ABSORPTION IN HUMAN TISSUES DUE TO THE BODY-WORN UWB ANTENNAS

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ABSTRACT

Due to the rapid development of wireless technologies, new frequency bands in the microwave region operating at higher frequencies up to 10 GHz have been opened up. Currently, these frequencies are mainly used for wireless local networks, but their range of application extends to health support systems or consumer electronics in general. These devices may operate in the immediate vicinity of the human body, and they are a part of the so-called Wireless Body Area Network (WBAN). Ultra-wideband (UWB) technology is a promising candidate for future WBANs, due to its low-power operation.

In this paper we investigate electromagnetic energy absorption in human tissue due to the body-worn UWB antennas, between 3 GHz and 8 GHz. The aim is to examine energy absorption, depending on a composition of the human body model, and also on the antenna type. We compare results obtained for homogeneous muscle tissue model layered (skin, fat, muscle) model. Planar and cylindrical models are used, representing different part of the human body. For the layered model, thickness variations of the skin (0.5-2mm) and fat (3-20mm) are considered. Regarding UWB antennas, we consider different types of antennas, e.g. omni-directional UWB monopole and slot antennas, as well as the low-profile directional UWB antenna, designed specially for UWB WBANs applictions. We investigate only very close (near-field) distances between the body and antennas, between 2 and 10 mm (reflecting realistic WBAN scenarios).

We will show that the absorption mechanism of the electromagnetic energy is differs significantly, between homogeneous and layered human body models, for frequencies between 3 and 8 GHz. This conclusion is clear when one looks at the peak SAR values (without mass averaging). However, for averaged SAR, these differences are not so pronounced, due to the averaging process. Additionally, we will present variation in the transmit transfer function of different UWB antennas, depending on the antenna type and distance to the body model. Transfer function is the most relevant parameter in characterizing UWB antennas; therefore these results are crucial for understanding of the human body impact on the performance of UWB antennas.

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