STUDY OF THE INTERACTION OF RADIATED EM FIELDS WITH HUMAN OPERATORS

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Abstract

In the information society, each human being is subjected daily to a significant amount of electromagnetic fields, which comes from power lines, wireless networks, radio transmission and the computers that we use for any aspect of our lives professionally as well as for leisure.

So every human being is immersed nowadays in an ocean of radiofrequency fields, which extend all over the world.

In this paper we present an analysis of the influence of wireless antennas, developed in our department and its effect on human operators.

INTRODUCTION

The exposure of human beings to electromagnetic radiation has been a subject of growing concern over the last decades. The study of the possible effects on human health of EM fields, namely the interaction of low frequency fields associated with power lines goes back to 1979, when a study was conducted, in the state of Colorado (U.S.A.) aiming at proving the connection between the development of child cancer and EM power lines EM fields [1].

Several studies were performed by leading experts, trying to identify a mechanism of cause-effect [2], [3].

A statistical analysis showed some connection concerning the incidence of child leukemia and exposure to EM fields connected to power lines. Despite the intense efforts developed in this field of research, to date no credible mechanism could be identified and no cause-effect relation has been established.

In recent years, other studies have been performed, namely by the European Commission, in order to identify quantitatively the values of magnetic fields which are harmful to human health and also, to investigate if an iterative effect is present leading to long-term consequences.

A study conducted in 2004 [4], identified the value of 100μT at 50Hz as a boundary value to be avoided for human exposure.

For long term effects, it was noted that a long exposure to magnetic fields could lead to a substantial reduction at the same frequency for these effects.

In the publication referred above, a value of 0.2 to 0.4 μT, connected to a 24h exposure time was considered potentially harmful.

Another interesting point is the recently appointed connection between EM low-frequency fields and neuro-pathologies such as Alzheimer disease and amyotrophic lateral sclerosis [5].

The study of these effects by our group started in 2002 when some colleagues from the Department have been involved in the project of electrical vehicles for public transportation. Several studies were published on the possible effects for public health of aerial or underground power supply.

Our group is devoted to the design, testing and implementation of antenna systems for telecommunications applications in the radio frequency band, so we had the idea of carrying the same research to higher frequency bands.

SIMULATION AND MEASUREMENT

One of such projects was the development of antennas for wireless communications in laptops. Due to long term exposure of our students to the fields radiated by these antennas, an interesting point was to investigate the influence of the operator nearness on the radiated field, and also the dual effect: how these fields where absorbed by the operator.

The objectives of this project were to obtain a numerical analysis of human- radiated EM fields, considering specifically the following effects:

- how the presence of the user affects the antenna operation,
- how the operating antenna illuminates the human biological tissues,

Dependence of antenna-human EM interaction on:

- antenna location and laptop screen opening angle,
- antenna type,
- antenna housing type (internal/external),
- position of the operator (typing/ non typing)

Simulations were made using a grid method, and measurements ere performed in the anechoic chamber of the Department. The dimensions of this chamber which supports testes from 1GHz to 18 GHz are: length- 3.6 m, width-2.4 m and height – 2.4 m.

