

Off-Body Sub-GHz Wireless Channel Characterization for Dairy Cows in Barns

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Abstract : The herd monitoring and managing - in particular the detection of 'attention animals' that require care, treatment or assistance is crucial for effective reproduction status, health, and overall well-being of dairy cows. In large sized farms, traditional methods based on direct observation or analysis of video recordings become labour-intensive and time-consuming. Thus, automatic monitoring systems using sensors have become increasingly important to continuously and accurately track the health status of dairy cows. Wireless sensor networks (WSNs) and internet-of-things (IoT) can be effectively used in health tracking of dairy cows to facilitate herd management and enhance the cow welfare. Since on-cow measuring devices are energy-constrained, a proper characterization of the off-body wireless channel between the on-cow sensor nodes and the back-end base station is required for a power-optimized deployment of these networks in barns. The aim of this study was to characterize the off-body wireless channel in indoor (barns) environment at 868 MHz using LoRa nodes. LoRa is an emerging wireless technology mainly targeted at WSNs and IoT networks. Both large scale fading (i.e., path loss) and temporal fading were investigated. The obtained path loss values as a function of the transmitter-receiver separation were well fitted by a lognormal path loss model. The path loss showed an additional increase of 4 dB when the wireless node was actually worn by the cow. The temporal fading due to movement of other cows was well described by Rician distributions with a K-factor of 8.5 dB. Based on this characterization, network planning and energy consumption optimization of the on-body wireless nodes could be performed, which enables the deployment of reliable dairy cow monitoring systems.

Keywords : channel, channel modelling, cow monitoring, dairy cows, health monitoring, IoT, LoRa, off-body propagation, PLF, propagation

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