INFLUENCE OF THE DRIVER PROFILE ON THE AUTONOMY OF ELECTRIC VEHICLES

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Abstract: In response to the growing pressure from civil society on the automotive industry and governments regarding the sustainability and reduction of environmental impacts of vehicular fleets, in recent years there has been a substantial increase in the application and development of technologies applied to vehicular electrification. Among the efforts to massify electric vehicles there are aspects of their reduced autonomy compared to combustion vehicles. The study of vehicle aspects that influence vehicle autonomy becomes imperative so that the best driving practices and energy management strategy are mapped and known. This work aimed to evaluate the influence of the driver profile on the autonomy of electric vehicles. Data were obtained through a device connected to the OBDII port and collected significant information for the evaluation of vehicle parameters such as: speed, battery level, distance covered, autonomy and so on. The results obtained, albeit preliminary, indicate that the profile of the driver influences the autonomy of electric vehicles.

Keywords: Vehicle Autonomy, Electric Vehicles, Driver Profile.

INFLUÊNCIA DO PERFIL DO CONDUTOR NA AUTONOMIA DE VEÍCULOS ELÉTRICOS

Resumo: Em resposta à crescente pressão da sociedade civil sobre a indústria automotiva e governos em relação à sustentabilidade e redução dos impactos ambientais das frotas veiculares, nos últimos anos houve um aumento substancial na aplicação e no desenvolvimento de tecnologias aplicadas à eletrificação veicular. Entre os esforços para massificar os veículos elétricos, há aspectos de sua autonomia reduzida em relação aos veículos de combustão. O estudo dos aspectos do veículo que influenciam a autonomia do veículo torna-se imprescindível para que as melhores práticas de direção e estratégia de gestão de energia sejam mapeadas e conhecidas. Este trabalho teve como objetivo avaliar a influência do perfil do motorista na autonomia de veículos elétricos. Os dados foram obtidos por meio de um dispositivo conectado à porta OBDII e coletadas informações significativas para a avaliação dos parâmetros do veículo como: velocidade, nível de bateria, distância percorrida, autonomia e assim por diante. Os resultados obtidos, ainda que preliminares, indicam que o perfil do motorista influencia na autonomia dos veículos elétricos.

Palavras–chave: autonomia do veículo, veículos elétricos, perfil do motorista

1. INTRODUCTION

The way of driving an electric vehicle has a great influence on the vehicle's autonomy considering some habits that contribute to the reduction of energy consumption of the electric vehicle and as shown in several studies [1,2,3] considering combustion vehicles, the driving behavior has an important effect on fuel consumption, regardless of the type of vehicle being driven. Respecting speed limits and optimizing the use of regenerative brakes are actions that contribute to a lower consumption of battery charge [4].

According to a study by Sofit [5], evaluating the behavior of drivers for companies that employ drivers is important because it can have a significant impact on the financial results of companies and that evaluating the profile of drivers requires work based on serious and concrete parameters. The study also mentions that choosing a driver with an adequate profile for the company's goals can even bring savings in fuel consumption.

Research developed by E. Ericsson [6] suggests that driving behavior is affected by several factors such as street design, traffic management methods, traffic conditions, weather conditions and the physical and mental condition of the driver.

In research carried out by Catarina C. Rolim [7], results indicate that the adoption of electric vehicles impacted daily routines in 36% of participants and 73% of drivers observed changes in driving style.

In this context, the present work aimed to evaluate the correlation between the driver's profile and the autonomy of electric vehicles.

2. METODOLOGY

In this study, we fixed the type of vehicle and the route of the trip. The variable factor is drivers (ie their driving behavior) and traffic conditions. Therefore, all of the data for our experiment was collected using a road route (view Figure *1*). The total distance of the route segment was 200 km.

Data were obtained through a data collector device connected to the vehicle OBDII port, which is responsible for monitoring and recording vehicle parameters on the Chevrolet Bolt. The device was connected to the OBDII port and collected significant information for the evaluation of vehicle parameters: speed, battery level, distance covered and autonomy. The vehicles followed a road route between Salvador and Feira de Santana in Bahia. The data was made available on an online platform and updated daily in real time.

For an analysis of the impact that the profile of the driver causes on the vehicle autonomy, six drivers were evaluated and the drivers covered a total of 1,200km on the test route of this research.

ISSN: 2357-7592

3. RESULTS AND DISCUSSION

1.1. Route of Test

The Figure *1* shows the road route taken from SENAI CIMATEC (Salvador BA) to Amélia Rodrigues-BA, via BR 324. The vehicles travel on a round-trip route totaling an average of 200 km on an asphalt road and predominantly of flat feature.

