Estimating fuel consumption of cars based on movement data and its sensitivity to car and movement specific properties

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The transportation sector is responsible for approximately 20 percent of global CO2 emissions of which most of them are produced by road traffic. Moreover, emissions are rising and are rising faster than in other sectors. Reducing these emissions will be crucial to reach the goals of the 2016 Paris agreement. Efficient reduction strategies and their monitoring rely on broad and exact data about passenger car fuel consumption and emissions.

To encourage people to drive eco-efficiently and to collect traffic data the open Citizen Science Platform enviroCar (https://enviroCar.org) had been initiated. Data from the internal vehicle's communication bus can be sent to the enviroCar Android App via an OBD-Bluetooth adapter and the data can be anonymised and uploaded as open data to the enviroCar server. Fuel consumption - and thus also emissions - are conventionally calculated from motor-specific data like mass-air-flow. One drawback of this approach is that users need to have an OBD adapter installed to get these specific data. An easier and broader use of the app is achieved by basing the calculation of energy consumption on movement data only which can be measured by GPS sensors in many mobile phones.

We present such a purely GPS-based approach and means to assess the sensitivity of the resulting fuel consumption to parameters of the vehicle and the movement pattern. The analyzed vehicles and track patterns show a high degree of heterogeneity regarding size and weight of vehicles and driven speed, acceleration and road gradient. In total, 51 tracks from the open enviroCar server covering 7600 km within 95 hours were analyzed.

The calculation is done using simple physical laws and is very lightweight, yet the fuel consumption values are relatively precise when compared to the OBD data based approach. The differences of fuel consumption per 100 km are typically below 1 l. Only for tracks which include a significant amount of stop-and-go characteristics, the observed discrepancies exceed 1 l.

The approach can also be adapted to electric cars as it is load-based. In this case, a recuperation model has to be included and the model to calculate efficiency has to be adapted.

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