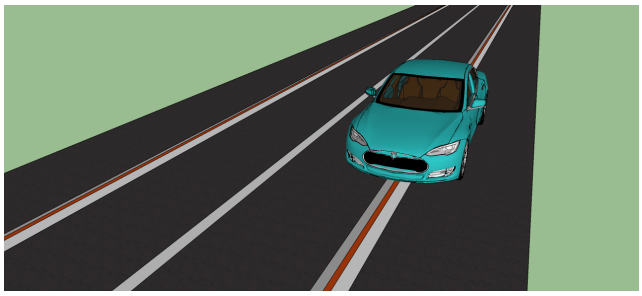
Ultrasound Enables Charge of Moving Electric Vehicle

Robin Hedlund, Marcus Romner

Electric vehicles can charge their batteries on road by connecting to a conductor integrated in the roadway. In this specific case the integrated conductor consists in an elevated structure. This structures location relative the car needs to be tracked to ensure the car stays connected.



Elonroad's concept with an elevated road structure and the ultrasonic positioning system.

Background

The company behind this concept of powering vehicles on road is Elonroad. Elonroad is recently founded and is currently co-developing the concept with the Faculty of Engineering at Lund University. Their vision is that tomorrows fleet of electric vehicle will be powered from a conductor on the roadway. The concept utilizes an electric power conductor which is placed on top of the existing roadway. The power conductor is contained in a triangular shaped elevation. The triangular shape is detectable by ultrasonic distance sensors mounted underneath a vehicle.

The main expense that makes fossil fueled vehicles more affordable than electric powered vehicles is the cost of the batteries. The batteries needs to be fairly large for electric vehicles to have a decent driving range. Powering cars and charging its batteries directly from the roadway increases the range the vehicle can drive before stopping and recharging. Thereby, the capacity requirements of the batteries can be decreased. It is therefore possible to reduce the initial costs of the electric vehicle and make it a more competitive option to fossil fueled vehicles.

Connecting to the Conductor

The challenge of connecting the vehicle to the conductor on the roadway and keep the connection remains to be solved. The idea in Elonroad's concept is to use a "pick-up", a sort of sledge placed on the bottom of the vehicle. The pick-up can move both vertically and horizontally relative the vehicles intended way of direction. The connection to the road conductor is made with the use of sliding contacts. The idea in this project is that the pick-up receives a positioning of the elevated structure, in relative to the vehicle. The positioning is obtained by the use of several ultrasonic distance measuring nodes, evenly distributed in an array going side to side under the vehicle. Every node contains two ultrasonic transducers, one transducers is sending out bursts of ultrasound against the surface under the vehicle and the other transducer records the returning echo. A microcontroller temporarily stores the signal from the recording transducer directly after the ultrasound burst is sent. An algorithm is searching through the stored data to find the beginning of the echo. By finding the beginning of the echo, the time between the moment the recording started and the echo began to return, is known. The speed of sound in air is known, it is therefore possible to translate the time of flight to a distance.

Verifying the System

Simulations and tests in laboratory environment has shown that a relative accuracy of 4mm for each distance sensor is adequate to give a sufficient relative positioning of the elevated structure. However, the system that has been built during the project have currently about 8mm accuracy which relates to the wavelength of a 40kHz ultrasound signal. It is possible to improve the accuracy by refining the algorithm and or upgrading the hardware that detects the echo. Some possible improvements and topics for future work is mentioned in the report TEIE-5378 2016[1].

[1]Thesis Title: Ultrasonic Positioning System for Electric Road System