

## SHORT TERM SCIENTIFIC MISSION (STSM)

STSM Reference Number: ECOST-STSM-FA1308-300617-095054

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STSM Type: Standard

COST Action: FA1308

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STSM Title: Characterization and optimization of wireless data transmission paths within a WBAN for sheep and goats

### Financial Support:

Amount for travel	500 Euro
Amount for subsistence	2000 Euro
Total amount	2500 Euro

### Workplan summary:

1. Aim & motivation This STSM project aims at providing stable wireless transmission and sufficient signal coverage for the ruminal sensing bolus for small ruminants. The in-to-out body transmission path between the ruminal sensing bolus and on-body receiver is crucial to the functionality and power efficiency of the bolus. Unlike sensing boluses for cattle, the ones for small ruminants have much stricter requirements on size and weight which has therefore increased the difficulty in radio component design. It will be the novelty of this project to devise proper radio component as well as a in-to-out body transmission model for ruminal sensors for small ruminants. The objectives of this STSM project are as follows: i) Re-evaluate existing radio solutions of ruminal sensing bolus for small ruminants and improve the antenna model of the bolus. ii) Develop a path loss analysis model for the in-to-out body transmission which could be used to predict the propagation in and through the real animal body. iii) Prepare for publications about the work and results from this STSM project.

2. Proposed contribution to scientific objections of the Action The radio solution of the bolus for small ruminants from this STSM project will be recommended for use in the DairyCare SWIG project of "Development of sensor technology suitable for monitoring feeding and behavior of small dairy ruminants", proposed and led by Professor Gerardo Caja. Meanwhile, the in-to-out body path loss analysis model to be devised in this STSM project can be used to predict in-vivo propagation of wireless signals in small ruminants.

3. Techniques i) Computational electromagnetics (CEM) which includes Finite-difference time-domain method (FDTD), Methods of moment (MoM) and Finite element methods (FEM) etc. ii) Tools of CEM that will

be used are Sim4Life which uses FDTD and FEKO which mainly uses MoM. Both are able to model and simulate the antenna propagation in the desired scenarios. iii) RF measurements with bio-equivalent phantom and living animal to evaluate antenna performance and transmission path with Network Analyzer, Spectrum Analyzer and their accessories. iv) Scripting for advanced uses of Sim4Life and FEKO respectively.

#### 4. Planning

01/05/2017-31/05/2017 i) Review of the problems in existing antenna and transmission path from previous design. ii) Improve the antenna design with simulation tools. 01/06/2017-15/06/2017 i) Prepare for antenna fabrication and measurement. 16/06/2017-31/07/2017 i) Design and conduct in-situ measurement of antenna performance and in-to-out body propagation with bio-equivalent phantom. ii) Perform simulations of the in-situ scenario and compare the results with measurements. iii) Perform simulations of in-vivo scenario with 3D animal model. iv) Integrate the antenna to bolus prototype and conduct in-vivo measurement with living animals. 01/08/2017-31/08/2017 i) Design review targeting at devising further improved antenna models for the ruminal bolus. ii) Paper writing and revision.

STSM coordinator approval date: 2018-02-07