Bayesian Neural Networks Approach for Daily Global Solar Radiation Prediction in Gran Canaria Island

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Abstract

Solar energy power plants need daily global solar radiation prediction of the next day due to Spanish legislation. Moreover, Gran Canaria electrical grid is not connected with any other territory so it is necessary to generate and consume all the electricity inside the island. Solar energy, as a fluctuating energy source, may lead island's power grid to have unstable behaviour. Indeed, solar radiation forecasting is critical to increase solar energy proportion into the power system. This paper presents a daily solar radiation forecasting model based on Artificial Neural Networks (ANN). ANN is a statistical method used for establishing non-linear relation between input and output datasets, making this method very useful for solar radiation purpose. In this paper a multilayer perceptron with one hidden layer is used. Final parameters are obtained optimizing the error between real data and output results using an iterative scaled conjugate gradient method. The available data arise from ground measurement stations in Gran Canaria and predictions for next day offered by Integrated Forecast System (IFS) operated by the European Centre for Medium-Range Weather Forecasts (ECMWF). The ANN uses, as inputs, ground measurement data (both global solar radiation and other meteorological parameters) from the day before and two previous days and ECMWF data. Next day global solar radiation is the output. The architecture of the network may lead to poor results with new data if during the training process the overfitting problem is not controlled. This paper sets a Bayesian framework to study the model complexity. The Bayesian Network (BN) approach sets the optimal distribution of network parameters weights as the maximum of a probability density function over the weight space. The BN gives also the possibility to study the network architecture computing a probability for each model and using this measure to select the best one. In this case, we have selected the optimal number of hidden units and studied the relevance of several meteorological inputs. BNs forecast daily global solar radiation of the next day, obtaining different errors for southern and northern stations.

References

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