

Calculation of Electromagnetic Field Influences on Humans with Metallic Implants

L. Olooska*¹, Lj. Janev², S. Loskovska³

¹Faculty of Electrical Engineering, 1000 Skopje, Macedonia, lidijao@mt.net.mk

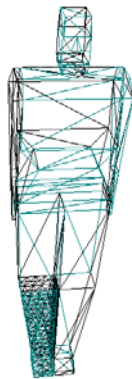
²Faculty of Electrical Engineering, 1000 Skopje, Macedonia, ljanev@etf.ukim.edu.mk

³Faculty of Electrical Engineering, 1000 Skopje, Macedonia, suze@etf.ukim.edu.mk

The investigations connected with biological effects from EMF exposure on humans in present time attract more and more attention. Series of studies are done, because of the influence of the enormous number of electrical devices involved in human living and working environments. In such environments, the determination of EMF influence when exposed on EMF for humans with metallic implants is a question, which should be investigated precisely.

Paying more attention on calculation of high frequency electromagnetic field influences, it can be concluded that the excitation (incident field) source is obviously various. The most common type of high frequency EMF source are the units where the incident field can be described as antenna field, or as a plane wave field. One of the main problems when determining the EMF influence on human, is to find it's appropriate model. There are several ways of human model selection. Our system offers semiautomatic procedure for development of individual human models. The human model is presented with description of his external surface using triangles. Such representation is used to describe the surface between different tissues and the surface of metallic implants inside human body. During the investigations of EMF influence on humans with metallic implants, the frequency depended electrical characteristics of tissues must be taken in consideration. When a metallic implant is inside the body, it is obvious that implant's electrical characteristics must be taken in consideration during calculation also.

Knowing the complex body structure, even more when an implant is in the body, the determination of EMF influences on human is based on electromagnetic field determination in inhomogeneous media. The procedure is based on equivalency of body influence with characteristics different from those from the free space with equivalent current. The human body is divided in regions with homogenous media, where the influence of other regions is given with equivalent surface's electric and magnetic currents, located on the boundary surface.



Our method solves the problem in two steps. In the first one, the calculations are done using rough human model. The next step uses precise model of the selected part for calculations. For example, if an implant is posed under the knee, that part has much finer presentation as given on figure 1.

When calculating the electromagnetic field influences on humans with metallic implants, the parameters, which describe the electromagnetic field influences, can be obtained. The possibility of solving in steps makes the method suitable for calculation. The developed system has no specific restriction for the analyzed body connected with its geometric or electric characteristics, metallic implant form, or restriction on an incident field form. The results obtained in these calculations, are basis for discussion for possible biological effects on human with metallic implants exposed on high frequency EMF field.

Fig. 1. A Human model