User Interface Development for Bidirectional EV Charging

Relevance to the Automotive Industry:	With the increase of renewable energy sources comes the challenge of volatile power generation, which can lead to instabilities within the electric energy grid. One way to solve this problem is to integrate electrical storage systems into the grid, for instance in the form of electric vehicles capable of bidirectional charging, which can act as an energy buffer and feed power back to the grid if necessary.
Research Location:	Technical University of Darmstadt Institute for Mechatronic Systems (IMS)
Homepage (Engl.):	http://www.ims.tu-darmstadt.de/
Faculty Mentor:	Prof. Dr.-Ing. Stephan Rinderknecht
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Project Description: May 30 - Aug 06, 2022 (10 weeks, 40 h/week)	The Technical University of Darmstadt Institute for Mechatronic Systems (IMS) is participating in the research project KI4ETA, which aims to increase energy efficiency and flexibility within an industrial context, including the implementation of a bidirectional charging infrastructure to integrate electric vehicle (EV) batteries into the energy system of a model production plant and thus create further possibilities for optimization. As the driver of the EV plays an important role when selecting an operating strategy, communication is needed between the driver and the charging infrastructure. The goal of this NSF REU project is to develop a communications interface that enables the exchange of relevant data for the negotiation of an operating strategy of the charging point. The NSF REU student will perform research on the state of the art of bidirectional charging of EVs and related operating strategies. The knowledge gathered will be used to design a suitable communication system to transmit the necessary data for an optimized control of the energy system. The NSF REU student will develop a demonstration environment, including a driver interface, the communication system, a vehicle model, and a basic charging strategy. This environment will help demonstrate and visualize the benefits of bidirectional charging. **PHASE A** (2 weeks): First, the NSF REU student will review relevant research; get familiar with the bidirectional charging infrastructure at the model plant and identify suitable modeling approaches, control methods, and communication solutions. **PHASE B** (6 weeks): Next, the NSF REU student will develop a proof-of-concept communication infrastructure, vehicle model, and a suitable operating strategy, considering the environment of the model plant and selected use cases. **PHASE C** (2 weeks): Finally, the NSF REU student will document the research performed, prepare a written report, and deliver an end-of-summer presentation on the research performed.
Target publications:	• ICCIEV 2023: 17th International Conference on Charging Infrastructure for Electric Vehicles, March 11-12, 2023, Miami, Florida, USA. https://waset.org/charging-infrastructure-for-electric-vehicles-conference-in-march-2023-in-miami • ETG-Kongress 2023, May 3-4, 2023, Wuppertal, Germany
Necessary Skills/ Knowledge:	• Experience with MATLAB • Basic Experience with other programming languages (e.g. Python)
Desirable Skills/ Knowledge:	• Experience with MATLAB Simulink • Electric vehicles and charging infrastructure
Additional Online Resource(s):	https://www.ims.tu-darmstadt.de/forschung_ims/energie_systeme/projekte_5/ki4eta_1/ki4eta.en.jsp https://www.caiso.com/documents/curtailmentfastfacts.pdf

NSF REU Students must have completed at least two semesters of engineering studies prior to the proposed summer research, and they must have at least one semester remaining before they can earn their BS in Engineering.