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Experimental Ultra Wideband Path Loss Models for Implant Communications

This work corresponds to an accepted paper for the 27th Annual IEEE International Symposium on Personal, Indoor, and Mobile Radio Communications (PIMRC2016)

Abstract—Ultra wideband (UWB) signals possess characteristics that may enable high data rate communications with deeply implanted medical sensors and actuators. Nevertheless, this application could be hindered in part by international spectrum regulations, which restrict UWB communications to 3.1-10.6 GHz where propagation conditions through the human body are rather unfavorable. Therefore, for the proper feasibility assessment and design of implant communications using UWB signals, accurate models of the radio channel are of utmost importance. Hence, we present UWB path loss models for the two most commonly used implant communication scenarios, i.e., in-body to on-body (IB2OB) and in-body to off-body (IB2OFF). These models were extracted from in vivo measurements in the abdominal cavity within 3.1-8.5 GHz using a living porcine subject. A thorough comparison between this modeling approach and channel measurements using a homogeneous phantom, which mimics the electromagnetic behaviour of muscle tissue, is presented too. Measurements in a homogeneous propagation medium are simpler to perform, but they fail to capture several physiological effects observed in a living subject. Thus, we measured the deviation between the phantom-based and in-vivo-based path loss models. In general, phantom measurements yielded a more pessimistic estimation of the path loss. We provide the correction factors to adjust easy-to- perform phantom-based measurements to more realistic path loss values, which can assist the biomedical engineer in the early stages of design and testing of wireless implantable devices.

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