Variations of vehicle energy consumption informed by real-world GPS trajectory data and driving cycle

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Abstract

Researches have shown that inadequate representativeness of testing cycles could lead to significant discrepancy in vehicle energy and emission assessment between on-road performance. On-board measurement has been used in past researches to collect vehicle activity data but the amount of data is usually insufficient, and the statistical coverage of various road/traffic types could not be guaranteed. Using "big data" mining techniques, this study examines second-by-second GPS data of 459 private passenger cars in Beijing, covering over 17,000 sampling days to characterize vehicle speed profiles under various traffic condition and road types. We then applied the Markov Chain method to generate sub-cycles and corresponding weighting factors that have similar properties as real-world driving. As case study, two typical driving cycles (i.e., Off-peak Cycle, Peak Cycle) are constructed from six sub-cycles representing different road types and traffic conditions, which depict fine-scale discrepancies of driving characteristics among different situations. Vehicle fuel consumption simulation results show that the developed typical driving cycle leads to up to 20% higher fuel consumption than regulation test cycles (i.e., NEDC, WLTC). This study proposes a practical method to construct driving cycle from massive GPS trajectory data and highlights the variations of vehicle energy consumption caused by different driving cycles.

Keywords

Driving cycle; large-scale GPS data; Markov Chain process; Spatial and temporal classification; Vehicle energy consumption