

A Numerical Study on the Interaction Between Different Position of Cellular Headsets and a Human Head

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Abstract — In this paper the interaction between a human head exposed to a bluetooth-based cellular headset in different positions is studied. The exposure to the electromagnetic fields is a concern when people use these devices. The interaction of human head and bluetooth mobile headsets has not been considered in related standards. In this research three installed positions for the headset and two scenarios for the user are defined. In the first scenario the user is in free space and in the second scenario the user is in a car. For both scenarios path loss, antenna gain, total isotropic sensitivity, and specific absorption rate values for three positions of the headset on the head are obtained. SEMCAD X software is used as an FDTD-based simulation platform for our numerical studies. The result of our study can help manufacturers to consider the compatibility of these devices with safety guidelines of electromagnetic exposure specified by relevant institutes. Designers of wireless devices can use results of this study to design new headsets that can be used in an appropriate position while the performance of the device is less affected by the human head and the environment.

Index Terms - Bluetooth, electromagnetic field, FDTD, headset, human head, and SEMCAD.

I. INTRODUCTION

Telecommunication technologies attract more users each day and spread all over the world. Cellular phones are a part of this technology that attract users from all different age groups. The continuous growth of high-end devices forces companies to ensure their new products to be compatible with safety guidelines specified by related standards like IEEE Standard-1528 [1] and International Electrotechnical Commission, IEC 62209-1 [2]. Bluetooth headsets are one of applications that communicate to the cellular phone via bluetooth protocol [3] at 2400 MHz-2450 MHz frequency range. The question is that: *Is user head exposure to bluetooth headsets safe?* To answer this question we aim to evaluate the interaction between a human head exposed to a bluetooth-based cellular headset. Several headset models are produced with different specifications. Each product has a different effect on the user head based on its antenna type, operation frequency, housing, case material, and installed position.

SAR measurement of a human head exposed to a bluetooth headset has not been considered in related standards [1, 2, 4-9]. This is while the interaction between human body and wireless devices has been an interesting subject of studies over the past sixteen years [10-15]. The effect of