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Optimal Location of Dynamic Wireless Power Transfer in the National Expressway Network

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Dynamic Wireless Power Transfer (DWPT) is attracting attention as a promising infrastructure to support electric vehicle (EV) mobility on expressways. This study examines the optimal deployment of DWPT on the national expressway network in Japan. Unlike previous studies that maximized covered demand under a given installation length, this study addresses the inverse problem of minimizing the total DWPT installation length required to support a predefined set of trips. The target trips are defined as OD trips whose travel distance is below a given threshold and whose energy demand cannot be satisfied by the onboard battery alone.

A linear optimization model is formulated to minimize the total installed DWPT length while requiring all target trips to remain feasible. The model is applied to the actual national expressway network with observed OD data, route assignment results, and link-based energy consumption settings. As an illustrative example, a case with a 600 km trip-distance threshold is presented.

Figure 1 shows the spatial distribution of target OD demand, indicating that relevant trips are distributed widely across the national expressway network. Figure 2 presents an example of the resulting optimal DWPT layout for the 600 km case. The results suggest that DWPT is concentrated on key expressway links rather than being allocated uniformly across the network. These findings provide a basic perspective for discussing phased DWPT planning on a national expressway network.

Fig. 1 Spatial distribution of target OD demand on the national expressway network

Fig. 2 Example of optimal DWPT layout on the national expressway network for the 600 km case