# A Data Acquisition Methodology for the Development of Local Driving Cycles

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**Abstract**

Driving Cycles (DCs), the time speed profiles of a certain vehicle type for a given road segment can be considered as one of the main tools to quantify and to assess the performance in terms of fuel economy and emissions of a given vehicle category. There have been numerous approaches that have been adopted to develop DCs locally, representing various geographical regions of the world. Despite various approaches adopted, the researchers have defined a four-stepped common methodology for DC development viz. Route Selection, Data Acquisition, Cycle Construction and Cycle Assessment. During the study, approaches have opted under each step pertaining to the purpose of the DC development, i.e. for the characterization of fuel economy.

Acquisition of data for DC development is one of the most important steps of the procedure since the representativeness of the DC of local driving behaviour depends on the quality of the data collected. Regardless of the approach adopted, the acquired data should be reliable, representative, consistent and homogeneous. The three main approaches that are in practice throughout the world can be listed viz. chase-car method, instrumented-car method and hybrid method. During this study, more focus is concentrated on suggesting a methodology of data collection for DC development. Since local driving behaviour incorporates irregular kinematic patterns integrated with aggressive driving behaviour, the instrumented-car method has opted over the chase-car method. Moreover, the operational complexity and the cost associated with the latter approach is higher than that of the opted method. Furthermore, on par with the introduction of On-Board Diagnostics (OBD) protocol as a worldwide standard for automobiles in the later 1990s, the invention of many OBD data logging devices happened. Consequently, the data logging on an automobile has been made convenient than ever. When it's funnelled down to the instrumented-car method, the techniques in practice can be listed under two main categories viz. device-based methods and device and app-based methods. In device-based methods, the data are saved in internal storage and then it'll be transferred for analysis. On the other hand, the device and app-based method facilitate the real-time data to be transferred to the connected app-hosting device viz. a mobile device, tablet or a laptop. In the latter method, the data logging device is connected with the app-hosting device primarily via Bluetooth or WIFI.

Car manufacturers have introduced their own OBD data logging devices with internal storage viz. Chrysler DRBIII, Ford New Generation Star Tester, General Motors Tech II, Toyota Diagnostic Tester, Nissan Consult, VAG 551, etc. The said devices have mostly been introduced with the manufacturers' proprietary technology which has made them costlier. Due to the cost factor in the device-based method, most of the researchers have adopted device and app-based methods which have come up with low-cost alternatives. A dedicated data logging device, ELM-327 adapter has opted for the research study. Due to its lower cost and hence multiple devices can be used for parallel data collection in vehicles. Out of several third-party software applications for OBD data logging, Torque ProTM has been opted for the study mainly due to its feature-rich interface, operational convenience and compatibility with a wider range of vehicle variants. The data is sampled at a frequency of 1 Hz. The logged data onto the app-hosting device is saved in two main types i.e. '.csv' file type and '.kml' file type. The mechanical parameters viz. engine speed and fuel flow rate, the spatial parameters viz. latitude, longitude and altitude have been logged using the said device-app arrangement.

During the study, data is planned to collect from two-wheelers (2W), three-wheelers (3W) and four-wheelers (4W). The initial phase of the study would be to analyze the data streams pertaining to 2W, 3W and 4W, then evaluate whether there are significant discrepancies among the driving behaviours and patterns. Then the second phase of data collection would be conducted to develop the local driving cycle. Unlikely in 4W, in 2W and 3W, an OBD port cannot be found in common. Thus, an app-based data acquisition method is recommended for 2W and 3W. With respect to this case, several readily available applications are tested. The major limitations of the applications are that they log data at lower frequencies such as less than 1 Hz and the operational difficulty of obtaining the logged data from the users' devices since the real-time data logging feature is unavailable in most. Therefore, a locally developed application at the University of Moratuwa which suits the data collection requirements has opted. The sample size has been selected as thirty vehicles from each category, accounting for ninety vehicles altogether in all three types. The geography of data collection has been selected as the urban areas of Colombo City.

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