The average speed estimated by Google Maps for this route is 70km/h [8] considering an ambient temperature of 28ºC on average, Air conditioning setting at 25ºC and maximum allowed speed of 100km/h.

The traffic condition on this road is considered moderate, taking into account that the average speed of the route was 57kmh on a road with a maximum allowed speed of 100kmh and which exposes the driver to a large variation in speed.

Figure 1 - Route Feira de Santana

Fonte: (AUTOR, 2021)

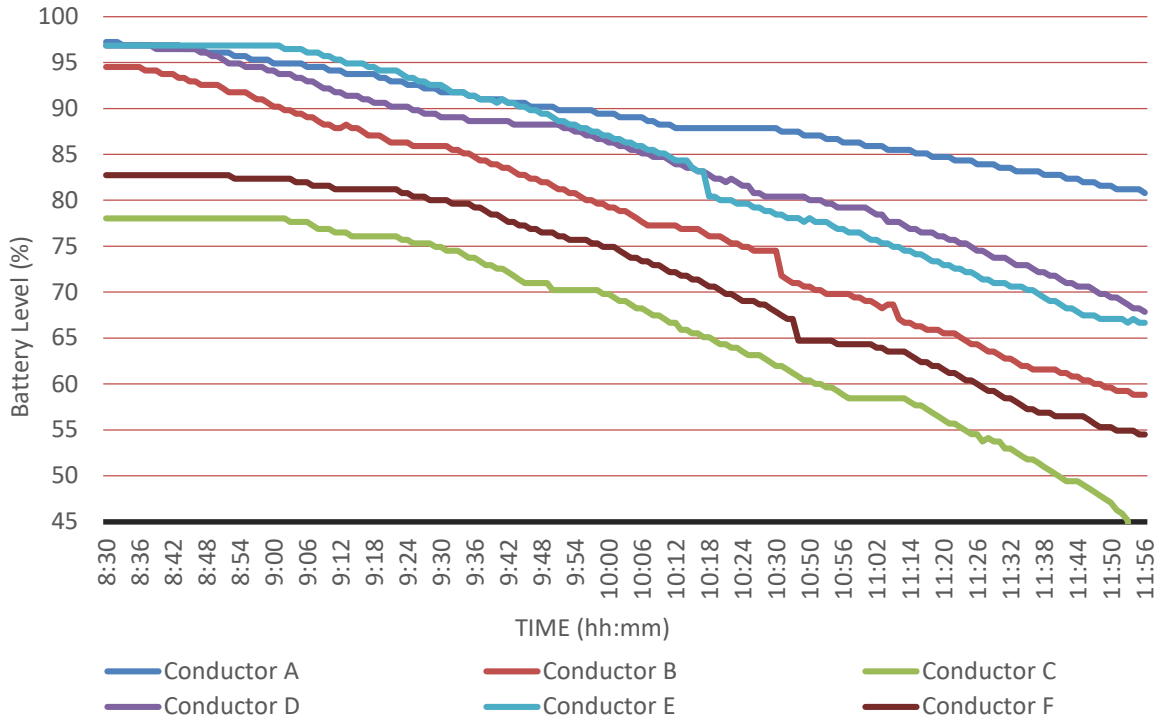
1.2. Battery Level

Just as conventional cars have large or small fuel tanks, lithium-ion batteries for electric cars come in different sizes. Instead of liters of fuel, its capacity is measured in kilowatt-hours (kWh). A typical 40kWh battery in a conventional electric car might be enough to power you for 150 miles or more, while Tesla's larger 100kWh battery is good for 375 miles according to the WLTP standard - which is intended to give an estimate Realistic real world range or fuel economy [9].

Based on the collected data, we tried to relate the vehicle performance with the battery charge, in order to compare the autonomy between drivers as shown in Figure

2. The battery charge level is reported in percentage and the Battery capacity of the Bolt EV used in the test is 66kWh.

Figure 2 - Battery level - Route Feira de Santana



Fonte: (AUTOR, 2021)

The data in Figure 2 shows the battery charge level at a specific moment and considering a period of execution of the chosen route in which the vehicle starts the test with a charge above 80%. In Table *1* shows the battery charge condition at the beginning and end of the test period with each driver and based on the distance traveled and the test vehicle's battery capacity of 66kwh we have the consumption for each driver's kWh/100km.

Table 1 - Autonomy of Vehicles on the Route Feira de Santana

X	Start %	End %	Variation %	km	kwh/100km
Conductor A	97	59	38	205	12,2
Conductor B	94	59	35	183	12,6
Conductor C	78	29	49	174	18,6
Conductor D	97	63	34	200	11,2
Conductor E	**97**	**66**	**31**	**184**	**11,1**
Conductor F	83	47	36	184	12,9

Fonte: (AUTOR, 2021)

ISSN: 2357-7592

From the collected data we can observe that conductors D and E performed better than the other conductors, conductor C having the worst performance.

