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Calculation of Internal Electric Field Induced by Simultaneous Exposure to Uniform ELF Electric and Magnetic Fields in Consideration of Phase Difference

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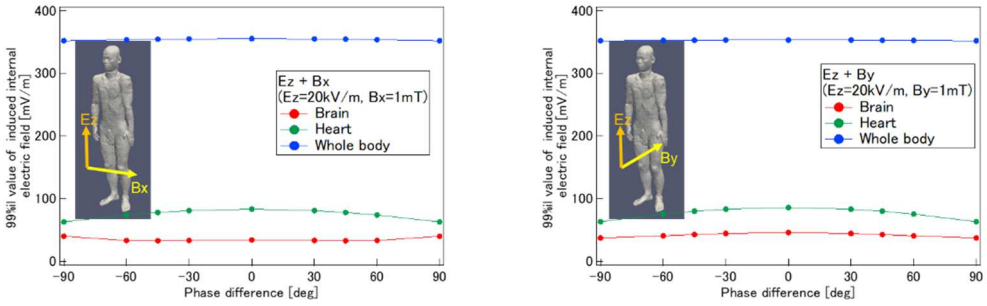
Concerning human safety to electromagnetic fields induced in the vicinity of electric power facility, exposure guidelines such as ICNIRP guidelines [1] or IEEE standard [2] are referenced. These guidelines derive the limit considering exposure of electric and magnetic fields separately whereas simultaneous exposure of electric and magnetic field may occur when the human body is placed under overhead transmission lines. In such a condition, there is a phase difference θ (-90 to +90 degree range) between electric and magnetic field due to the phase difference of the voltage and current of the power line. Although there are several studies [3, 4] which evaluate simultaneous exposure of electric and magnetic fields, these studies did not consider their phase difference.

In this study, we examined the impact of phase difference of electric and magnetic fields on induced internal electric field assuming a numerical adult human model [5] under power line where vertical electric field and horizontal magnetic field exist as the main components. Simultaneous exposure of spatially uniform vertical electric field Ez and horizontal magnetic fields Bx , By (sagittal and coronal direction, respectively) of 50 Hz were assumed. Figure 1 shows the results for simultaneous exposure to electric and magnetic fields with ICNIRP occupational exposure reference level (20kV/m and 1mT). As this figure shows, internal electric field strength varies with the phase difference, and the variation caused by the phase difference are different in each body part. Basic restriction of ICNIRP guideline for occupational exposure (CNS of the head : 100 mV/m, All tissues of head and body : 800 mV/m) is still satisfied under the simultaneous exposure of electric and magnetic fields with reference level even if we consider the phase difference.



(a) Ez and Bx (b) Ez and By

Figure 1. 99th percentile value of induced internal electric field for simultaneous exposure to electric and magnetic fields with ICNIRP occupational exposure reference level (20kV/m and 1mT, 50 Hz).

References

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