Effects of 2.4 GHz radiofrequency radiation to pacemaker

Zuzana Pšenáková*, Mariana Beňová*

*Faculty of Electrical Engineering University of Žilina, Univerzitná 1, Žilina, Slovakia, e-mail: zuzana.psenakova@fel.uniza.sk
*Faculty of Electrical Engineering University of Žilina, Univerzitná 1, Žilina, Slovakia, e-mail: mariana.benova@fel.uniza.sk

Abstract **Electromagnetic field (EMF) could make interference with some implantable devices like pacemakers. The aim of this work is to show some effects of radiofrequency radiation on pacemaker.**

Keywords **electromagnetic field (EMF), radiofrequency radiation, pacemaker, skin tissue**

I. Introduction

Using of high-frequency sources of electromagnetic fields (EMF) is very common in this time. This group includes all sources from frequency of 1 MHz as mobile phones, digital cordless phones, baby phones, Bluetooth technology, Wi-Fi equipment, microwave ovens and so on. Using a high frequency source of EMF near people with implanted pacemakers represents a higher risk than the interaction of low-frequency sources. It is necessary to hold exposure limits and eliminate the risk to the lowest level. The recommended optimal distance between the mobile phone and the pacemaker is not less than 10 cm. These principles are related to the performance of mobile phones, moving from 0.25 to 3 W, varies according to different factors. The greatest power is in establishing a connection between two mobile phones, while sending messages of weak signals, which applies inverse relationship, i.e. the weaker the signal, the greater the power, then in blocks of steel, cars, trains, etc.

For identification of adverse effects in addition to watching the performance and other factors such as the depth of penetration of radiation, exposure and biological effects of high-frequency EMF is very important to know more about EMF.

II. Numerical modelling of biological tissue

Our work deals with modelling of human skin as a biological tissue and effects of EMF right on this tissue, because pacemaker is usually implanted under the skin. Thickness of human skin is not the same for all parts of the body. In general, for an adult it ranges from 0.4 to 15 mm, which is affected by the different thickness of the individual layers. It consists of three main parts which are the skin (epidermis), corium (dermis) and subcutaneous tissue (body subcutanea, hipodermis). Dielectrical properties of each parts of the skin are in the Table.I

TABLE I
Relative permittivity and conductivity of the skin parts [1], [2]

f=2,4GHz	ε_r	σ [S.m^{-1}]
epidermis	38,1	1,44
dermis	25,2	5,76
hipodermis	30,5	3,6

SAR (Specific absorption rate) [W/kg] is important value in our simulation (1). It depends on $|\vec{E}|$ – maximal value of intensity of the electric field [V/m], σ – electrical conductivity [S/m], ρ – mass densities [kg/m3], [3]

$$SAR = \frac{\sigma |\vec{E}|^2}{\rho} \qquad (1)$$

III. Simulation

In Fig.1 we can see distribution of intensity of EMF from radiofrequency radiation. Near the dipole antenna (2,4GHz) is higher distribution of intensity of EMF.

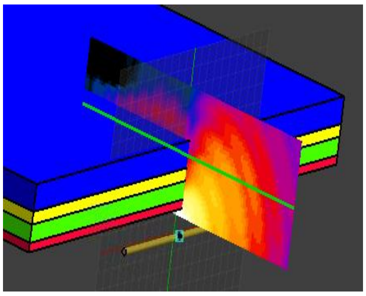

Fig. 1Distribution of intensity of electromagnetic field [4]

IV. Conclusion

In this contribution we were investigated distribution of EMF with frequency of 2,4GHz in the skin tissue near pacemaker. As we can see level of intensity of EMF depends on position of EMF source.

V. Acknowledgements

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