

A method to construct driving cycles based on micro-trips and cluster analysis

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Abstract

Global warming and environmental pollution are common concerns for several agencies and society (RTVE, 2016), with transport being one of the sectors that contributes most to this problem (World Bank, 2014). One of the developments that help reduce its impact is the application of driving cycles in the design or redesign of vehicles adapting it to their specific needs, depending on the characteristics of the region under study and the way of driving. For this, it is required to have a driving cycle with representativeness of the driving patterns in a certain region or route. In order to obtain a representative driving cycle, a clear, justifiable and validated construction methodology must be available.

The purpose of this study is to design a methodology to build driving cycles using statistical techniques, such as cluster analysis, and the construction method of driving cycles with micro-trips, which is the most commonly used and easy to handle method. The simultaneous application of these two techniques is the great value and the differentiating point with respect to the methodologies proposed until now.

Finally, a validation of the proposed methodology is performed by comparing the driving cycle obtained by the proposed methodology and the one generated by a deterministic methodology (the MWD-CP). The comparison was made in three selected variables: the average speed, idle speed and SAPD (speed acceleration probability distribution). Being the average speed one of the most used performance measures used for the evaluation of driving cycles, results show that the relative difference of this variable, when we compare the average from the sample data and the average from the proposed driving cycle, is 1.25% while the driving cycle obtained by the MWD-CP has 15.67% relative difference.

Keywords

Driving cycles, micro-trips, real-world, cluster analysis, vehicles

Biographies

Marco Felipe Astaiza Castro is industrial engineer graduated from the Pontificia Universidad Javeriana - Cali, Colombia; with emphasis on manufacturing operations, services and logistics. He did a research internship in the Energy and Climate Change research group at Tecnológico de Monterrey, Monterrey, Mexico. He currently works as Quality and Planning Coordinator at San Marcos Hospital in Cali.

Michael Daniel Giraldo Galindo is a doctor in engineering science at Tecnológico de Monterrey, Mexico and has a master's degree in automotive engineering in the same university. He studied mechanical engineer at Universidad EAFIT, Colombia. He has worked in Energy and Climate Change Research Group and Automotive Engineering Research Group at Tecnológico de Monterrey. He was a visiting scholar at University of California – Davis in Institute of Transportation Studies – ITS. He has worked in research projects with international companies like Coca Cola FEMSA, General Motors, Ford and Bosch. He is the author and co-author of scientific articles on topics such as air quality, energy efficiency in transport and mechanical vibrations.

Jenny Díaz Ramírez is currently a professor of the Department of Engineering at the University of Monterrey. She has worked previously as professor at Tecnológico de Monterrey, Mexico and Pontificia Universidad Javeriana Cali, Colombia. She is industrial engineering from Universidad del Valle, Colombia. She holds an MSc in industrial engineering from Universidad de los Andes, Bogota, Colombia, an MSc in operations research from Georgia Tech, US and the PhD in Industrial Engineering from Tecnológico de Monterrey. She is a member of the National System of Researchers of CONACYT, SNI Level I, since 2015 and recognized as an associated researcher by Colciencias, since 2016. She is the author and co-author of scientific articles on topics such as applied optimization and statistics in health systems, air quality, energy efficiency in transport and logistics.

José Ignacio Huertas is mechanical engineering from Los Andes University, Bogota, Colombia. He holds a M.Sc, and a Sc.D. in Mechanical Engineering at Washington University, MO, USA. Currently, he is a researcher professor of the Mechanical Engineering Department at Tecnológico de Monterrey, Campus Monterrey. He is member of the Energy and Climate Change Focus Group at Tecnológico de Monterrey, member of the National System of Researchers of CONACYT, SNI Level I, and member of the Mexican Institute of Sciences. He has published 3 books, 4 book chapters and more than 47 articles in indexed magazines related to energy and air pollution. He has completed more than 90 research and technological development projects financed by companies and government entities in Colombia, Mexico, Spain, France, and US. He has graduated 65 teachers and 6 doctors. His research topics are fuel consumption reduction, air quality modeling, motors and combustion, driving cycles, and smart cities.