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

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Abstract

Inadequate representativeness of driving cycles used by regulatory in-lab tests is one significant factor leading to large discrepancy between real-world fuel consumption and type-approval levels. On-board measurement devices have been used in past researches to collect vehicle activity data but the amount of data is usually limited. With second-by-second GPS-informed trajectory data of 459 private passenger cars in place, covering over 17,000 sampling days, we enabled to use 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 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 NEDC type-approval fuel consumption median value is lower by 28% than on road fuel consumption of Off-peak cycle, and lower by 36% than that of Peak Cycle. This lab-to road gap also varies among different driving cycles and different vehicle models. This study constructed typical driving cycle from massive GPS trajectory data; the result highlights the discrepancy of vehicle energy consumption between real-world driving cycles and regulation test cycles and the importance to address real-world driving conditions in future regulation.

Keywords

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