A Survey of Approaches to Describe Driving Patterns.

Jessica Gissella Maradey Lázaro
Mechatronics Engineering Program
Universidad Autónoma de Bucaramanga
Bucaramanga, Santander, Colombia
jmolina54@unab.edu.co, bacuna152@unab.edu.co, jmaradey@unab.edu.co

Jose Ignacio Huertas Cardozo
Mechanical Engineering Department
Tecnológico de Monterrey
Monterrey, Nuevo León, México
jhuertas@tec.mx

Abstract

The efficient use of resources, sustainability, innovation, the inclusion of information technologies such as IoT and industry 4.0, urban planning, public management, social cohesion, citizen security, mobility and transport are the tools which a city must be considered smart. Smart cities have emerged as a response to problems such as climate change, high energy consumption due to population density of cities, difficulty in mobility due to the imbalance between roads and vehicle systems (i.g motorcycles, vehicles, bicycles, public transport), competitiveness and economic growth. Also, the need for intelligent mobility arises as a solution to the problems of vehicular traffic (i.e congestion), pedestrian traffic and lost time, unsafety , air pollution, the growth of the vehicle fleet both in quantity and in diversity of vehicle types and the limited availability of road infrastructure. These factors have a direct impact on driver behavior (i.e trend and style), on vehicle use and performance (i.e modes of operation) and on energy consumption (i.e fuel consumption, or electricity) and on the direct or indirect emission of pollutants.

The way the population drives is known as the Driving Pattern (DP). Currently, there is no clear definition of DP. Commonly, DP has been defined as that which describes the behavior of the driver. In a broader sense, DP should describe the way in which one drives in a specific region, including not only human factors (driving behavior) but operational factors (driving style) as well as reflecting the driving conditions (driving conditions). Then, it is necessary to determine other characteristics of the driving pattern and not only the average speed is enough. DP varies from one region to another, which limits the application of valid and widely used techniques. For this reason and the availability to collect sufficient data, it is unknown whether Latin American cities present similarities in their driving patterns.

Frequently, driving patterns are represented by Characteristic Parameters (CP) which are dependent on speed and time. To obtain the CPs, a second-by-second record of the vehicle speed is required, which is obtained through GPS (Global Position System). This process must be carried out on a representative sample of vehicles for at least one year of operation to capture seasonal behaviors, which makes it highly costly. Currently, there is no consensus on the number of CP's that should be used to recognize the driving pattern nor on what is the appropriate methodology to describe them in a generalized, reliable, and representative way. Other alternatives to describe DP are: Vehicle Specific Power (VSP), Speed- Acceleration Probability Distribution (SAPD), Driving Cycles (DC) and Driving Pattern Recognition (DPR).

Knowledge of local driving patterns is required to identify and design strategies that help reduce energy consumption and vehicle emissions. Likewise, is possible to recognize and evaluate the driving styles of a region respectively. This project aims to show current methodologies and evaluate the performance to describe local driving patterns.

Keywords
Driving patterns, driving cycles, driving styles.

Acknowledgements

Biographies

Jessica Gissella Maradey Lázaro is an Associate Professor. She is a Mechanical Engineer, Master in Engineering with emphasis in Quality Systems and Productivity, Master in Mechanical Engineering and Ph.D student in Engineering from the Universidad Autónoma de Bucaramanga. Certified Vibration Analyst ISO Category I. Member of RELIEVE (Red Latinoamericana de Investigación en Energía y Vehículos). Her areas of interest are: energy and vehicles; dynamics, vibration and control; structural health. ASME and SAE Member. Researcher at Control and Mechatronics Research Group (GYCIM) by Universidad Autónoma de Bucaramanga and Dynamic, Control and Robotic Research Group (DiCBoT) by Universidad Industrial de Santander. 8 years automotive industry experience.

Jose Ignacio Huertas Cardozo is an Titular Professor of the Mechanical Engineering Department at Tecnológico de Monterrey, México. Researcher of the Energy and Climate Change Research Group. Member of the Mexican Academy of Science and of the National System of Researchers. Research areas: Energy, Combustion, Vehicular Emissions, Air Pollution and Smart mobility. A mechanical engineer from Los Andes University, Colombia (1988). Master's in mechanical engineering from Los Andes University (1990) and from Washington, St. Louis, USA (1994). Doctor of Science from Washington University (1997). Associate professor at Los Andes University until 2002. Since then, a full-time professor at Tecnológico de Monterrey, Mexico. Works leading a team of the Energy and Climate Change Research Group of the School of Science and Engineering at Tecnológico de Monterrey. Currently, is a member of the National System of Researchers in both Mexico (SNI 2) and Colombia (Senior).