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Feasibility analysis and development of on-road charging solutions for future electric vehicles

ANPR & SuperCaps shelter: POLITO charging Infrastructure

The Automatic Number Plate Recognition (ANPR) allows only the charging to the authorised vehicle while Supercaps improve the quality of the power required during the dynamic charging from the electrical network

Overview

The entrance of the charging line represents the point of interface between the IPT charging infrastructure and the external world. In this strategic point two elements are present: The Automatic Number Plate Recognition (ANPR) camera that detects the ID of each vehicle that is directed in the Charging Zone. The second one, inside the shelter, is a Supercaps bench that has the functionality to mitigate the effect on the grid of the peak of power requested by the dynamic charging.

Fig 1. Test site bird view

Partners involved

POLITECNICO DI TORINO

Authorization methodology

The ANPR camera is connected with the Charging station control unit (CSCU). When the vehicle books a charge, an ID number is associated to the plate number of the vehicle.
When an ANPR Event occurs and the plate number read from the camera is the same associated to the authorised vehicle, the Power Electronics (PE) of the charging line can start the vehicle identification procedure.

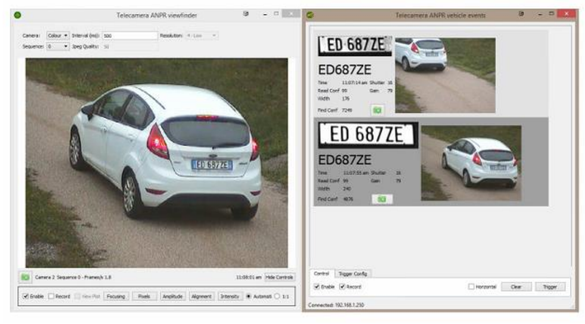

Fig 2. Screenshot of the ANPR camera software during the ID recognition

Power smoothing methodology

In the wireless charging infrastructure a relevant problem is due to the interspacing of the transmitters: the abrupt variations of the absorbed power during the passage of the vehicle from a transmitter coil to the next one represents a huge stress at the common coupling point with the electric network causing the degradation of the power quality related to possible voltage fluctuations. In order to improve the quality of the required power, a passive compensator on the DC distribution must be introduced (Fig.3). The role of the compensator is to absorb the harmonic contents of the current caused by the vehicle transitions (Fig.5, Fig.7).

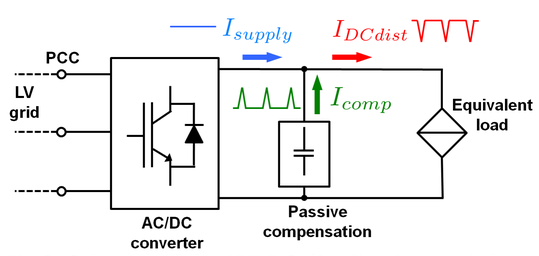

Fig 3. Scheme of the IPT DC distribution and the system for the passive compensation

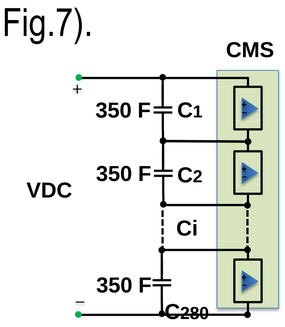

Fig 4. Capacitors bench and CMS

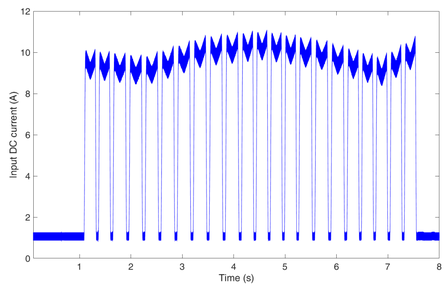

Fig 5. Idc distortion on the charging line without passive compensation

Fig 6. Capacitors bench and CMS

A passive compensator, realised by a bench of capacitor of 1.25 F, has been designed. The capacitors bench is composed by 280 Supercaps, BCAP0350, characterized by a capacitance of 350 F each, a nominal voltages of 2.5V and a maximum voltage of 2.85V. A Capacitor Management System (CMS) is used in order to limit the maximum voltage rating of each capacitor under the maximum voltage. The scheme of the capacitors bench (Fig.6) is reported in Fig. 4.

Achievements

The effectiveness of the bench capacitor has been tested by simulations (Fig.7). Laboratory tests have been done on the capacitor test bench showing drawbacks related to the series resistance of the capacitors (0.8 ohm). According to the experimental results, an active compensator must to be implemented using the capacitor bench, designed for the passive compensation, as energy storage .

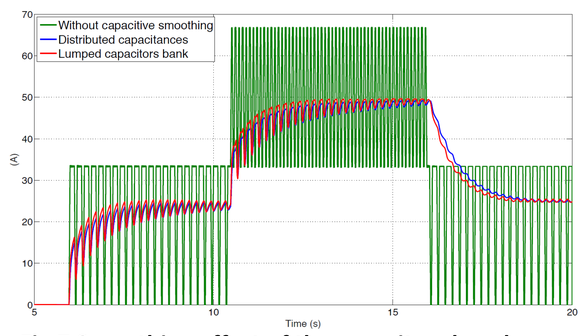

Fig.7 Smoothing effect of the capacitors bench

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