Chapter 14
Brushless Motor and Wireless Recharge System for Electric Vehicle Design Modeling and Control

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ABSTRACT

This chapter deals with the problem of energy storage inside an electric vehicle. The main source of energy is based on a wireless system. This recharge tool regroups inside several components as the storage system, which consists of an ensemble of batteries and serving as the main power source, a special electronic converter that is based on the buck-boost principle and a coil receiver placed undo the vehicle. From the other side, one or more than coil transmitters are placed on the road, where the vehicle is. Modeling all of these components and expressing their mathematical models seems interesting for defining the possible control method that can guarantee a high autonomy when the vehicle is moving. So, taking into account if the care is driving or stopped, this recharge system is studied for verifying the effectiveness of this recharge system and showing the relationship between the vehicle situation and the quantity of received power. Using the platform Matlab/Simulink the results were shown and discussed.

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INTRODUCTION

After years of debate over whether or not there is global warming, most experts agree that the earth's temperature is indeed rising. This increase is directly linked to greenhouse gases. CO_2 has seen its concentration increase by 30% since 1750, while methane has increased by 150%.

However, it is CO_2 which constitutes the main contributor among greenhouse gases, this being linked to human activities: 90% of its emissions come from the combustion of fossil fuels (petroleum products, coal, natural gas) (Hamidi, Weber, & Nasiri, 2013), and in particular to 34% of the transport sector, which remains the first sector in terms of greenhouse gas emissions (Sarkar & Bhattacharyya, 2012) . The particles released by heat engines are also very harmful to humans: they enter the lungs and can cause many respiratory and cardiovascular diseases. Mainly rejected by diesel engines, most of them are captured by particulate filters (Sudimac, Ugrinović, & Jurčević, 2020). However, according to some studies, the latter would manage to effectively remove a large number of particles, but in return release smaller particles, which would go deeper into the lungs (Mousavi Agah & Abbasi, 2012).

In this context, the electrified transportation infrastructure calls for the development of a wide range of charging networks to promote the worldwide adoption of electric vehicles (Spichkova & Margaret Hamilton, 2016). As there are many charging systems and modes, it seems important to find a useful solution to help solve the issue of autonomy for an electric vehicle (Chau, Chan, & Liu, 2008). The plugin recharging mode is currently the most useful technic, based on the concept of connecting the vehicle to the grid through a recharging cable (R. G. Mohamed, Ebrahim, & Bendary, 2017). This type has two versions, the high-speed recharge mode, which is generally based on DC voltage, and the low-speed version, which is based on the home version of 220 voltages. The high-speed charging system can take 30 minutes for the vehicle to be fully charged, but it can take 8 to 10 hours for the low-voltage mode to do this. Nevertheless, whether it is in motion or halted, the only difficulty that characterizes this recharge mode is attached to the vehicle situation. Thus, if the vehicle battery has decreased to the low region on a high-speed road or a simple long road, using these techniques may not be effective. This scenario poses a frightening situation for electric vehicle users. It is safe to assume that this is why the world does not use electric cars as much (C. S. Lee, Jeong, Lee, & Hur, 2011).

Concentrating on haw help resolving the vehicle autonomy problem, this chapter deals with the field of energy storage and how it is possible to facilitate the recharge phase for an electric vehicle on the road. The idea is to use the wireless recharge system for charging the vehicle when it is in movement. In the future, the wireless charging systems for electric vehicles (Wr) will be a potential alternative technology to charge electric vehicles. Basing on the existing literature, various researchers were focused on this field to improve the global system efficiency. These works have studied the relationship between various parameters as the quantity of transmitted power (Rosu, S. G 2016), the needed recharge times, the related battery SOC, the vehicle speed, and the user control technic. Concerning this field, different results are compared to highlight the benefits and the disadvantages of each method (Flah. A, 2018).

According to those researches, the major problem is how to estimate the recharge time of the vehicle when it is in movement and haws the vehicle speed can affect the efficiency of this recharging method.

Generally, the efficiency of such a recharge method is maximum when the vehicle is stopped. Then the time recharge duration can be founded or estimated easily.

The reliability of the recharge system is guaranteed only in home-use applications, such as garages fitted with wireless recharge systems (Abdelwahab & Shaaban, 2019). However, for the bus applications, this is not the case, where they stopped time is limited relative to the car in a garage. The main problem