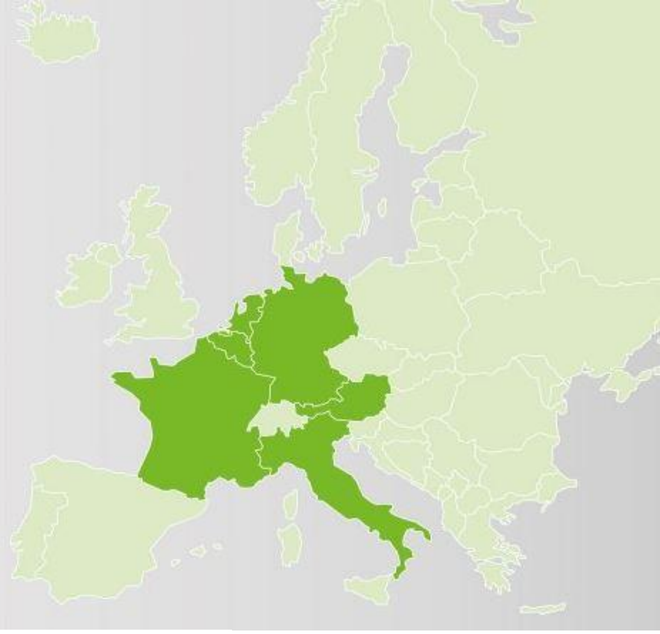
CEVOLVER

Connected Electric Vehicle Optimised for Life, Value, Efficiency and Range



Optimization of charging time at high powers through optimal and predictive thermal conditioning of the battery: Smart Fast Charging

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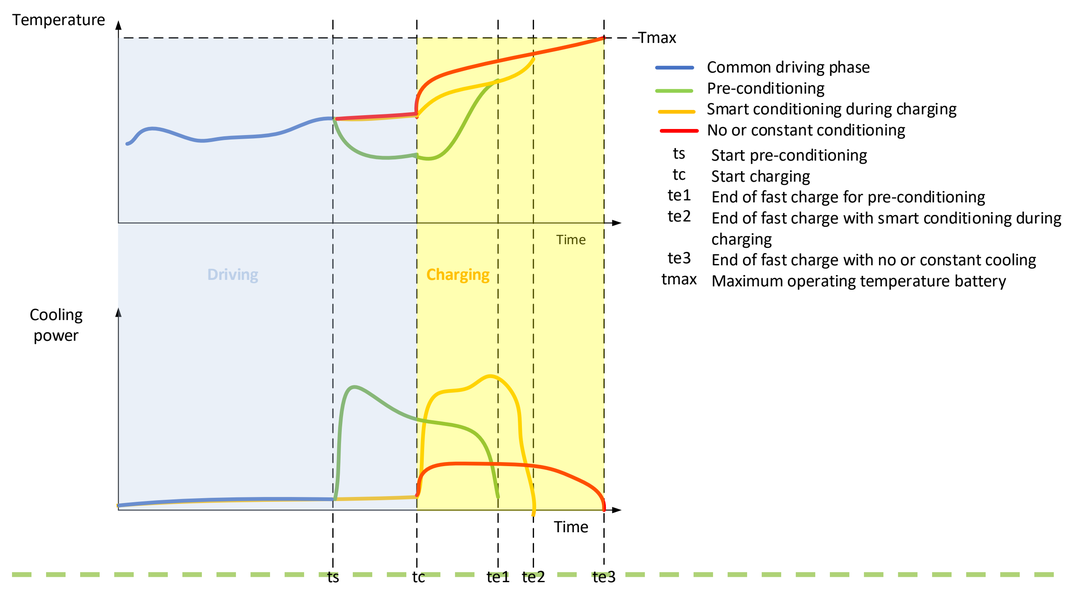
Principle

"Define the **cooling** or **heating** strategy such that:

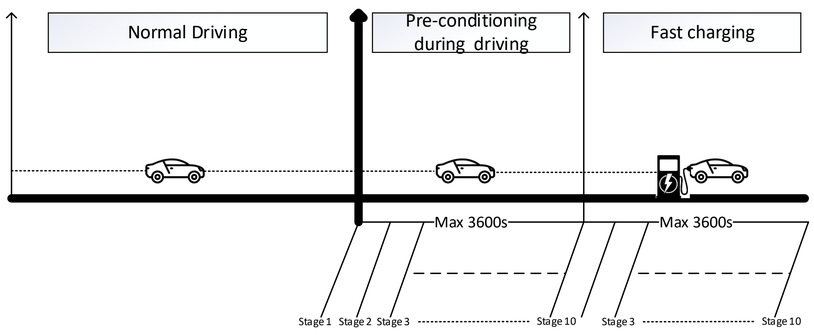
given the expected driving profile,
given the planned charging power,
given the planned arrival time at charging station,
given the predicted environmental conditions during driving and at the charging location,

- the battery operating boundaries are respected
- The time loss due to charging is minimum (maximum charging power)
- The energy consumption of the of the system is minimal."



