Our goal is to develop an HEMS using in-vehicle batteries.

Validation of Model Predictive Home Energy Management System
Using Actual Equipment
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Introduction of renewable energy for low-carbon society

[Issue]
• Power supply highly depends on the weather
• Power demand should be handled according to power supply

Background

<table>
<thead>
<tr>
<th>Products</th>
<th>Stationary battery</th>
<th>Electric vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>82,040,000</td>
<td>82,628,000</td>
</tr>
</tbody>
</table>

Storage system is the most important component

Our previous study
Collaborative research with Nagoya University

Proposal viewpoint

Dynamic characteristic model
Load rate vs. power conversion efficiency

Proposed viewpoint
Non-linear characteristics

Modeling based on input-output characteristics

Power conditioner unit model

Experimental equipment and validation approach

Chemical reaction model
Proposed viewpoint
Input-output characteristics

Model predictive HEMS using in-vehicle batteries

Validation approach
We performed 3 types of experiments to evaluate the proposed model.

Experimental results

Electricity price setting

(1) Without MPC
(2) With MPC

Validation of the effect of the proposed model
Verification of the proposed model's extensibility when connecting a plurality of power conditioner units and batteries

Discharge characteristics

Experimental results

Experimental equipment

PV inverter 5 kW
PV simulator 5 kW
DC/DC converter 2.5 kW
Solar panel (PV simulator) 5 kW
Electronic load 5 kW (Appliance)

PV inverter 4.3 kW
PV simulator 5 kW
EV inverter 2 kW
EV (Electronic load) 2 kW
In-vehicle battery 3 kW
DC/DC converter 2.5 kW
AC/DC converter 2.5 kW

Conventional model
Proposed model

SOC

Conventional model
Proposed model

Conventional model
Proposed model

With MPC
Without MPC

Conventional model
Proposed model

Proposed model
Conventional model

SOC

Conventional model
Proposed model

Conventional model
Proposed model

Our proposed viewpoint is effective for reducing the deviation.

Summary
We have proposed the simple models for power conditioner units and batteries. These model contribute to reduce the deviation between theoretical values and actual measurements.

Future plan
- Verification of the proposed model’s extensibility when connecting a plurality of power conditioner units and batteries
- Development of a battery model taking into account an environmental condition

According to the experimental results of (1), the deviation can be reduced dramatically by applying the proposed model due to improvement the accuracy of the prediction of the grid power consumption.

As you can see from the experimental results of (2), the deviation can be reduced further by applying MPC due to the feedback structure.