Magnetic Induction Communications for Wireless Body Area Network

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Wireless Body Area Network (WBAN) is a new promising short range communication technology operating within or at close proximity to the human body. WBAN technology spans a wide range of medical and non-medical applications to improve health care and the quality of human life. However, signal propagation around the human body is challenging due to the complex and lossy nature of the biological tissues. Although various wireless communication techniques using electromagnetic (EM) waves have been successfully deployed for WBANs, they encounter several problems. A major issue is that EM waves experience a high level of attenuation and as a result the devices consume a lot of battery power. Multi path effects and interference with other existing systems are other issues. Magnetic Induction (MI) is an alternative physical layer technique for WBANs which can address the problems of EM-wave propagation techniques.

In this paper we present a model for the mutual inductance of coupled coils, which is vital in computing the path loss in MI communication system. In the proposed model, the relative alignment and positioning of transmitting coil and receiving coil are considered. To validate the model HFSS software, which is a simulator based on the finite element method (FEM), is used to compute the mutual inductance between two coils with/without presence of human body. The computed results from the model compare well with the results of HFSS simulations and are significantly quicker than computation using the full-wave simulator. Based on the results it can also be concluded that the induction model is valid for the operating frequency up to 50 MHz where the dimension of human body is relatively small compared to the wavelength and the effect of human body on the performance of MI system is negligible. This is beyond the magnetic induction regime, and propagation and scattering effects become significant.