Methodology

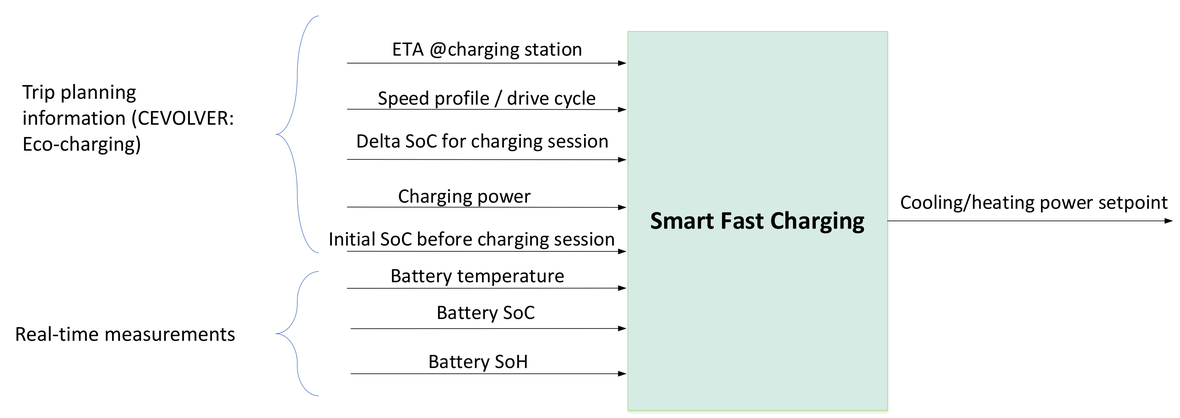
1. Offline optimal control map generation



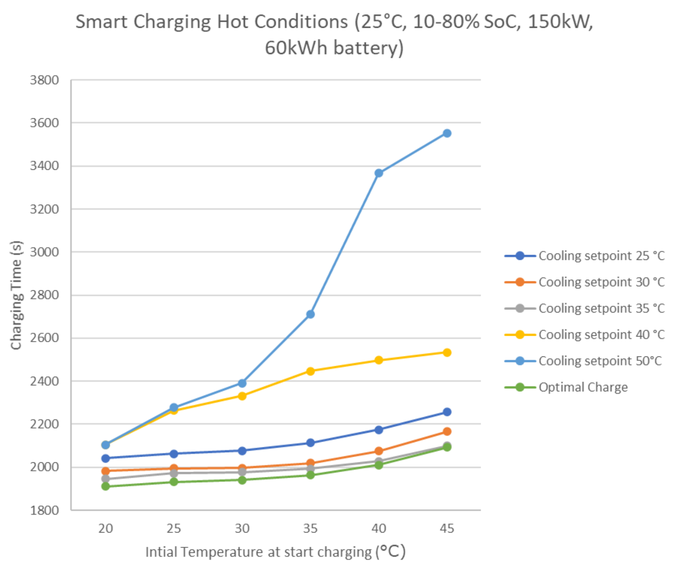
- Each phase split into stages with fixed states
- Offline optimization using Dynamic Programming (DP)

- DP runs simulations through stages with different control settings to find optimal control for states
- Stores results in multi-dimensional maps

2. Optimal control using pre-calculated maps

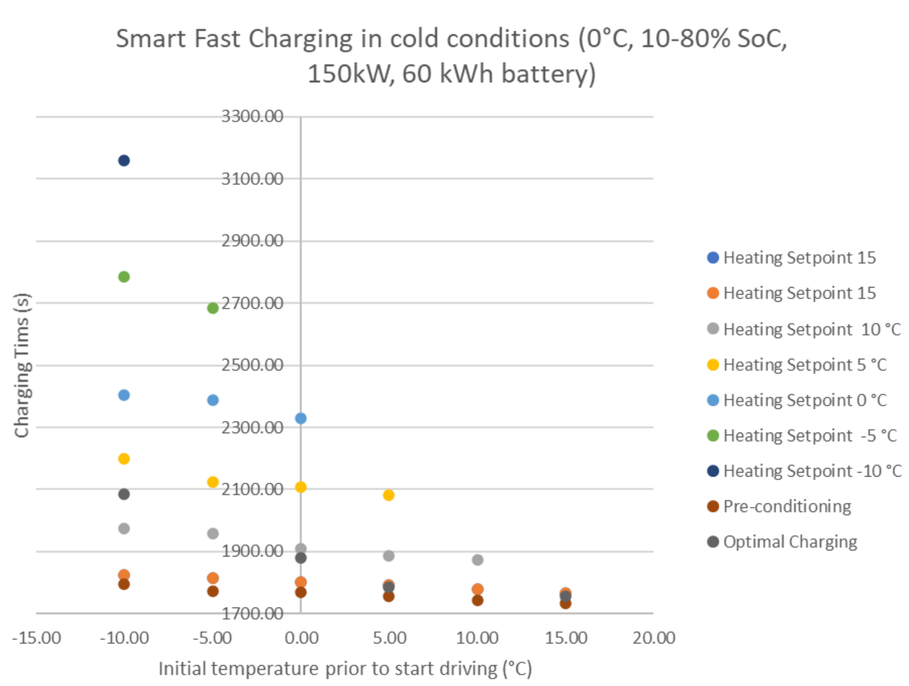


Results



- Advantage dependent on competing control strategy and characteristics of power de-rating during charging
- Pre-conditioning only relevant at higher C-rate or extreme conditions

Pre-conditioning has significant advantage to only optimal charging unless battery is actively heated during driving to moderate temperatures already



Simulation demonstrates preconditioning benefits ✓
- ✓ Moderate gains in hot conditions, benefit more significant for high C-rate or extreme conditions
- ✓ Significant gains in cold conditions

Workable set-up in Fiat 500 demonstrator with good results ✓
- ✓ Simple logic in vehicle
- ✓ 15,8% and 35,4% time gain for fast charge 21%-75% SoC at 8 °C and 0 °C respectively
- ✓ Results in line with simulations

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