



A charging management-based intelligent control strategy for extended-range electric vehicles

- ❖ Cite this as: Wen Song, Xin Zhang, Yi Tian, Li-he Xi, 2016. A charging management-based intelligent control strategy for extended-range electric vehicles. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 17(11):903-910.
- ❖ <http://dx.doi.org/10.1631/jzus.A1600036>

Global Energy Trend



Energy



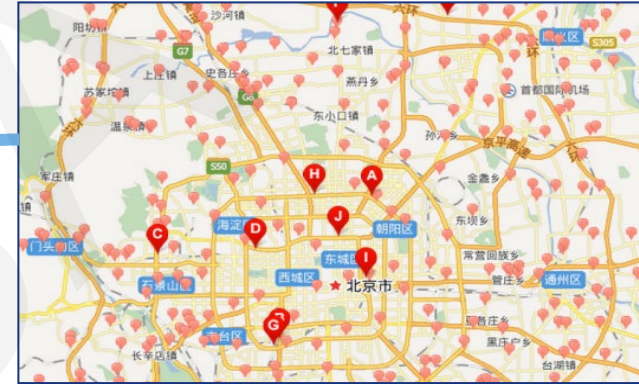
Electric Vehicle



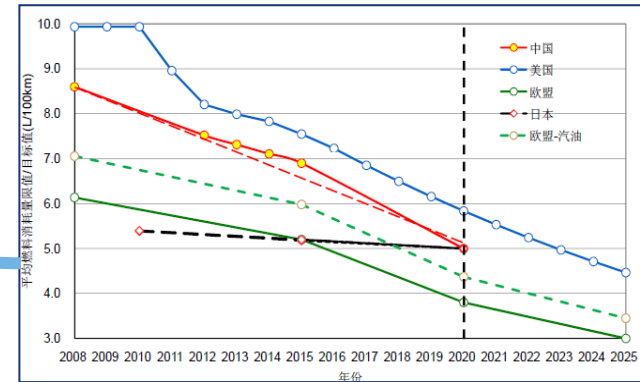
Extended-Range EV



Gasoline Car



Charging VS gas station



Regulation



Environment Problem



Intelligent Transportation System

The entire driving cycle is shown in Figure 1, which can be described as a battery charging cycle encompassing "pure electric driving → extended range → charging from outlet → pure electric driving."

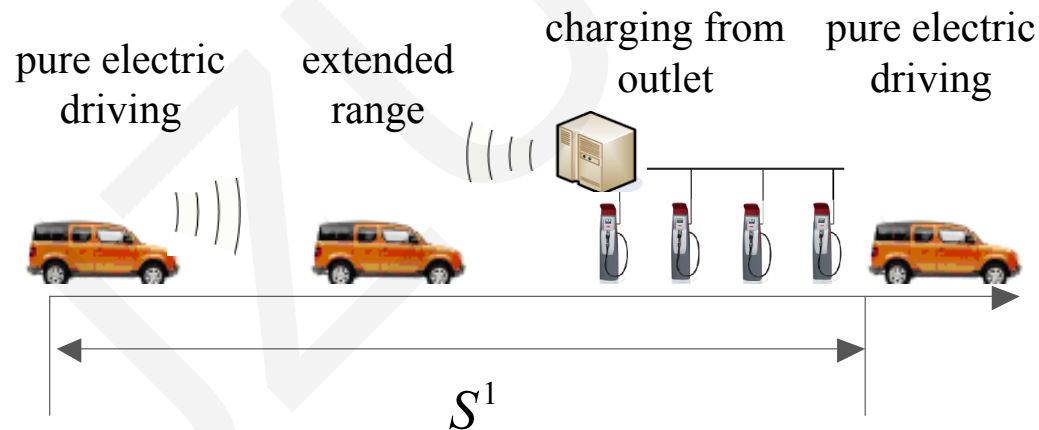


Fig. 1 Schematic diagram for the E-REV driving cycle

Road Type Analysis

Most city roads are divided into four main categories; namely, expressways, arterial roads, secondary roads, and access roads. Table 1 shows a statistical analysis of arterial roads and the expressway driving cycle in Shanghai, Wuhan, and Guangzhou. This indicates that the road conditions for arterial roads are more congested and the power demands are lower.

Table 1 Velocity data table for driving cycles for urban arterial roads and expressways

City	Shanghai		Guangzhou		Wuhan	
Road type	Art	Exp	Art	Exp	Art	Exp
Max (kph)	57.0	79.9	60.2	79.8	59.6	79.9
Mean (kph)	17.1	57.7	21.7	39.5	28.6	38.5



Fig. 2 arterial roads



Fig. 3 Highway

The initial strategy of the E-REV thermostat control strategy and its simulation results can be seen as Fig. 5. As driver decides to go to the charging station at 172.5 kilometers into the route, the initial strategy keeps the SOC rising to the highest value before the range-extender turns off. When the E-REV arrives at the charging station, the SOC value is 52%. Due to the higher SOC, too much energy remains in the battery. Thus, the ability to obtain more clean electricity from the charging station for the E-REV is limited.

