Chapter 7
Wearable Antennas:
Breast Cancer Detection

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ABSTRACT

Having the merits of being light-weight, energy efficient, in addition to low manufacturing cost, reduced fabrication complexity, and the availability of inexpensive flexible substrates, flexible and wearable technology is being established as an appealing alternative to the conventional electronics technologies which are based on rigid substrates. This chapter is organized as follow into three major sections. In the first part, a detailed review of wearable antennas including applications and antenna families is presented. The second part of this project deals with the flexible antennas materials and fabrication methods. A wearable antenna prototype for medical applications, more accurately, early breast cancer detection, is discussed in the last section of this chapter.

DOI: 10.4018/978-1-5225-3290-3.ch007

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INTRODUCTION

Flexible and wearable electronics, which are lightweight, bendable,rollable, portable, reconfigurable and potentially foldable, would substantially expand the applications of modern electronic devices, are beginning to enjoy tremendous popularity thanks to the great advances in materials science and electronics manufacturing and packaging. This technology is recognized as one of the fastest growing technologies in today’s world. According to a recent market analysis, the global revenue of this technology is estimated to be 45 billion USD in 2016 and over 300 billion USD in 2028 (Afyf et al., 2015). Moreover, recent developments in miniaturized and printable energy storage, flexible photovoltaic, and green (self-powered) electronic components have paved the road for the success of this technology. Consistently, wearable and flexible devices would often require the integration of antennas operating in specific frequency bands to provide wireless connectivity which is greatly demanded by modern information-oriented consumers. The aim of this chapter is to provide a comprehensive guide to various technologies and methods applied in the realization of flexible and wearable technologies along with state of the art antenna designs and implementations. Moreover, this document serves as an extensive reference in wearable topics. An example of a wearable flexible antenna for early breast cancer detection is designed.

WEARABLE ANTENNAS BACKGROUND AND OVERVIEW

Wearable antennas have been a topic of interest for more than the past decade, and hundreds of scientific papers can be found on the subject. This large number of publications asks for some classification in order to get an overview of the trends and challenges. To this aim, an overview of wearable antennas according to the applications, antenna families, materials, and technology, is proposed.

1. Applications of wearable antennas:
2. Security (Military and Police) and Rescue Service Applications

Our main focus will be orientated towards wearable robust antennas intended to operate in various harsh environments. These antennas are mainly used for security and defense applications (Psychoudakis, Lee, Chen, & Volakis, 2010) and within different rescue services like firefighters (Hertleer et al., 2009), mountain and water rescue workers, (Figure 1), (Serra, Nepa, & Manara, 2011), (Corner, 2013).

Frequency bands intended for security and rescue applications are regulated by special government regulatory offices. In our case, we will mainly consider
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