Analyzing relationships between cattle grazing behavior and pasture attributes using the inertial measurement (IMU) of a mobile phone

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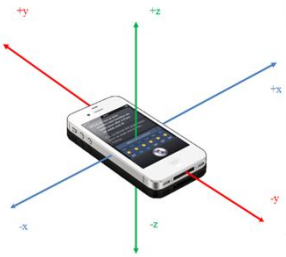
INTRODUCTION

- Recent technological developments boost the opportunities of accurate method of resource use monitoring in agriculture;
- The Precision Livestock Farming (PLF) concept experienced huge developments over the past decade and could be useful for grazing monitoring;
- PLF aims to optimize of individual performances of farm animals.

AIM: Accurate detection and analysis of cattle's grazing and ruminating behaviors with the iPhone Inertial Measurement Unit

MATERIAL: the iPhone/iPod is fixed with a halter on the cow's neck

iPhone/iPod IMU



- 3-D Accelerometer
- 3-D Gyro
- 3-D Magnetometer
- Location data
- Proximity Sensor

41 recordable signals

- …
- Inclination
- Gravitational acceleration
- User acceleration
- Rotation rate
- …

METHODS: 2 steps

FIELD SESSION: signals and video recording

Signals recording frequency: 100Hz

VIDEO OBSERVATION: Observed behavior matrix

DATA ANALYSIS: determination of detection criteria

Main differences

Head inclination

+

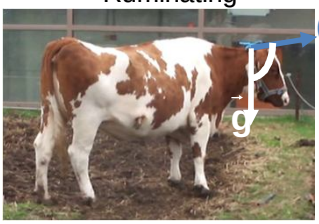
Jaw movements intensity

Grazing

High intensity:

Grass pulling + bite

Ruminating



Low intensity and regular:
Chewing + Swallowing

Criteria

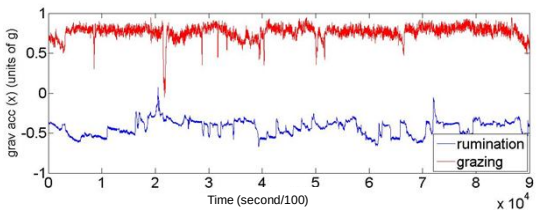
μ(Gravitational acceleration on x-axis)

σ(User acceleration on x-axis)

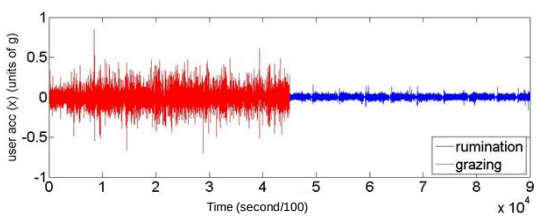
DETECTION ALGORITHM ➔ Detected behavior matrix

RESULTS: grazing vs rumination on time-domain

Gravitational acceleration on x-axis



User acceleration on x-axis



RESULTS: detection accuracies (observation vs detection)

	N° Data	N° Cow	Record date	Grazing	Rumination
Calibration data	Field1	1973	Sept. 2012	100%	-
	Field2	1973	Sept. 2012	-	98%
	Field3	1973	Sept. 2012	97%	-
Validation data	Field4	1376	May 2013	84%	-
	Field5	1376	May 2013	100%	100%
	Field6	1973	Sept. 2013	-	90%
	Stable1	1973	Nov. 2013	-	84%
	Stable2	1376	Nov. 2013	-	80%

CONCLUSION

- ❑ Relevancy of using the iPhone's IMU as a tool to record cattle movements
- ❑ 84% to 97% of accuracies when detecting grazing behavior

PERSPECTIVES

- ❑ Signal processing analysis
- ❑ Deeper analysis of each behavior
- ❑ Link between grazing behavior with pasture attributes (sward heights, composition, nutritive values)