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Professor Euiseok Hwang's research team develops contactless detailed power usage monitoring technology based on artificial intelligence

▫ GIST (Gwangju Institute of Science and Technology, President Kiseon Kim) School of Electrical Engineering and Computer Science Professor Euiseok Hwang's research team developed an artificial intelligence-based time-frequency mask-based contactless detailed power usage monitoring technology *.

* contactless detailed power usage monitoring technology: A technology that performs power demand response control and management in a smart grid with a non-contact type of power identification and separation technology that estimates the power consumption of characteristic sub-loads from the total amount of power measured by a smart meter.

◦ The research team improved the resolution accuracy of sub-loads through an approach to estimating a time-frequency mask based on an artificial intelligence model of deep neural networks (DNN) and confirmed that it can be applied to the identification and separation of flexible power loads that are highly useful for power demand response in small and medium-sized buildings.

- Existing contactless power usage monitoring technology mainly performs load decomposition in the time domain, which is when sub-loads show similar patterns or have complex consumption patterns. It is difficult to separate or identify each target subload pattern in the total amount of power.

- The research team overcame the limitations of the existing time domain decomposition method for non-contact power consumption monitoring by first applying a time-frequency mask method based on a deep neural network, which can consider time and frequency characteristics at the same time.

  - The power consumption monitoring method using artificial intelligence-based time-frequency masks is to first generate a time-frequency mask suitable for each target flexible load to be separated from the entire load as a deep neural network model, and then use each generated mask as a power source. This is a method of separating the power consumption of target sub-loads by applying it to the total amount of time-frequency signal.

- To reduce the computational complexity and correctly learn the artificial intelligence model, the research team performed clustering on the load data in advance using highly correlated environmental information and applied load decomposition methods using deep neural network-based time-frequency masks for each cluster.

  - To check the load decomposition performance of the proposed technology, the existing method and the decomposition performance were simulated when the target flexible load is the heating ventilation and air conditioning (HVAC) and the light load of a residential and commercial building. Compared to the existing methods, the root mean square error (RMSE) of partial load estimation is reduced to about 32~68% and 15~40%, respectively, confirming that the accuracy of load decomposition is improved.

- Professor Euiseok Hwang said, "This study enables similar or complex patterns of power load monitoring, which were difficult to identify in conventional contactless power usage monitoring techniques, and improves load decomposition accuracy. It is expected that it will be used for energy ICT

convergence platforms for power demand response control and management systems in the future."

- This research was led by GIST School of Electrical Engineering and Computer Science Professor Euiseok Hwang and conducted by Ph.D. student Jun-ho Song and Korea Atomic Energy Research Institute researcher Yong-gu Lee with support from the GIST Research Institute (GRI) and the Information Communication Planning and Evaluation Institute (IITP) and was published online on March 17, 2021, in *IEEE Transactions on Smart Grid*, a world-renowned journal in the field of engineering, electricity, and electronics.

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