

## Development and Practical Use of Prediction System for PV Output

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### **Abstract**

Photovoltaics (PV) systems are rapidly spreading, since they are clean renewable energy and don't emit CO<sub>2</sub>. However their output change according to the weather and we can't control them. When PV systems are installed in large quantities, it is difficult to control and make a plan of electric power system. But we need to effectively use their generated power. Based on this background, we developed the output prediction system of PV systems.

Our system consist of two part, they are current output estimation function and future output prediction function.

At first we developed the current output estimation system, because we have to know the accurate PV output to predict the future PV output and control electric power system. Since PV systems are small equipment and dispersed in wide area, it is difficult to measure all PV output in detail. We can only measure 7% of PV output in real-time in our electric power company. Our system estimate the solar radiation using cloud images observed by meteorological satellite, and we correct their bias to make it more accurate using measurements of pyranometer. We convert the solar radiation to PV output in consideration of efficiency, temperature compensation, self-consumption, and so on. We evaluated the accuracy of estimated PV output by monthly measurements. As a result, we found that the mean error between estimated value and measured value are about 1-2%.

Next we developed the output prediction system. This system has the feature of the hybrid system, because it predict the PV output by combining numerical weather forecast and satellite cloud images. We evaluated the accuracy of predicted PV output. As a result, when lead time is 1 hour, MAE (Mean Absolute Error) is about 2.9% and RMSE (Root Mean Square Error) is about 4.0%. Similarly, when lead time is 24 hour, MAE is 7.4% and RMSE is about 9.9%.

Our system was already put into practical use in electric power company. We will introduce a detail of prediction method and prediction accuracy.