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Abstract

Characterization and Implementation of in-to-out Body Wireless Sensor Data Transmission for Smaller Ruminants †

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Among bioclimatic indicators for ruminants, the rumen stability is crucial to determine the animal's health status. A modern solution to monitor the rumen condition consists of an implant sensing bolus that collects and transmits bioclimatic ruminal data, such as temperature and pH value, and a wearable on-body receiver which also communicates with a remote control platform. Such a solution is being adopted in cattle management as the bovine animal size does not impose strict requirements on the dimensions and weight of the bolus. However, for smaller ruminants such as sheep and goats, research on autonomous health monitoring and ruminal sensing bolus development is lagging behind. In this work, we characterized numerically the in-to-out body wireless data transmission in smaller ruminants using the 3D electromagnetic finite-difference time-domain (FDTD) solver available in sim4life (ZMT, Zurich, Switzerland). First, we dimensioned a spiral antenna operating at 433 MHz for integration in a ruminal bolus whose volume is 70% less than that of a bovine bolus while taking into account the frequency detuning due to the proximity of the printed circuit board (PCB) and animal tissues. Next, we investigated the in-to-out body path loss in a homogeneous animal model and verified it with a bioequivalent phantom. The in-to-out body path loss analysis can be used to predict in vivo propagation with living adult sheep or goats.