**Project Title:**

From relationships to disease.....Real time tracking of social interactions, locomotion and grazing patterns and their potential associations with common production challenges: A pilot study

**Aim of Research** (100 words max.) [Explain both specific aims and their wider application]

Investigate the grazing and locomotor behaviour of livestock to inform current land and livestock management and production practices.

This tracking and classification system will benefit industries far beyond the immediate optimised farming. Improved understanding in this area will benefit farmers, animal welfare groups, environmental agencies and the academic community but will also promote closer links between agricultural research, modern technology and academics from different areas including animal welfare, veterinary science, virologists, bacteriologists, infectious disease specialists and epidemiologists with the principles being applicable across a variety of interacting animals in a range of domestic and natural environments.

**Outline of Research** (200 words max.) [What was done and by whom – focus on role of students and partner organisations and how the data being collected allowed the aims to be addressed]

The trackers will be developed between Duchy Stoke and Camborne alongside teaching in particular the Equine MSc module ‘Technological advances…’ along with Equitation Science in both the FdSc and BSc.

Trackers based on the Arduino microcontroller and its associated ecosystem of sensors and C++ software will be developed. Sensors are expected to include a triple axis accelerometer and gyroscope as well as GPS. We already have a working basis for such a model and have used it within the Equine MSc, but many details remain to be investigated and optimised.

In order to classify animal behaviour from an analysis of the IU data a machine learning approach will be used, using a classification schema (probably Random Forest), initially within the R framework but including also, if necessary, the Spark framework for large data sets.

A video camera will be required during the development and model training phase to provide a labelled set of data.

Initial trials will then be carried out in conjunction with students across all equine courses as well as the possibility of some data collection being done in conjunction with some of the agriculture students if the opportunity arises alongside video to support in identification of specific parameters for use in developing the classifier and associated model.

**Outcomes** (200 words max.) [Focus on collaborations initiated / strengthened; staff & student expertise gained; publications and presentations; press / social media reports]

This project would be a collaboration between Equine at Duchy Stoke and Science and Natural Environment, Camborne utilizing the experience and support from the contrasting areas. This collaboration will provide a new depth of knowledge to both departments and student cohorts.

As a pilot study, we propose to focus on the development of cost effective global positioning systems (GPS) and inertial measurement unit (IMU) recording device and associated driver and machine learning software for automated analysis of grazing.

This system will be tested on a small scale (single farm/herd) to examine the relationship between health and production/performance with that of grazing and locomotor behaviour through milk yield, breeding rates, health, foot trimming and lameness records. Spatial and temporal characteristics will be classified for development of a log to include activities such as grazing, walking, resting and interacting.

Once developed as a proof of concept we would hope to refine the equipment and promote within the equine and bovine industries.

With other sensors, the combination of microcontroller, driver software (C++) and analysis software (R, but likely also some “Big Data” platform such as Spark) would have ready application in a wide range of field research, not limited to bio-logging.

**Photograph** attachment showing project activity, ideally staff/students/partners in action.

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(left) An Arduino Uno with data logger shield and 10-DOF sensor. (right) *x*,*y* and *z* accelerometer data taken at 20 Hz with the logger attached to one of the authors as he jumped first in the *z*, then the *x* and then the *y* directions, before finally slowly oscillating the logger in the *z* direction.