Characterization of the Off-Body wireless Channel and Network Planning for Dairy Cows at 2.4 GHz

Said Benaissa\textsuperscript{1, 2}, David Plets\textsuperscript{1}, Emmemic Tanghe\textsuperscript{1}, Leen Verloock\textsuperscript{1}, Luc Martens\textsuperscript{1}, Nobby Stevens\textsuperscript{3}, Jeroen Hoebeke\textsuperscript{1}, BartSonck\textsuperscript{2}, Frank Tuyttens\textsuperscript{2}, Wout Joseph\textsuperscript{1}

\textsuperscript{1}Department of Information Technology, Ghent University/iMinds, Gaston Crommenlaan 8 Box 201, B-9050 Ghent, Belgium
\textsuperscript{2}Institute for Agricultural and Fisheries Research (ILVO), Scheldeweg 68, 9090 Melle, Belgium
\textsuperscript{3}DraMCo research group, ESAT, Faculty of Engineering Technology, KU Leuven, Gebroeders De Smetstraat 1, 9000 Ghent, Belgium

Abstract: The size of dairy cattle herds and the number of animals per stockperson are increasing. This renders herd monitoring and managing - in particular the detection of 'attention animals' that require care, treatment or assistance - a challenging task. Wireless sensor networks (WSNs) can be effectively used in health tracking of dairy cows to facilitate herd management and cow welfare. However, the deployment of these networks in barns requires a proper characterization of the off-body wireless channel between the on-cow sensor nodes and the back-end base station. The goal of this work was the characterization of the off-body wireless channel and network planning in indoor (barns) environment at 2.4 GHz. Both large scale fading (i.e., path loss) and temporal fading were investigated using ZigBee motes and spectrum analysis equipment. The measured path loss values were well fitted by a one-slope log-normal path loss model. The path loss was increased by 5 dB when the cows were in the barn. The increase was caused mainly by the cow wearing the sensor node. The temporal fading due to the cow movement was well described by Rician distributions with K-factors of 10 dB. Based on the characterization of the off-body wireless channel and the specifications of the CC2420 chip, an indoor network planning tool was used to design a ZigBee-based WSN for dairy cows. The optimal number and location of the base stations inside the barn were determined and the minimally required transmit power of the sensor nodes were derived.
After three successful North-American conferences, we now proudly announce the first International Conference on Precision Dairy Farming. Scientists, manufacturers of precision technologies, and veterinarians/advisors are welcomed to discuss developments in sensor technologies for dairy farming.

CALL FOR ABSTRACTS