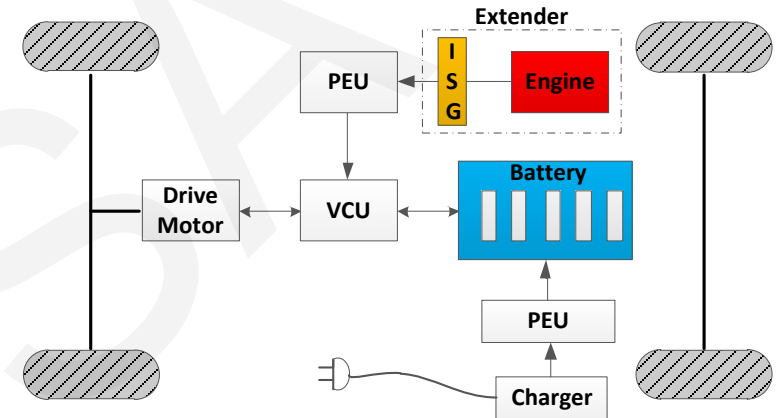


Fig. 4 E-REV power system structure.

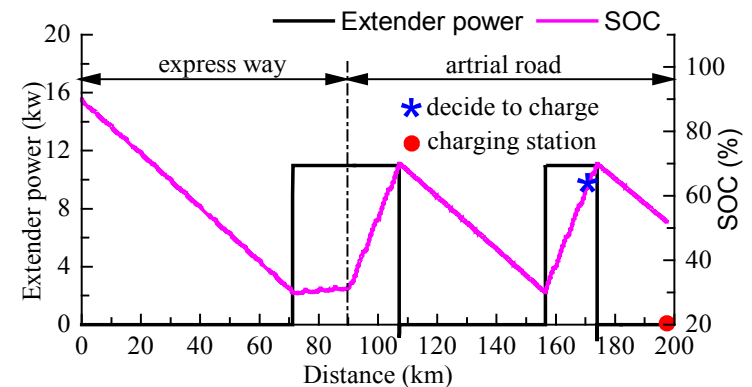


Fig. 5 Initial strategy simulation results

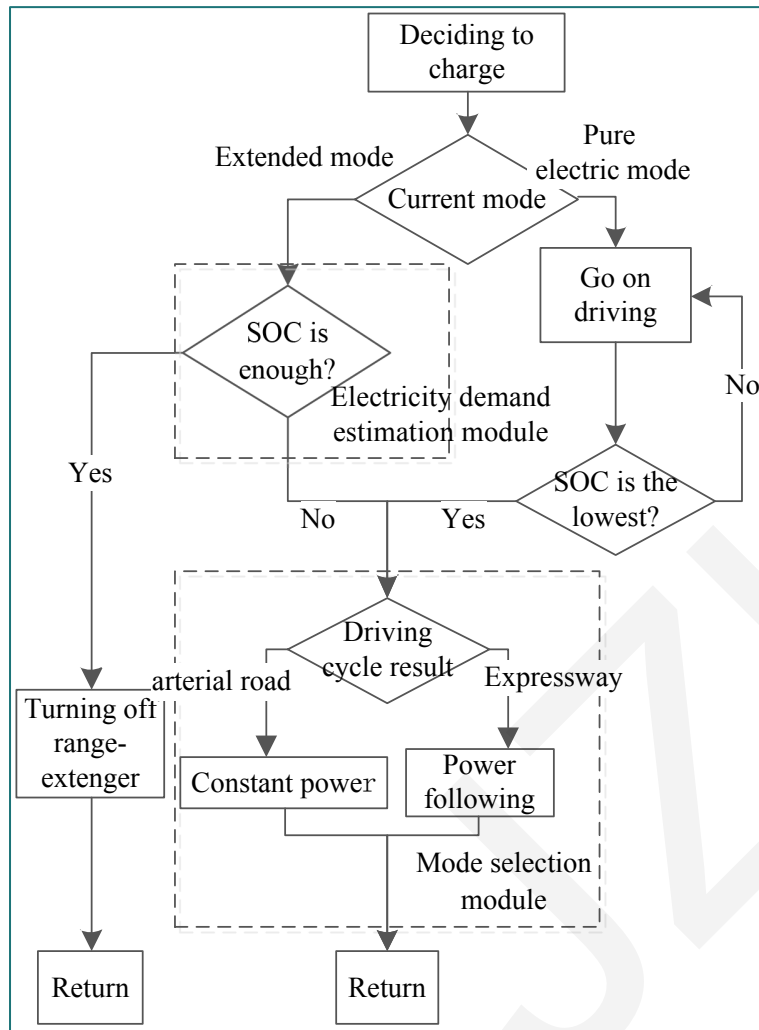


Fig. 5 Proposed control Strategy framework diagram

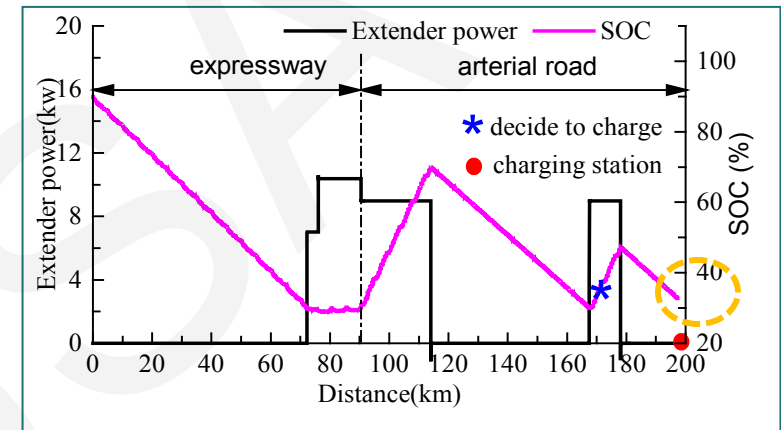


Fig. 9 Simulation results for the charging management-based intelligent control strategy

The intelligent control strategy operates the range-extender in different modes according to the current driving cycle by using the power following control strategy on the expressway, and a constant power control strategy on arterial roads.