Chapter 10
Advance and Innovation in Wireless Power Transmission Technology for Autonomous Systems

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ABSTRACT

This chapter focuses on the concept of transmitting power without using wires that is also known as Wireless Power Transmission (WPT). This chapter attempts to present the most important and relevant works in this field of research in order to develop a topical 'overview', present the current results, and also share some contributions and 'vision' for the future. The technological developments in Wireless Power Transmission is also presented and discussed. The advantages, disadvantages, biological impacts and the most potential applications of WPT are also presented. This chapter presents also new and efficient designs of a rectifying antenna (rectenna) involved to be used at low and high input power levels constraints at microwave frequencies of ISM band in particular at 2.45 GHz and 5.8 GHz. The rectennas have been developed were based on microstrip technology incorporating a new class of phased antenna arrays with circular polarization associated with a new RF-to-DC rectifiers.

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INTRODUCTION

Actually in our daily life, wireless technology has become a popular means of transmitting signals from the use of satellite in space to the use of cell phones and sensors networks. Anybody, anywhere and anytime wireless technology has provided the easiest way to us, which enhances our life quality. Then wireless technology based on radio-frequency (RF) enables three different basic system functions, namely, wireless communication (data/voice), wireless sensing (parameter), and wireless powering (energy). The first two well-known wireless applications have been found today in nearly all social and economic activities, which have been transforming our daily life. However, the wireless power transmission or transfer (WPT), which is less known at least publicly, has not yet been well developed and established as one of the fundamental driving forces for wireless applications.

Currently, emerging technologies enable proactive energy replenishment of wireless devices, it is advantageous in supporting applications with quality of service (QoS) requirements. A weak point of future ubiquitous information systems is the rising demand for energy and power source. In addition, there has been a growing usage of wireless sensors networks and their applications such as wireless body area networks (WBANs) which directly leads to the increased battery usage. Until today, the limitation of energy supplies has become a crucial issue for the lifetime of these sensors since they operate on conventional batteries with a limited lifespan and fixed energy rate (Shuttleworth et al, 2009). Further, the deployment of a large number of sensor nodes results in periodic battery replacement which is impractical and cost-consumed (Vaghela et al., 2009). However, electrical energy is being distributed using the conventional grid which is characterized by out dated infrastructure, delayed communication and heavy transmission losses. One of the promising solutions of the heavy line losses is the transmission of electricity without wires which is called wireless power transmission. Eventually, in the present situation where the production of energy is reliant especially on gas and oil industry whose price is irregular daily, and regarding need to reduce our reliance on fossil fuels has led to the development of surrounding self-regenerating energy source. For these reasons RF energy transfer and harvesting is considered as one of the wireless energy transfer techniques that can be used as an alternative energy source to supply power to the electrical and electronics equipment that can increase the portability and convenience. There are three main methods of wireless power transmission. The first method is to transfer electric power by the phenomena of mutual induction between two coils operating at same resonant frequency; second method is by microwave transmitter and receiver while the third method is the transfer of electric power using laser technology (Ramasamy et al., 2010; Summerer & Purcell, 1999). These techniques will be described with more details in the next section.

WIRELESS POWER TRANSMISSION TECHNIQUES

In the past few years, scientists have faced challenges involving power: the continuity of supplied power, recharging batteries, optimizing the location of sensors, and dealing with rotating or moving joints, and they are looking for alternate and efficient technologies to provide efficient electricity transfer. Although those challenges remain, new demands that arise from increased use of mobile devices and operation in dirty or wet environments. Where almost of these devices are powered by disposal batteries that they present many disadvantages such as: the need to either replace them or recharge them periodically and their big size and weight compared to high technology electronics, which mean that designers, engi-