A little review on EV SOC when using MPC

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Paper 1:[CDiAMa2018]

The paper describes a general formulation of MPC before moving to a case study of charging Electric Vehicles. In this study, a reference day ahead of SoC scheduling is provided. The control horizon H_c equals the prediction horizon H_P, and both covers at least the time an EV spends at the charging station.

In order to build the day ahead SoC reference sequence, an open-loop optimisation (no disturbances included) where for each electric vehicle, the arrival time, the departure time, the initial Soc at the arrival time, the minimum SoC at the departure time are all known.

Given the SoC reference sequence obtained from solving the previous, a real-time dispatch is proposed to adjust the power injected in each Ev to compensate for the effect of the disturbances and uncertainties in the arrival SoC. To fulfil this goal, an MPC strategy where the cost function minimises the difference between the reference trajectory and the power injected while reducing the energy cost is used.

Paper 2: [SBaMZe2014]

Same as [CDiAMa2018] with the difference that here, the reference sequence is not SoC but voltage. The computation of this reference sequence is made at the first stage. The MPC strategy tracks the previously found voltage reference at the second stage and charges the EVs while satisfying the system constraints. The voltage deviation from the nominal voltage reference and the difference between the current SOC and the desired SOC are both penalized in the cost function.

Paper 3,4: [ADiFLi2014], [BRyWPo2018]

Same as both previous; however, here the reference is the Power. Although the strategy used is MPC, there is no mention of the length of the horizon used for the simulations.

Paper 5,6: [RHaNPo2012]

This paper describes the usage of the so-called Economic MPC to improve the electricity bill of one house with an EV. No difference is made between the prediction and the control horizon (24h and 48h), and both cover largely the time the EVs spend at the charging station. Based on the day ahead driving behaviour (to access the energy needed by the EV to sustain an entire trip home-Work-home for a day) and the electricity tariffs, the optimal SoC is attained at the departure time.

Paper 7: [YSiHDu2019]

This paper describes MPC usage to control the charging of multiples EVs charging stations in a smart grid. No assumptions are made on the arrival of the EVs, and there is no reference used for the PEV charging. However, the MPC Horizon is not constant over time. At each instant, the optimisation problem is solved over the horizon defined by $[t, \psi(t)]$, where t is the current instant and $\psi(t)$ is the maximum over the departure time all the current connected EVs. Defined as it is, the horizon length always covers the dwell time of each EV