



## Heating Patterns in Patient Body by Capacitive Heating Device Using 8 MHz Radio Frequency Current

Kazuyuki Saito\*, Yukiko Furusho, and Ryo Manago  
Chiba University, Chiba 2638522, Japan  
e-mail: kazuyuki\_saito@faculty.chiba-u.jp

In recent years, various types of medical applications of electromagnetic techniques have been investigated. Especially, thermal effect of the electromagnetic field to human body can be used for treatment of cancer. Today, large number of capacitive heating devices, which utilize electric current of 8 MHz, are employed in Japan. In the device, electric current of 8 MHz is applied to a patient via pair of electrodes. Temperature of target tumor(s) inside the patient and their periphery elevated by Joule heating of the current. The temperature in and around the target can be measured by some thermocouples equipped with the device. However, the temperatures are not measured in many cases because of invasiveness. So, in this study, the temperatures inside the body were calculated under practical situation. In this study, realistic high resolution whole body voxel model [1] developed by National Institute Information and Communications Technology (NICT, Tokyo, Japan) is employed as a patient under the thermal treatment. The patient is placed between two electrodes, whose diameter is 250 mm, with water boluses. In the calculation, first, specific absorption rate (SAR) is calculated by use of finite difference time domain (FDTD) method. Then, the bioheat transfer equation is numerically solved based on the resultant SAR values with several practical parameters. From the calculated result, some high temperature regions are observed around the surface of the patient body. On the other hand, the temperature of deep region of the body such as some organs are not increased compared with the surface. In addition, a patient model whose liver includes spherical tumor region has been calculated. Here, the tumor is a low blood flow region. In this case, temperature elevation can be observed at the tumor region because of low cooling effect by the blood flow. As a further study, many treatment cases should be considered for understanding the characteristics of the capacitive heating scheme.

1. T. Nagaoka, S. Watanabe, K. Sakurai, E. Kunieda, S. Watanabe, M. Taki, and Y. Yamanaka, "Development of Realistic High Resolution Whole-Body Voxel Models of Japanese Adult Male and Female of Average Height and Weight, and Application of Models to Radio-Frequency Electromagnetic Field Dosimetry," *Physics in Medicine and Biology*, **49**, 1, December 2003, pp. 1-15.