Real-world driving cycles and energy consumption informed by large-sized vehicle trajectory data

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Abstract

The inadequate representativeness of driving cycles used by regulatory lab tests is one significant factor leading to the large discrepancy between real-world fuel consumption and type-approval levels. On-board measurement devices have been used in previous researches to collect vehicle activity data but the amount of data is sometimes limited. With second-by-second GPS trajectory data of 459 private passenger cars, covering over 17,000 sampling days, we used big-data mining techniques to study the variations in real-world driving cycles. A Markov chain method was developed to generate typical driving cycles that have representative features of real-world driving. As a case study, two typical cycles, Off-peak cycle and Peak cycle, are constructed from six sub-cycles representing different road types and travel periods, which could depict fine-scale discrepancies of driving characteristics among different situations. The simulation results of vehicle fuel consumption showed that different driving cycles could lead to different lab-to-road gaps when comparing with the NEDC type-approval levels. For example, the fuel consumption (median value) of Off-peak cycle and Peak cycle were higher than the NEDC type-approval level by 29.3% and 37.5%, respectively. This study highlights the importance of real-world vehicle activity data in improving future fuel economy regulations.

Keywords

Driving cycle; second-by-second GPS trajectories; Markov Chain process; Light-duty vehicles; Real-world energy consumption