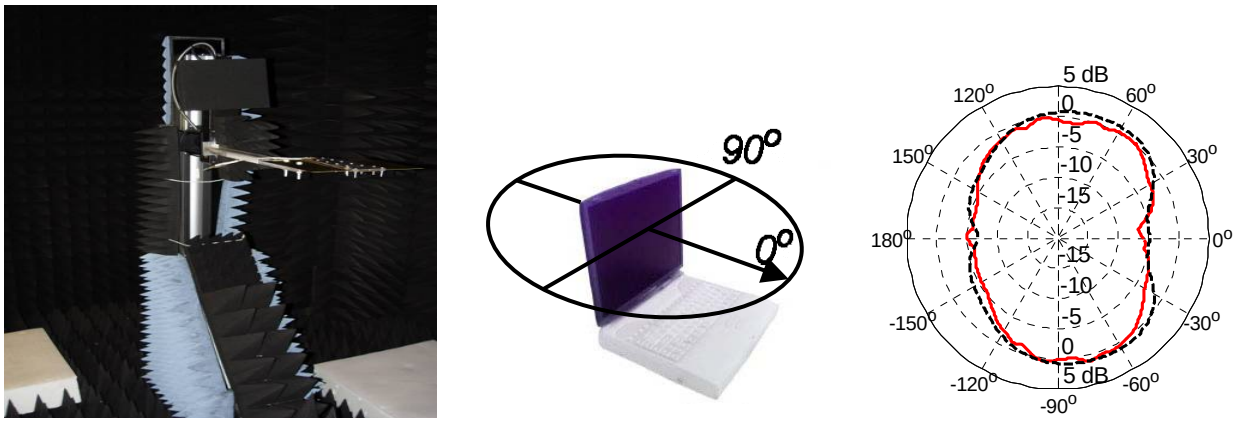

Fig. 1. a) Measurement set–up (transmitter side), b) results obtained by simulation i(black lines) and by measurement (red lines), without operator in the H plane.

Figure 1 a) shows the testing of the patch antenna inside the chamber. Figure 1b) shows the measurement scenario, without considering the presence of the operator in the H plane

An important aspect for the simulation of the interaction was the modeling and therefore the parameters attributed to the user.

In this first phase, we have considered an homogeneous distribution of human tissue with a loss angle of 0.16, a relative dielectric permittivity of 40 and a density of 1000kg /m^3.

Figure 2 shows the influence on the radiation pattern of the presence of the operator.

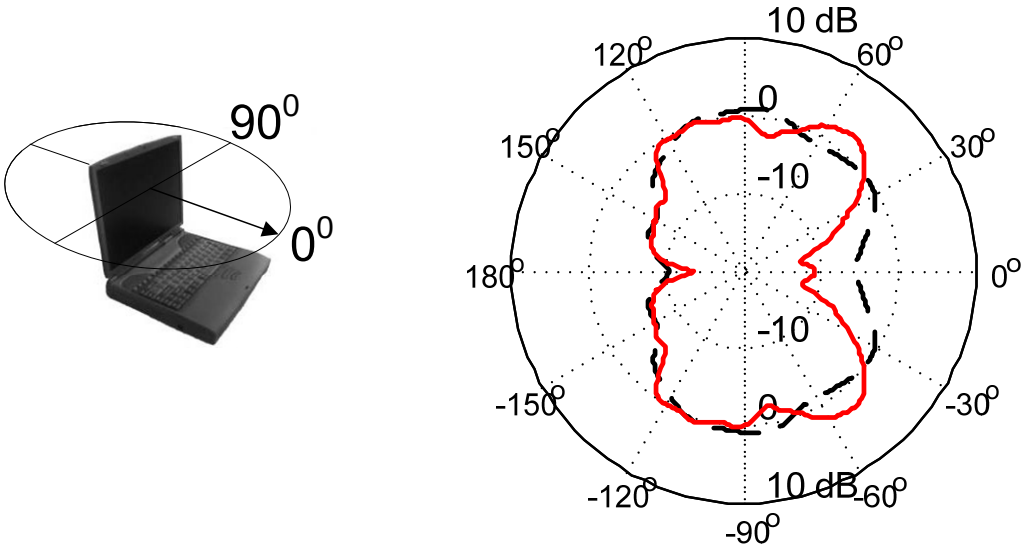

Fig. 2. H-plane Comparison: black lines refer to the simulation without operator. The red line corresponds to the radiation pattern with the operator in the typing position

A significant difference occurs also in human exposure depending on the antenna position and relative position of operator and computer.

In the full paper we will present the different scenarios and the results obtained.

CONCLUSIONS

Computers are nowadays an essential tool of everyday life especially for students. The portability, low weight and wireless access of laptops make them a first choice for most students.

The fields radiated by the wireless antennas inserted in these apparatus interact significantly with the operator. We have computed the influence of the operator in the laptop operation and also the power absorbed by the human operator in different scenarios.

References

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