University of Victoria | Graduate Studies

Notice of the Final Oral Examination for the Degree of Doctor of Philosophy

of

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MEng (Northwestern Polytechnical University, 2012)
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"Modeling and Analysis on Electric Vehicle Charging"

Department of Electrical and Computer Engineering

Thursday, December 14, 2017
10:00 A.M.
Engineering and Computer Science Building
Room 468

Supervisory Committee:
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Dr. Tara Ney, School of Public Administration, UVic

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Abstract

The development of electric vehicle (EV) greatly promotes building a green and sustainable society. The new technology also brings new challenges. With the penetration of electric vehicles, the charging demands are increasing, and how to efficiently coordinate EVs' charging activities is a major challenge and sparks numerous research efforts. In this dissertation, we investigate the EV charging scheduling problem under the charging station and home charging scenarios from different perspectives.

First, we investigate the EV charging scheduling problem under a charging station scenario by jointly considering the revenue of the charging station and the service requirements of charging customers. We first propose an admission control algorithm to guarantee the non-flexible charging requirements of all admitted EVs being satisfied before their departure time. Then, a utility based charging scheduling algorithm is proposed to maximize the profit for the charging station. With the proposed charging scheduling algorithm a win-win situation is achieved where the charging station enjoys a higher profit and the customer enjoys more cost savings.

Second, we investigate the EV charging scheduling problem under a parking garage scenario, aiming to promote the total utility of the charging operator subject to the time-of-use pricing. By applying the analyzed battery charging characteristic, an adaptive utility oriented scheduling algorithm is proposed to achieve a high profit and low task declining probability for the charging operator. We also discuss a reservation mechanism for the charging operator to mitigate the performance degradation caused by charging information mismatching.

Third, we investigate the EV charging scheduling problem of a park-and-charge system with the objective to minimize the EV battery degradation cost during the charging process while satisfying the battery charging characteristic. A vacant charging resource allocation algorithm and a dynamic power adjustment algorithm are proposed to achieve the least battery degradation cost and alleviate the peak power load, which is beneficial for both the customers and charging operator.

Fourth, we investigate the EV charging scheduling problem under a residential community scenario. By jointly considering the charging energy and battery performance degradation during the charging process, we propose a utility maximization problem to optimize the gain of the community charging network. A utility maximized charging scheme is correspondingly proposed to achieve the utility optimality for the charging network.

In summary, the research outcomes of the dissertation can contribute to the effective management of the EV charging activities to meet increasing charging demands.