ALLOCATION METHOD OF REQUEST POWER FLOW FOR HOUSE GROUP CLUSTERED BY CHARACTERISTIC OF HOUSE LOAD

Ryota Watanabe¹, Yuzuru Ueda¹, Masakazu koike², Takayuki Ishizaki³, Jun-ichi Imura³

¹Tokyo University of Science, Japan, ²Tokyo University of Marine Science and Technology, Japan, ³Tokyo Institute of Technology, Japan

Recently, photovoltaic power generation is receiving a lot of attention, and increasing of PV installation is expected. However, the photovoltaic generation greatly exceeds the peak demand power in the daytime and adjustment of the supply-demand balance becomes difficult only by the supply side. Therefore, installing battery system to reduce surplus power and to use power effectively is desirable for the demand side. Based on the above background, we propose the day-ahead planned value called “request power flow” to achieve economical and efficient operation of conventional generators belonging to aggregators. Aggregator would allocate the request power flow to consumers and each consumer would achieve allocated request power flow by using the battery. However, the power flow of each house varies according to the time. When the request power flow is equally allocated, some houses cannot achieve the request, because of the variety of loads. Therefore, the purpose of this research is grouping houses according to the characteristics of the load, allocating the request power flow to each group, and optimizing the capacity of the battery based on the change of each group’s state of charges (SOC).

In this study, estimated load data of 540 houses from January 1, 2010 to December 31, 2010 in Maebashi City, Gunma Prefecture, was used. To group houses according to the characteristics of the load, the k-means method known as the simplest clustering method is used. An average of the each house’s load data for one year was calculated and grouped into six clusters. Figure 1 shows the pattern of each cluster’s load. Large load in the morning and evening is one of the characteristics of houses’ load. In Figure 1, there are large differences between the cluster with the largest and with the lowest load in the morning and evening.

Next, the allocation of the request power flow was carried out. First, the average load of each cluster \(l_g\) and all 540 houses \(l_{all}\) were calculated. Second, a provisional request \(r_n\) is created using \(\left((l_g/l_{all}) \times R\right)\) in the discharge time and \(\left((2 - (l_g/l_{all})) \times R\right)\) in the charging time, where \(R\) is equally distributed request power flow. Third, \(r_n\) and the estimated power flow of each cluster are compared and the discharge and the charge amount are calculated. Here, the discharge and the charge amount must be equivalent so as to make the beginning and the ending value of the SOC into 50%. Therefore, the calculated discharge and the charge amount of each cluster are compared, and \(r_n\) for the cluster with the large discharge amount is adjusted to get the same charge amount as discharge amount. Then, \(r_n\) for the cluster with the large charge amount was adjusted to fix the total request power flow.

Figure 2 shows the change of SOC by allocating request power flow. In Figure 2, the capacity of all batteries is set to 20 kW. In the cluster 2, the lower limit value of the SOC of the battery is nearly 0 kW. Moreover, in the cluster 2 and 3, the upper limit value of the SOC is larger than 16 kW. On the other hand, the SOC of cluster 4 and 5 does not change so much, and the widths between upper limit and lower limit of SOC were 6 kW. The optimum size of the battery depends on the life style of users. This study used only estimation data, in the future, we will consider the forecast errors by using a measurement data. This study was supported by JST CREST Grant Number JPMJCR15K1, Japan.

![Figure 1: Average load of each cluster](image1)
![Figure 2: The battery SOC of each cluster](image2)