Abstract

Forecasting of solar power generation is important in successful evacuation of the solar power into the existing electricity grid. The importance of solar photovoltaic (SPV) plant yield forecasting is crucial in the power scheduling, balancing, and grid control operations. These operations of electricity grid depend on the approaches used and followed to minimize the effect of solar power variability. This variability arises due to the atmospheric processes as well as system conditions.

This thesis concentrates on the solar power generation forecasting of rooftop (small scale) and ground based (large-scale) solar photovoltaic plants. Various case studies in which 15 minute averaged data, daily averaged data and monthly averaged data from two plants in India are considered. Seasonal (summer, winter and rainy) categorization of the data is also studied. The generation of solar power plant depends on the variation in ambient conditions. Several empirical correlations and simple lumped dynamic models help in validation of the experimental data. This work proposes the use of an intelligent approach to forecast the power generation of solar photovoltaic plant.

The main objective of this work is to explore the ability of neural network models to forecast the solar power generation. We propose models using Artificial Neural Network and Generalized Neural Network for solar power generation forecasting. Here, historical data of solar irradiation (Global Horizontal Irradiation, GHI), global tilted irradiation (Global radiation on an inclined plane, GTI), ambient temperature, module temperature, wind velocity, sun availability are the input parameters to the neural network in the modeling for forecasting. The neural network has adaptability and has been trained with values of input parameters and power generation of a PV plant.

Forecasting models were developed for particular time horizon for various seasons. These models are tested and validated for various forecasting time intervals. It is observed from the obtained results that, compared to the artificial neural network, generalized neural network-based forecasting model is able to capture the nonlinearity effects of solar power generation. In addition, comparative study of forecasting results have shown that proposed generalized neural network-based forecasting model outperforms the artificial neural network model.

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