A support vector machine–firefly algorithm-based model for global solar radiation prediction

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Abstract

In this paper, the accuracy of a hybrid machine learning technique for solar radiation prediction based on some meteorological data is examined. For this aim, a novel method named as SVM–FFA is developed by hybridizing the Support Vector Machines (SVMs) with Firefly Algorithm (FFA) to predict the monthly mean horizontal global solar radiation using three meteorological parameters of sunshine duration ($\bar{n}$), maximum temperature (T_{max}) and minimum temperature (T_{min}) as inputs. The predictions accuracy of the proposed SVM–FFA model is validated compared to those of Artificial Neural Networks (ANN) and Genetic Programming (GP) models. The root mean square (RMSE), coefficient of determination (R^2), correlation coefficient (r) and mean absolute percentage error (MAPE) are used as reliable indicators to assess the models' performance. The attained results show that the developed SVM–FFA model provides more precise predictions compared to ANN and GP models, with RMSE of 0.6988, R^2 of 0.8024, r of 0.8956 and MAPE of 6.1768 in training phase while, RMSE value of 1.8661, R^2 value of 0.7280, r value of 0.8532 and MAPE value of 11.5192 are obtained in the testing phase. The results specify that the developed SVM–FFA model can be adjudged as an efficient machine learning technique for accurate prediction of horizontal global solar radiation.
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Keywords: Support vector machine; Firefly algorithm; Hybrid model; Global solar radiation prediction; Meteorological parameters

1. Introduction

The long-term knowledge of solar radiation at any particular locations is essential for variety of areas such as agricultural, hydrological, ecological as well as solar energy applications. It has been proved that the abundant potential of solar energy can play an important role to meet the ever-growing energy demand of the world (Ming et al., 2014; Akikur et al., 2013; Azoumah et al., 2011; Bajpai and Dash, 2012; Hasan et al., 2012). Among different types of renewable resources, solar energy has attracted enormous attention because not only it is

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