Solar Irradiance Forecast Methods using Meteorological Data for Photovoltaic Generation Prediction

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Abstract

For stable supply of electric power, the generation from power-stations (thermal, nuclear, hydro, and so on) is adjusted according to changes in demand. If the balance of supply and demand is lost, the frequency fluctuates, resulting in problems such as unstable operation of generation plants and electrical devices.

Recently, a large number of grid-connected photovoltaic (PV) systems have been installed. It is also necessary to keep the supply-demand balance against the power variation of PV systems principally by controlling the thermal generation. Therefore, accurate predictions of area-wide generation of the PV systems are required. As the power variation of PV systems heavily depends on the solar irradiance, accurate forecasts of the area-wide solar irradiance are also required.

We have developed solar irradiance forecast methods using meteorological data (GSM: Global Spectral Model, MSM: Meso-Scale Model, and so on) provided by Japan Meteorological Agency, and pyranometers installed at a number of locations in Japan. We evaluated the forecast error of solar irradiance with the observed irradiance by RMSE (Root Mean Squared Error). As a result, the yearly RMSE of a day ahead forecast of the developed methods was found to be 100~160 Watt/m2 (Nov, 2010 ~ Oct, 2013).

The developed solar irradiance forecast methods have been adopted by several electric power companies in Japan. The development results are serving as a benchmark for the solar irradiance forecast field.

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