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Conference or Workshop Item

Title: The use of multivariable sensor data to early detect lameness in sheep


Version: Presented version

http://nectar.northampton.ac.uk/9023/
THE USE OF MULTIVARIABLE SENSOR DATA TO EARLY DETECT LAMENESS IN SHEEP

SENSORS IN FOOD AND AGRICULTURE CONFERENCE 2016

MOLLER CENTRE – CAMBRIDGE

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30 Nov. 2016
OUTLINES

• Problem definition.
• Research aim.
• Related works.
• Sensor prototype.
• Data Collection/Data collection obstacles.
• Lame & Sound Sheep data examples.
• Data analysis and machine learning.
• Research Methodology.
• Preliminary results.
• What is next?
PROBLEM DEFINITION

- Lameness is a clinical symptom referring to locomotion changes, resulting in impair and erratic movements that widely differ from normal gait or posture (Van Nuffel, et al., 2015).
- Lameness represents a serious cost problem in sheep industry and farming productivity in the UK.
- The cost of the footrot disease (one of the common causes of lameness) to British sheep industry per year was estimated by £24 million (Nieuwohf and Bishop, 2005), and around £10 for each ewe (AHDB, 2014).
- It varies from mildly lame to severely lame.
RESEARCH AIM

• To develop an automated model to early detect lameness in sheep by analysing the data that will be retrieved from a mounted sensor on sheep neck collar.

• Minimize sensor power consumption by eliminating the sensor data which have less effect on decision making to identify lameness.

• This model will help the shepherd to early detect the lame sheep to prevent the worse situation of trimming or even culling the sheep.
RELATED WORKS

- Very divergent because of the **multidisciplinary** feature of this research study.

### Data Collection Methods
- Human Observation
- Video Cameras
- Sensor data (GPS, Accelerometer, head movements, ....)

### Data Analysis Methods
- LS /GS Scoring system techniques/done by trained observer
- Statistical Techniques
- Computerized techniques (Data mining use Machine Learning techniques)

### Analysis Purpose
- Detect animal illness (mastitis, lameness, ketosis)
- Classification (lying, standing, grazing, ruminating)

### Species Type
- Cattle
- sheep
- Other species
Sensor data is an Excel file like this:

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DATA COLLECTION

• Data were collected from Lodge farm at Moulton College on 13 June 2016 (9 sheep) and on 23 Sept. 2016 (22 sheep).

Video Footage example
DATA COLLECTION OBSTACLES

• Catching the sheep not an easy work, help is always needed. DBS check.

• Muddy soil in rainy weather.

• Sensor collar need to be fixed with clips.

• Sheep do not move. Need to walk to simulate them for continuous walking which is important for readings.
LAME SHEEP EXAMPLE

Acceleration data for lame sheep

Acceleration magnitude for lame sheep
LAME SHEEP EXAMPLE CONT.

Gyroscope data for lame sheep

Gyroscope magnitude for lame sheep
LAME SHEEP EXAMPLE CONT.

Angle data for lame sheep

Angle magnitude for lame sheep
SOUND SHEEP EXAMPLE

Acceleration data for sound sheep

Acceleration magnitude for sound sheep
SOUND SHEEP EXAMPLE CONT.

Gyroscope data for sound sheep

Gyroscope magnitude for sound sheep
SOUND SHEEP EXAMPLE CONT.

Angle data for sound sheep

Angle magnitude for sound sheep
DATA ANALYSIS

• Analysis of the data includes simple query and reporting, statistical analysis, more complex multidimensional analysis, and data mining.

• Data mining is the process of automatically retrieving useful information from huge data repository by predicting the results of future observations.

• Data mining incorporates with various techniques from different domains.
MACHINE LEARNING

• **Machine Learning (ML)** is a method of data analysis that automates analytical model building.

• ML investigate how the computers automatically learn from data to identify the output (class) based on the data attributes to predict an intelligent decision for unseen data.
RESEARCH METHODOLOGY

Input data
(9 predictors) + 2 classes (lame, sound)

Classifier

Trained model

New data
(9 predictors) with no classes

Trained model

Predicted the classes
PRELIMINARY RESULTS

- Preliminary results with Classifier

![Bar chart showing accuracy for different classifiers.]

- Accuracy:
  - Simple Tree: 46.14%
  - Linear Discriminant: 71.55%
  - Liner SVM: 71.86%
  - Fine KNN: 57.55%
  - Ensembler Boosted Tree: 62.86%
  - Ensembler Subspace discriminant: 71.59%
  - Bagged Tree: 64.91%
WHAT IS NEXT?

- Eliminate the variable data sensor that have less effect on making a decision (identify lameness class).
- Data preprocessing (normalization).
- Feature extraction (Apply window size scenario)
- Implementation:

  - The Sensor gives the lameness alarm
  - The developed Algorithm will be built in the sensor itself.

  - The Base Station gives the lameness alarm
  - The developed algorithm will be in a remote base station (communication part may be needed)
REFERENCES


THANK YOU FOR LISTING
CLASSIFICATION

• To predict the new classes in test data set based on the attributes of previously known classes in a training data set.
MATLAB CLASSIFIERS

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<th>Memory Usage</th>
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<td>Easy</td>
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<td>Discriminant Analysis</td>
<td>Fast</td>
<td>Small for linear, large for quadratic</td>
<td>Easy</td>
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<td>Easy for Linear SVM, Hard for all other kernel types.</td>
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<td>Fast to medium depending on choice of algorithm.</td>
<td>Low to high depending on choice of algorithm.</td>
<td>Hard</td>
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- **Speed**: fast 0.01 Sec, medium 1 sec., slow 100 sec.
- **Memory**: small 1MB, medium 4MB, large 100 MB.