UNIVERSITI TEKNOLOGI MARA

EMPIRICAL STUDIES OF INTRA-BODY COMMUNICATION (IBC) SIGNAL PROPAGATION LOSS AND ITS INFLUENCE ON IBC TRANSCEIVER DESIGN

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Intra-body communication (IBC) is a wireless communication system where the human body is used in developing the remote and monitoring system. In IBC, living tissue is utilised as a signal transmission medium, attaining power-saving and making communications more robust against external distortion and threat on data transmitted. Although IBC technology is in the early development stage, the IBC offers valuable contribution at real-time monitoring, diagnostic, or therapeutic levels. Due to the advantage of IBC, a new wireless body area network (WBAN) standard, IEEE 802.15.6 that was ratified in 2012 has included IBC in their physical layer. In IBC, there are two standard coupling methods used, which are capacitive and galvanic coupling. Therefore, the optimum suitable coupling method must be selected for the IBC system. While recent studies have conducted investigations that study the degradation of the IBC transmission signal between limb sections and the effect of human movement considering limb joint effect, these degradations have yet to be quantified when there is a movement of the human body. In this thesis, the research was further examined by investigating the signal degradation by applying gait cycle analysis that also called the walking cycle within frequency range 0.2 to 200 MHz. Empirical measurement was conducted to measure the effect of knee flexion during a gait cycle. The result shows that the transmission loss is increasing as the knee flexion angle increased. The maximum transmission loss between 70 and 90 MHz was up to 69 dB for a position called feet adjacent position where the knee flexion angle is at maximum flexion. Moreover, the IBC signal transmission was further investigated considering the difference body tissue characteristic of different people. The BMI value of each subject was used to differentiate the difference between body fat in the human body. The outcome of these measurements demonstrates that the higher BMI will lead to increase the signal attenuation. The current IBC transceiver design did not consider the dynamic body effect on communication performance. Finally, a new IBC transceiver design using FPGA Altera board was proposed. Binary Frequency Shift Keying (BFSK) modulation method was implemented where the digital data from transmitter input is modulated into 19 MHz and 25 MHz sinusoidal signals. Results demonstrate that the receiver can detect the transmitted signal from the transmitter considering the influenced of limb joint effect.

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