

## 論文の内容の要旨

論文題目     Design of a Novel Load Frequency Controller for EV Aggregators  
(EV アグリゲーターのための新たな系統負荷周波数制御手法の設計)

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In recent years, a large amount of renewable energy sources (RES) has been installed into power systems. However, the large integration of RES generation tends to cause frequency stability problems in power systems. To deal with these problems, power systems around the world are prompted to create or reform the ancillary market for frequency regulation to invite additional regulation resources, especially from the system demand side.

The utilization of electric vehicles (EVs) is one of the most prospective solutions in frequency regulation especially in the load frequency control (LFC) domain because of the fast-response characteristics of the EV batteries. Since the power level of a single EV is small, the EVs must be aggregated to participate in LFC. The EV aggregator is expected to receive a control signal sent by the control center of the local system operator and dispatch the signal to every single EV in the aggregation. There are two problems for the EV aggregator under this operation: firstly, the transmission and processing of the signal will cause communication delay; secondly, how to dispatch the received LFC signal to the aggregated EVs.

The novel load frequency control scheme for EV aggregators proposed in this dissertation consists of two parts: delay compensation control and optimal dispatching control. The former aims at compensating for the communication delay of LFC signal in a power system, while the latter is to search for an optimal dispatching control strategy that maximizes the revenue from the LFC regulation market. An adaptive control scheme is used to generate a delay-compensated control

signal, and the optimal dispatching control strategy is obtained with a novel modified genetic algorithm. The two parts are bonded together in a model predictive control scheme with a SARIMA prediction model on LFC market price for real-time operation. With the proposed control scheme, the performance of EV aggregators in LFC can be improved. The EV aggregators could earn more benefits and become more competitive in the frequency regulation market, while the system frequency stability could be better secured.