



## Review

# The artificial neural network for solar radiation prediction and designing solar systems: a systematic literature review



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## ARTICLE INFO

## Article history:

Received 18 December 2014

Received in revised form

8 April 2015

Accepted 13 April 2015

Available online 27 April 2015

## Keywords:

Solar energy

Solar radiation prediction

Solar systems

Data mining

Artificial neural network

## ABSTRACT

Solar energy generated by sunlight has a non-schedulable nature due to the stochastic environment of meteorological conditions. Hence, power system control and the energy business require the prediction of solar energy (radiation) from a few seconds up to one week in advance. To deal with prediction shortcomings, various solar radiation prediction methods have been used. Predictive data mining offers variety of methods for solar radiation predictions where artificial neural network is one of the reliable and accurate methods. A systematic review of literature was conducted and identified 24 papers that discuss artificial neural network for solar systems design and solar radiation prediction. The artificial neural network techniques were employed for designing solar systems and predicting solar radiations to assess current literature on the basis of prediction accuracy and inadequacies. Specific inclusion and exclusion criteria in two distinct rounds were applied to determine the most relevant studies for our research goal. Further, it is observed from the result of this study that artificial neural network gives good accuracy in terms of prediction error less than 20%. The accuracy of solar radiation prediction models is found to be dependent on input parameters and architecture type algorithms utilized. Therefore, artificial neural network as compared to other empirical models is capable to deal with many input meteorological parameters, which make it more accurate and reliable.

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## 1. Introduction

Renewable energy resources have gained significant importance in the 21st century due to awareness of environmental pollution and depleting reservoirs of fossil fuels. The researchers are striving hard to make a pollution free environment by proposing carbon free technologies in different forms such as automobile, garments, home appliances and other energy consumption sectors (Köhler et al., 2013; Koroneos and Nanaki, 2012; Liu and Wang, 2013). Renewable energy is available through different natural resources such as solar, wind, geothermal, biomass and tidal etc. The research shows that people want to utilize renewable energy due to their

concerns about environmental issues as well as limited available conventional energy resources (Yuan et al., 2015; Qazi et al., 2014). Solar energy is one of the most important clean, renewable energy resources, which comes directly from the sun in the form of radiations. The radiated energy is employed in two types of solar systems: (1) thermal and (2) electrical. Both forms of energy are used in variety of ways to make a clean environment. The solar collectors are designed to make decision analysis that is considered to have a wider potential for applications in the fields of renewable energy and sustainable design (Nixon et al., 2013; Fayaz et al., 2011). Solar radiation prediction is necessary on the broad level to build resourceful solar systems. For solar radiation prediction, many predictive data mining methods are successfully utilized, where, artificial neural networks (ANNs) are excessively used (Hepbasli and Alsuhaibani, 2011).

The global use of solar energy has grown significantly recently; the 100 GW milestone has already been surpassed in the first

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