Paris Session 2022

Risk Evaluation for Demand Forecast

C2 Power system operation and control

PS1-3 Question 1.7

The security of supply is a critical requirement for system operation and the implementation of algorithms that attempt to prevent critical network conditions is usually implemented. Given that most of these systems compute worst case conditions, how can we guarantee that the energy market is not being hindered due to the priority given on security of supply?

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Demand forecast error is a risk for power system

- For the security of power systems, it is important to accurately forecast for several hours and days ahead, and to prepare reserves for forecast errors.
- Forecast errors are uncertain and thus difficult to quantify in advance.
  - That is, we do not know in advance how large the forecast error will be.
- Preparing excessive reserves for forecast errors reduces the profit of energy market participants.

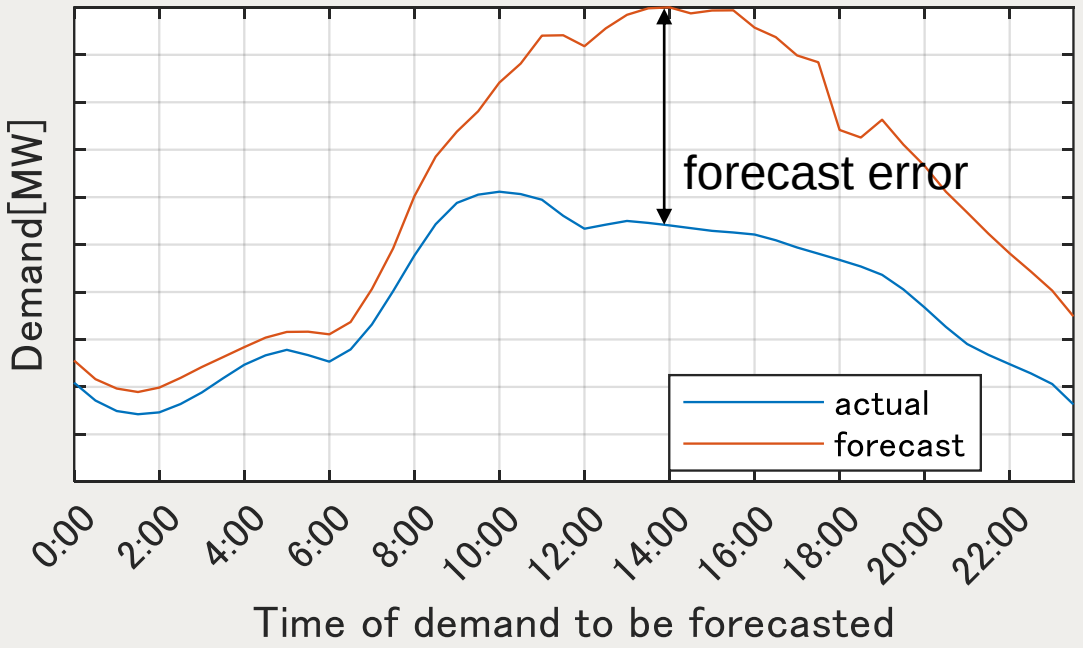


Fig. 1：An example of forecast error

What can we do for the risk of demand forecast?

- Forecast error cannot be reduced to zero.
  - Our proposed forecasting method[1] may reduce forecast errors, but there is a limit to the accuracy.

- In order to optimize reserve capacity or guarantee that the energy market is not being hindered, a method is required to accurately quantify forecast errors in advance.

- Towards developing the quantify method, there is no road map in sight. Where do we start?
  - A statistical analysis of trends and characteristics of forecast errors is the first step.

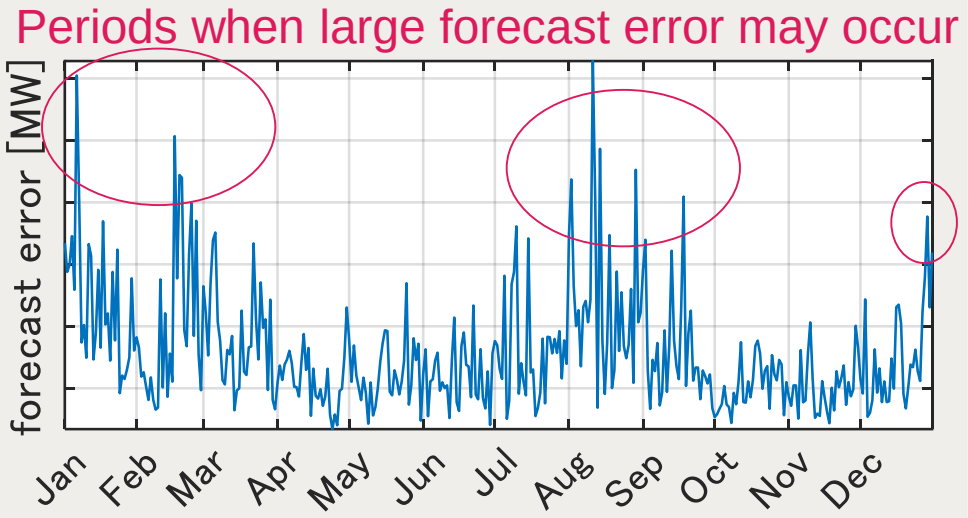


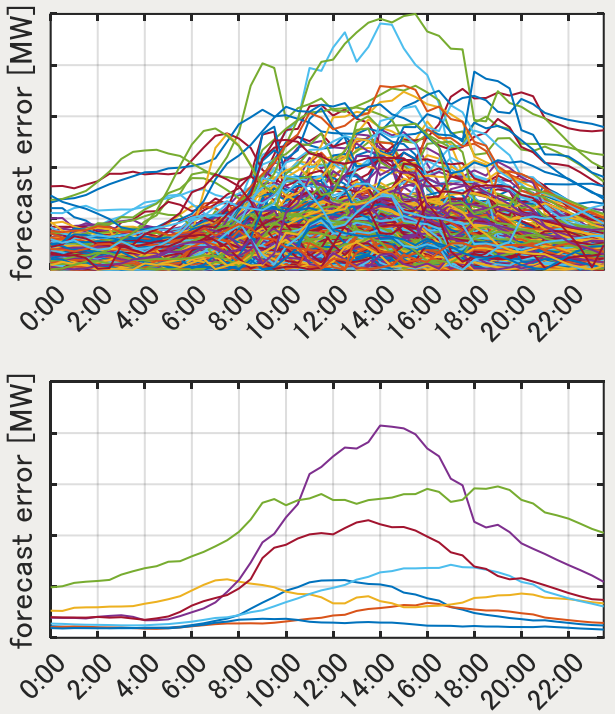
Fig. 2 An example of statistical analysis

[1] paper ID: 10635, Applying Big Data Analytics to Demand Forecast in Island Power Systems towards Large Installation of Renewable Energy

Research required for quantifying forecast errors

- More advanced statistical analysis of forecast errors are required.
  - For example, a research is underway to extract representative forecast errors by using K-means shown in fig. 3.
  - Explainable AI[2] may be related.

- Methods are required to evaluate the results of the statistical analysis in terms of power system operations and energy markets.
  - Stochastic and scenario-based unit commitment problem may be related.



365 series of forecast error (difficult to understand)

K-means

8 series of representative one (easy to understand)

Fig. 3 representative errors by using K-means

[2] Interpretable Machine Learning A Guide for Making Black Box Models Explainable https://christophm.github.io/interpretable-ml-book/index.html