Development of AI-based typical driving cycles using variations of the k-means clustering algorithm

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Introduction

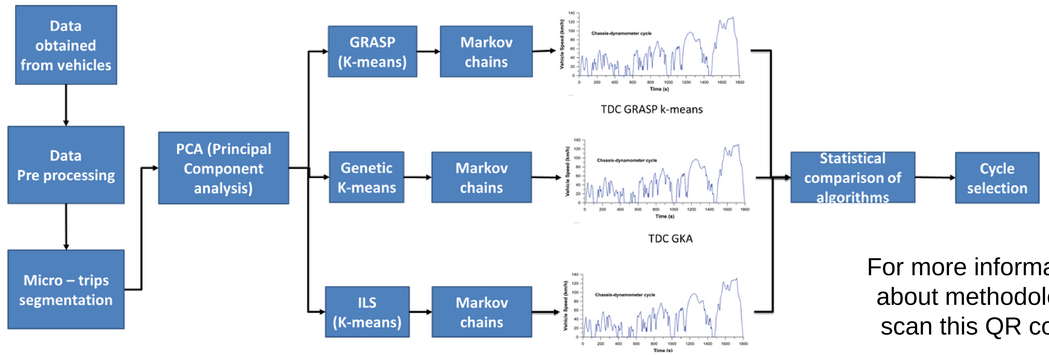
- In 2016, the World Health Organization evidenced that 4.2 millions of deaths were caused by air pollution. [1]
- A typical driving cycle is a graphical representation of velocity as a function of the time that describes in average the behavior of driving patterns in a specific region. [2]
- Standard driving cycles do not represent the behavior of cars in a specific region. [3]
- Construction methods of Typical driving cycles are primarily statistical and methods of artificial intelligence specifically machine learning [3-4]

Conclusions

- There is no significative difference of the algorithms used over the average medium error of the typical driving cycles
- In general, the genetic algorithm presents longer calculation time for typical driving cycle construction, in comparison ILS - FORGY algorithm, wich has a stable behavior in time development.
- Standard typical driving cycles (FTP75, WLTC and UC/LA 92) do not represent the behavior of vehicles for El Paso, San Antonio and Houston/Galveston.
- It is important to develop local typical driving cycles in order to develop accurate emission inventories and develop local regulation for vehicles.

Methodology

For the development of Typical driving cycles, three databases were selected from the National Renewable Energy Laboratory (NREL)[5], specifically for Houston/Galveston, El Paso, and San Antonio. Three different variations of the k-means algorithm applying metaheuristics such as GRASP, ILS with two types of initialization and a Genetic algorithm were developed. The results obtained with these algorithms were analyzed and compared statistically.



For more information about methodology scan this QR code

Results

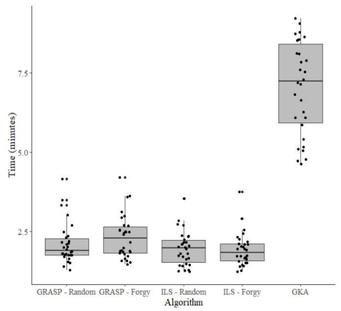


Figure 1. Time Results – El Paso

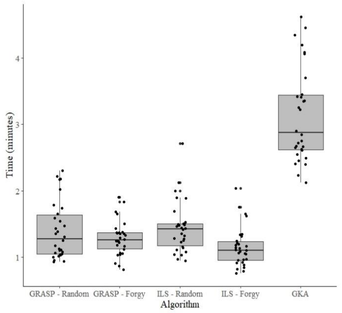


Figure 2. Time Results – San Antonio

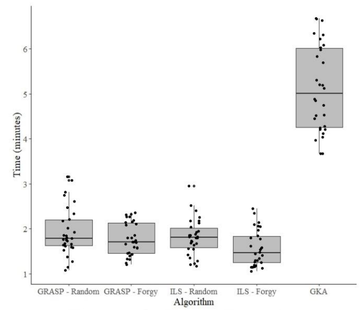


Figure 3. Time Results – Houston/Galveston

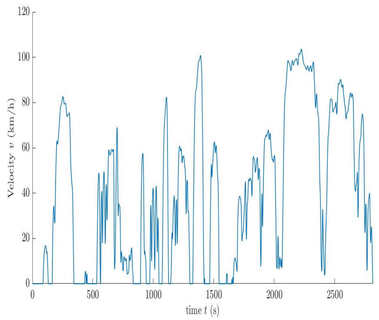


Figure 4. Typical Driving Cycle – El Paso

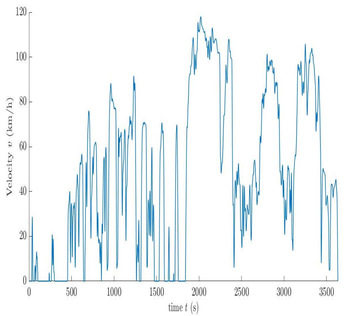


Figure 5. Typical Driving Cycle – San Antonio

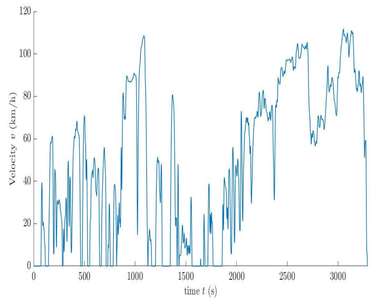


Figure 6. Typical Driving Cycle – Houston/Galveston

Ongoing Work

- Development of typical driving cycles with the algorithms presented based on data from Bogotá's Metropolitan area, for the analysis of vehicle emissions factors and the design of local regulation

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