

A Day-ahead Forecasting of Photovoltaic Power Generation using Neural Network and Meteorological Data

Kazuhiro Kobayashi, Yasushi Miwa
Chubu Electric Power Co., Inc., Nagoya, Japan
Kazuto Yukita, Yasuyuki Goto, Katsuhiko Ichiyanagi
Aichi Institute of Technology, Toyota, Japan

Keywords: *(solar irradiance, photovoltaic power, forecast, neural network, meteorological data)*

Abstract

Recently, the Photovoltaic (PV) power generation, as a clean energy source with a potential to reduce green-house gas emissions, is attracting more and more attention all over the world. In Japan, the government has set solar PV targets in 2004 and revised them in 2009 to install solar PV capacity of 28 GW by 2020, and 53 GW by 2030. Such a massive penetration of PV in the future power system is likely to have many issues which need to be addressed for ensuring stable and reliable power system operation, especially due to the fact that PV output is greatly influenced by the weather conditions. Hence, for the stable power system operation, it is necessary that the forecasting of PV power generation is as accurate as possible in order to have a reasonable reserve capacity to cope with variation in the PV output. Therefore many studies for the forecasting have been conducted in order to maintain stable power system operation with a suitable reserve capacity. In these studies, mostly, the weather forecasting model based methods using the observed data from meteorological satellite and so on, have been proposed. These methods are mostly precise but highly complicated and computation intensive. Therefore, a relatively simple and easy to handle method with a reasonable accuracy is proposed for a day-ahead forecasting of solar irradiance and PV power generation.

In the proposed method, the solar irradiance and PV power generation is forecasted by using the neural network with temperature data at some locations. The main feature of this solar irradiance forecasting method is that it uses only the day-ahead temperature data at some locations around the forecasting location as the input data. This is because we found that the temperature data has a close correlation with the amount of solar irradiance around the same location. In fact, the day-ahead and past temperature data are made available regularly on the internet by Japan Meteorological Agency, and are easily accessible by anyone. Hence, in the learning process of the neural network, the solar irradiance data and temperature data of same locations are used. The neural network is designed to have three hidden layer units and the number of learning iterations was set to 15,000. The day-ahead solar irradiance is forecasted by neural network by using the day-ahead temperature data of some points. Since the solar irradiation has a close correlation with PV power generation for similar location, the PV power generation is forecasted by using the forecasting data of solar irradiation. The validity of the proposed method is verified by forecasting the solar irradiation and PV power generation using the temperature data from 2012 to 2013 and by cross-checking these results against the measured data. From the results, it is found that the forecasting results have similar trend compared to the measured data, and the average forecasting error of this method is about 20-40%. Further, the studies are being carried out to improve the accuracy of the proposed forecasting method.