Model to study the biological effect of electromagnetic waves produced by mobile phone base station on life tissue

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Abstract

The theory is presented for determining the biological effect of Mobile phone base station on life tissue.
It has been studied theoretically that electromagnetic waves produced from mobile phone base station propagation and absorption by life tissue, the model is a plane homogeneous slab of tissue under the irradiance of normal incidence plane wave. It has been discussed by obtaining the electromagnetic field, absorbent power specific absorption rate in the model.

Introduction

With the advent of mobile communication technologies in the last 10-15 years, many people have been exposed to a different form of electromagnetic energy by mobile phone and base transceiver stations. The effects of electromagnetic energy depend on frequency, amplitude and modulation of the electromagnetic energy source. Many investigations of biological effect of electromagnetic fields at mobile telecommunication frequency have been studied theoretically and experimentally.

Computation of electromagnetic field inside a tissue at mobile communication has been study, which presents a new approach to calculate the electromagnetic field inside a tissue, composed of electrically excitable cell by means of the FDTD (finite difference time domain method). The theoretical that millimeter waves propagation and absorption in human body has been studied, the model is a plane stratificate homogeneous slab of tissue under the irradiance of normal incidence plane wave. It has been discussed by obtaining the electromagnetic field, absorbent power, specific absorption rate, temperature field and their distributions in the human trunk model. Mathematical analysis of microwave heating equations in one dimensional multi-layer has been discussed.

In this study we investigate the behavior of mobile phone base station in model of life tissue which can be assumed as a plane layered medium consists of skin, fat, muscles, and organs. It is assumed that a plane wave is obliquely incident upon the interface as shown in fig(1).
A plane electromagnetic wave is incident vertically upon the plane-layered slabs of medium in Z direction, which electric field is in X-direction. The field of incident wave can be given as

\[ E_{0x} = A_0 e^{-\gamma_0 z} \]

\[ H_{0y} = \frac{A_0}{\eta_0} e^{-\gamma_0 z}, \]

where \( \eta_0 = \sqrt{\frac{\mu_0}{\varepsilon_0}} \)

Is the impedance in free space

In every layered of medium, the electric field and the magnetic field are found to satisfy the equations:

\((\nabla^2 - \gamma_k^2)E_k = 0, \quad k = 1, 2, 3, 4,\)

and

\((\nabla^2 - \gamma_k^2)H_k = 0, \quad k = 1, 2, 3, 4\)

We solve the above equations, the interaction between the waves and plane layer are derived, electric field in each layer is plotted as function of layers’ thicknesses.

Electromagnetic field and depth skin has been computed, simulated by software program. With the numerical calculation of the field equation of the plane layer medium with the boundary conditions, the distributions of electric field and the power of absorption have been made in life tissue. From the curves, the distribution of electric field with base station frequency shows the absorbent power in human body.

The general solutions of equation above are

\[ E_k = A_k e^{-\gamma_k z} + B_k e^{\gamma_k z}, \quad k = 1, 2, 3, 4\]

\[ H_k = \frac{A_k}{\eta_k} e^{-\gamma_k z} - \frac{B_k}{\eta_k} e^{\gamma_k z}\]
We solve and plot the relation between the electric field and thickness, a Z direction for each layer as

\[
E_1 = A_1 e^{-\gamma_1 z} + B_1 e^{\gamma_1 z} \\
E_2 = A_2 e^{-\gamma_2 z} + B_2 e^{\gamma_2 z} \\
E_3 = A_3 e^{-\gamma_3 z} + B_3 e^{\gamma_3 z} \\
E_4 = A_4 e^{-\gamma_4 z}
\]

According the above equations, \(E_1\) represent the first layer skin and the second layer represent by \(E_2\), \(E_3\) is in the third layer which is fat, and the last layer is kidney represent by \(E_4\).

**Results and discussion**

In this theoretical work, the numerical calculation of the field equation of the plane layer medium has been discussed, the distributions of electric field and power of absorption have been made in life tissue with frequency 900 MHz

The curve \(E_1\) vs. \(z\) is plotted, \(E\) on y-axis and \(z\) in x-axis

![Electric field vs. d in four layer tissue by frequency 900 MHz](image1)

**References:**
