



Solar power plant performance evaluation through an Analog Ensemble scheme, based on satellite estimation of global irradiance at the surface.

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The rise of renewable power production in Europe is critical to meet emissions-cutting obligations under the Paris Climate Agreement. In Italy, since 2008 there's been an increase of more than 115% in renewable energy installations, according to the GSE (Energy Service Operator) statistical reports. These results are mainly due to wind and solar power installations, the production of which essentially depends on weather conditions. This rapid growth has however resulted in new problems and requirements, caused by the intermittency of the available renewable power on the grid, according to the meteorological variability. On one hand, an accurate weather forecast is fundamental in order to better predict the energy price, based on the hourly renewable production for the day ahead and to optimize the management of the grid.

On the other hand, it is important to estimate the potential production of a plant in the past when refunds are established if grid operators forced the shut down of some plants for the security of the power system and in order to evaluate the performance of a plant over time too.

After the installation, in fact, it is important to evaluate the plant efficiency and an early failure detection plays a significant role in maintaining a high performance of the plant production. In particular it is necessary to distinguish if a loss of production is due to bad weather or to equipment malfunctions. For these reasons, a performance evaluation system for solar plants, scattered across the territory, has been developed, using global irradiance data as input. The technique is suited for different types of plants (standard PV plant or solar tracking systems) and with no need of information about the plants characteristics, except for the position, necessary to calculate the exact solar position at each moment.

Using the statistical technique "Analog Ensemble", the potential power production can be estimated analyzing the behavior of the plant in the past for different conditions of irradiance at the ground. The projection of the production, for a specific moment in time, is obtained using the power production registered in the past in similar solar irradiance conditions. The similarity is evaluated minimizing the distance for few parameters: the height of the sun and the irradiance at the surface. Because of accurate data of surface irradiance near the plant are often not available, an estimate of global irradiance at surface from Meteosat data is used. The irradiance evaluation is based on the cloudiness characterization, derived from the SAFNWC software (Software Application Facility for NoWCasting), developed by the EUMETSAT SAF Network. With this application, a good solar irradiance estimate is available over a large territory and results in the applicability of the power performance evaluation system everywhere. Applying this method it is possible to send out an early warning to the producer, when the measured production begins to drift from the potential production obtained from the Analog Ensemble.