Estimation method of PV output forecast error according to PV output forecast and time of UC

Keito Nishida[1,*], Ryuto Shigenobu[1], Masakazu Ito[1], Norikazu Kanao[2], Hitoshi Sugimoto[2]

[1]University of Fukui, Japan, [2]Hokuriku Electric Power Company, Japan
[*]nishida.keito@pws.fuee.u-fukui.ac.jp

A power system installed with a PV has challenges of system frequency stability because the PV output has various fluctuation cycles and a forecast error. Therefore, it is important to consider the PV output forecast error for a unit commitment (UC).

This paper proposes an estimation method of the PV output forecast error according to the PV output forecast and each time of the UC scheduling. Firstly, the PV output forecast error of a previous year is classified into the PV output level and 30 minutes of the UC. Next, a mean (μ) and a standard deviation ($\pm\sigma$) are calculated from a normal distribution of the classified data. The mean and the standard deviation are different because the amount and direction of the PV output forecast error vary depending on the time and weather conditions. Finally, the PV output forecast error is learned as a larger value of $|\mu \pm \sigma|$. This method estimates the forecast error according to the PV output forecast level and time of UC. Figure 1 shows the actual PV output and the PV output forecast. The black lines show the estimated upper and lower limits of the forecast by the proposed method. The PV capacity of original data was 1010 MW. The PV capacity was increased from 1010 MW for a demand-supply and system frequency simulation.

The simulation results are shown in Figure 2. The proposed method showed a higher average number of operating generators than a conventional UC scheduling. The comparison of frequency deviation is also shown on the right side of Figure 2 at the PV capacity of 2210 MW. In the conventional method, the average number of operating generators was less than 6, and the frequency deviation deviated from the range of limits. On the other hand, using the proposed method, the power system was operated by at least 6 generators. The reason is that more operating generators were needed to secure the reserved power to compensate the estimated PV output forecast error. In conclusion, the frequency stability was maintained by the proposed method.

(a): PV capacity 1010 MW.   (b): PV capacity 2210 MW.   (c): PV capacity 3010 MW.
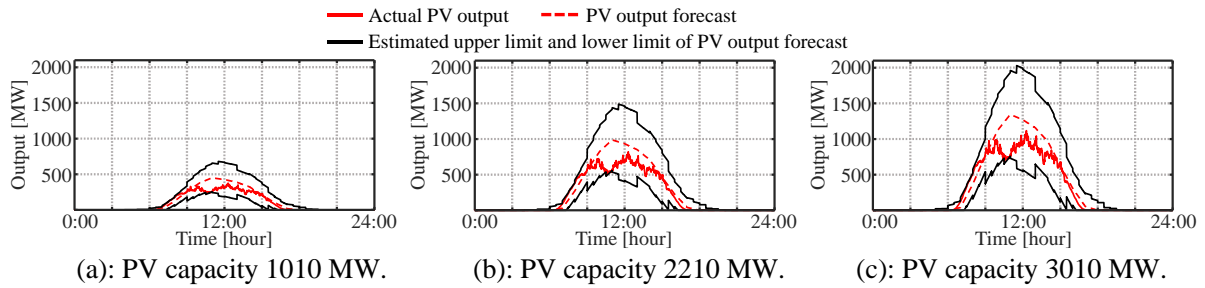
Figure 1: Actual PV output, PV output forecast, estimated upper and lower limit of the forecast.
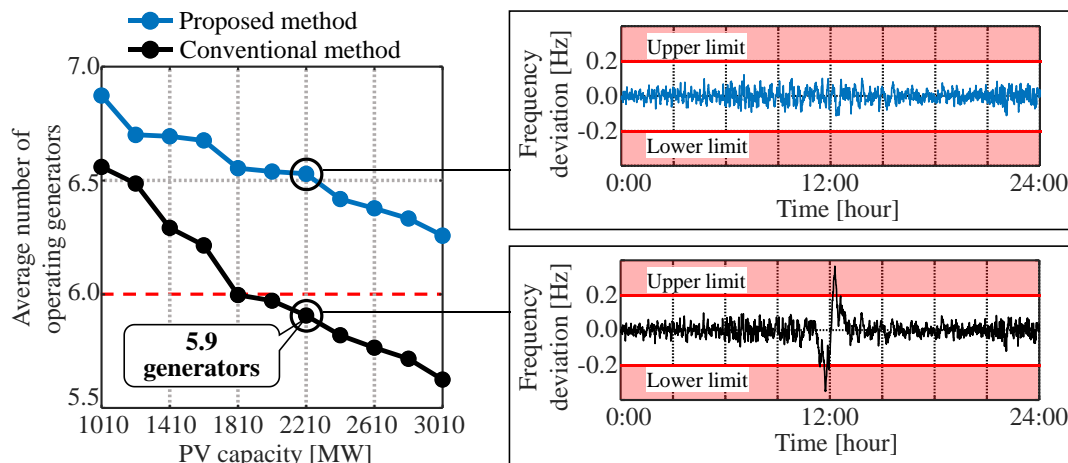

Figure 2: Average number of generators in operation and frequency deviation.