From the premise that the vehicles were exposed to the same road environment with the same atmospheric conditions, road traffic and departure time, the difference in consumption/autonomy in battery charge can be attributed to the direction profile of the conductor. However, we can extend the analysis a little further and check the average speed of each driver to assess whether this item confirms the idea that the profile influenced autonomy. In Figure 3 we see the comparative graph of the average speed of Conductor C (worst performance) and Conductor E (best performance).

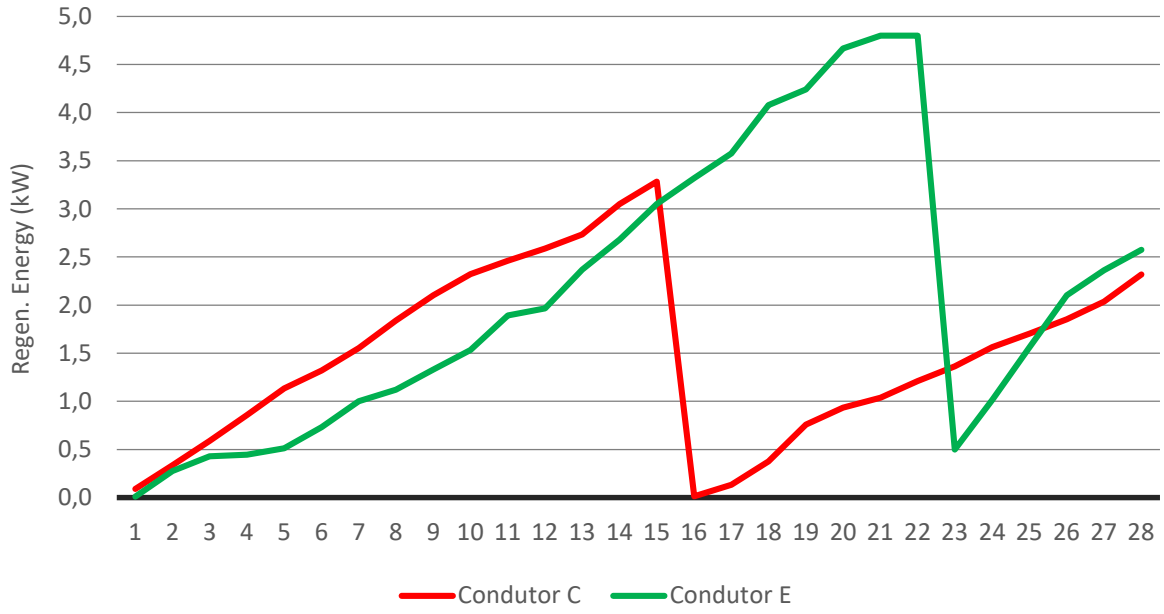
Figure 3 - The Average speed of Conductor C and E

Fonte: (AUTOR, 2021)

The average speed of Conductor C was 59km/h and Conductor E was 64km/h. Whereas electric vehicles are capable of recovering part of the charge from the batteries through a system that takes advantage of the "running" of the car during decelerations to generate energy with the movement of the wheels [10], and that the engine no longer consumes to generate electricity when the driver takes his foot off the accelerator, activating the so-called regenerative brake, we see that in Figure 4 that driver E had a greater regenerative capacity and therefore had a lower battery consumption.

ISSN: 2357-7592

Figure 4 - Energy Regeneration for Conductor C and E



Fonte: (AUTOR, 2021)

4. CONCLUSION

In view of the preliminary test data presented, there are the first clarifications on how much the steering profile affects the SOC of electric vehicles when subjected to the same running conditions. From the first results, it is possible to identify the driving characteristics that best meet the need to take advantage of the SOC, which directly impacts the autonomy of pure electric vehicle models, or 100% battery powered.

In a second stage of the research, vehicle parameters, such as: acceleration, pedal position, use of air conditioning, among others, will be better during the research in order to consolidate the assessment of the impact of the steering profile on the SOC, leading the influence of these variables on the vehicle dynamics and their influence on the electric vehicle battery, which is solely responsible for the energy supply for the electric motor of this type of vehicle, is taken into account.

From the data collected and the results obtained, to reach a more authoritative conclusion, it is necessary a greater number of drivers and repetitions of the tests on a route table, as well as the use of other vehicle models in order to obtain a more accurate investigation. deepened.

Acknowledgements

the authors thank the Green Corridor Project team, which has a partnership with NEOENERGIA, ANEEL, SENAI and others. We also thank the SENAI CIMATEC university center for providing the opportunity to be part of a research project of such great importance for the Northeast and for Brazil.

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