
Automatic fast charging through electric road systems

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With the electric vehicle market growing the needs for charging solutions are increasing dramatically. Both fast charging and electric road systems (ERS) are great answers to these needs, but can they be combined? The thesis *Automatic fast DC static charging for EV* investigates the possibilities for using an already developed fast charging standard to charge safely through an ERS module.

Fast charging through an ERS is a big challenge because of safety reasons. During a fast DC charge the charger is directly connected to the vehicle's battery, without galvanic isolation on-board. The solution is using the Japanese fast charge protocol, CHAdeMO. With this solution the charger provides galvanic isolation, however three physical connections (positive, negative and protective earth) are needed. These connections are established between the ELONROAD module and the pickup, seen in figure 1.

The remaining six connections, used for communication in CHAdeMO, are sent wirelessly between the car and charger. The application can be described as an extension to the fast chargers we have today. As a user, you will no longer have to plug the heavy charger into the car. Simply by parking the car on top of an ELONROAD rail, and by the press of a button, the car connects itself to the grid and starts fast charging.

Looking at the ELONROAD system, there are two main parts: The rail on the ground and the pickup on the bottom of the car. The rail contains three connection plates to where the three pickup arms connect to respectively. There are therefore only two positions of the vehicle where the three pickup arms are connected to one plate each, being the two possible direction of the car. The switchbox solution ensures only the correct positions of the car will be able to start charging. With checking circuits, the solution can determine how the car is

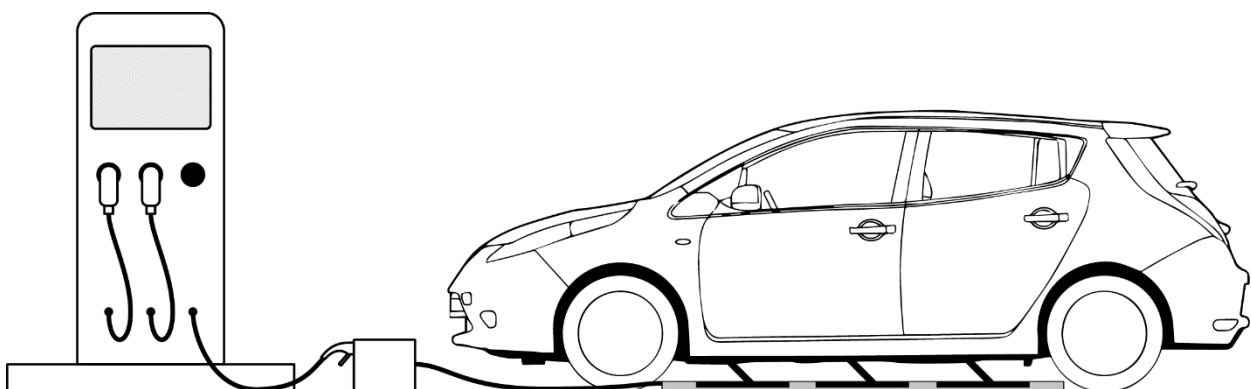


Figure 1: The developed solution combining fast charging with the ELONROAD system.

parked and what direction it is facing. It then switches the connections of the rail to match the ones on the car, ensuring a safe charge. The solution is one out of two subsystems, shown in figure 2, and is called the switchbox subsystem.

The second subsystem of the application is the communication subsystem. It handles all the communication connections of the fast charger, which are not directly connected to the ELONROAD. The communication is essential for controlling the charging process, ensuring a safe charge. There are two types of communication in CHAdeMO: complex digital communication protocol handling all the parameters of charging, and analog communication being simple on or off signals through a specific circuit. The communication subsystem manages these two communication types and sends them via WiFi between the charger and the car.

The built solution is able to recognise all the possible positions and directions of the car, and only allows charging if it is correctly positioned. It is also able to send all the communication wirelessly but has some limitations in compatibility with the fast charger protocol. Except for some compatibility issues, the overall system is expected to work completely.

The possibilities that the solution brings are endless. The way the system is built around handling the communication enables there to be modifications to the charging in the system. The charging power can be controlled to be dependent on the time the car expects to be parked on the charging station. For example, if the vehicle will be charging overnight the power is low, reducing stress on the battery and extending its lifetime.

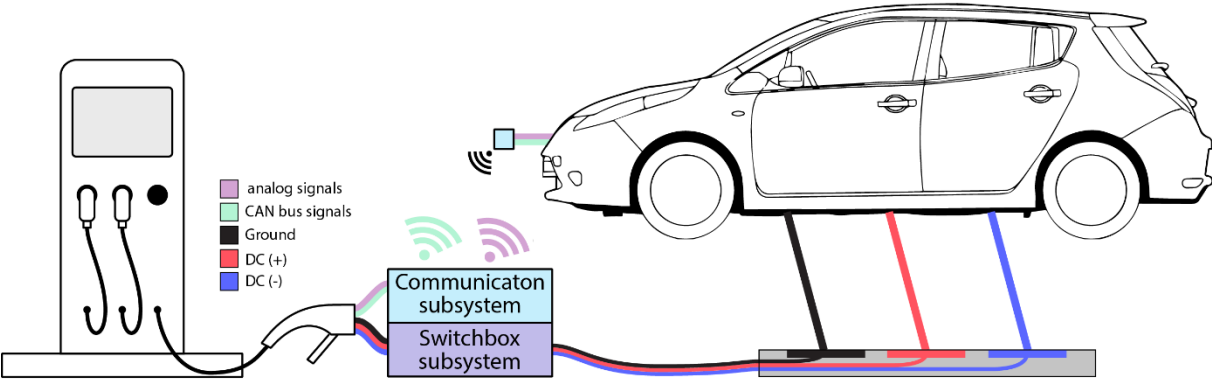


Figure 2: Illustration of the divided subsystems in the solution