Hocaoglu et al. developed a novel 2-D model for representation of hourly solar radiation data [7]. In that study, they used Gaussian and sinusoidal functions while constructing the surface model. In this study, after briefly reviewing the 2-D representation in Section 2, 8 more (and new) 2-D models are tested and verified for one year solar radiation data that is