

# Annual Project Report 2014



## Project Title

Summary sheet (up to two pages)

<b>Project number</b>	Automated foraging behaviour in free range sheep grazing a bio-diverse pasture in Shotwick, Cheshire, England OS location 333781,371970		
<b>Start date</b>	April 2013	<b>End date</b>	August 2014

### Project aim and objectives

- To develop a wireless sensor network system with incorporated accelerometer for locating and describing foraging movement in ewes based on RFID technology at paddock scales.
- To investigate the use of video technology to describe foraging activity from acoustic data in ewes grazing a bio-diverse pasture
- To investigate whether non structural carbohydrate concentrations in sward influence foraging activity in summer pasture

### Key messages emerging from the project

- RFID technology with inbuilt accelerometer can be used for locating sheep and describing foraging activity
- Acoustic data calibrated by video observation can be used to differentiate foraging activity in ewes grazing on a bio-diverse pasture

### Summary of results

- Water soluble carbohydrates in sward did not differ significantly on a diurnal basis in summer pastures indicating that growth and flowering precluded accumulation.
- Globally recognised sound descriptors Wiener entropy, amplitude, frequency and pitch could be used to discriminate between foraging events (rye, clover, sugar beet, meadow grass spp. Nettle thistle and fruit tree browse)  $p < 0.0001$ .
- This was applicable to sheep of different breeds (Texel, Balwen and Hebridean) and size.

<b>Lead partner</b>	J Sneddon , School of Natural Sciences & Psychology, Liverpool John Moores University, Byrom St, Liverpool L3 3AF 01512312191 J.C.Sneddon@ljmu.ac.uk
<b>Scientific partners</b>	Dr Alex Mason, BSc, PhD, PGCE, MIET, FHEA, CEng. Reader in Smart Technologies Programme Leader for Smart Technologies for Infrastructure and Buildings (MSc) Built Environment and Sustainable Technologies (BEST) Research Institute Liverpool John Moores University A: Rm 3.06, Peter Jost Enterprise Centre, Byrom Street, Liverpool, L3

# Annual Project Report 2014



	<p>3AF.          E: <a href="mailto:A.Mason1@ljmu.ac.uk">A.Mason1@ljmu.ac.uk</a>          T: 01512312847          M: 07456998777          W: <a href="http://www.staff.ljmu.ac.uk/enramaso/">http://www.staff.ljmu.ac.uk/enramaso/</a></p>
<b>Industry partners</b>	<p>Frits van Calker</p> <p><b>RFIDdirect</b>          Tel. (+44) 0845 249 0068          Tel. (+49) 02822 305 323</p> <p>Partner in the <b>Guidance in RFID</b> group:  <a href="http://www.RFIDdirect.eu">www.RFIDdirect.eu</a>    <a href="http://www.Cybernetics-associates.com">www.Cybernetics-associates.com</a>          RFID Direct,</p>
<b>Government sponsor</b>	n/a

<b>Has your project featured in any of the following in the last year?</b>	
<b>Events</b>	<b>Press articles</b>
<b>Conference presentations, papers or posters</b>	<b>Scientific papers</b>
<p>Automated Monitoring of Foraging Behaviour in Free ranging sheep November 2013            Daniel Spencer            EBLEX PhD Conference Kennilworth 10-11<sup>th</sup> December 2013</p> <p>Automated Monitoring of Foraging Behaviour in Free Ranging Sheep Grazing a Bio-diverse Pasture            J. Sneddon (J.C.Sneddon@ljmu.ac.uk)            A. Mason (A.Mason1@ljmu.ac.uk)            EBLEX conference Ewe Nutrition , Nottingham, 29-30 April, 2014</p>	<p><i>J. Sneddon and A. Mason, "Automated Monitoring of Foraging Behaviour in Free Ranging Sheep Grazing a Bio-diverse Pasture using Audio and Video Information", Eighth International Conference Sensing Technology (ICST2014), In-Press.</i></p> <p>A. Mason and J. Sneddon, "Automatic classification of foraging behaviour in sheep using Radio Frequency ID, movement sensor and video technology", BSAS Advances in Animal Biosciences, Vol 5, Part 1, pp. 16, ISSN: 20404700, 2014.</p> <p>A. Mason and J. Sneddon, "Automated monitoring of foraging behaviour in free ranging sheep grazing a biodiverse pasture", Seventh International Conference Sensing Technology (ICST2013), pp. 46-51, DOI: 10.1109/ICSensT.2013.6727614, 2013.</p>
<p><b>Other Outcomes:</b> A Mason, J Sneddon and F van Calker gained a 20K Technology Strategy Board Grant (Small Business Research Initiative Wales) which ran January to July 2014. 'Smart Radio Frequency Identification Platform with Acoustic Stimulus for Virtual Fencing' to keep sheep off watercourses in Welsh uplands'. Our bid for Phase Two of this call for 50K funding to design a path to market runs December 2014 to November 2015 and is being assessed via a submitted</p>	

# Annual Project Report 2014



report (60%) and an interview (40%) on 20<sup>th</sup> August 2014. We heard that we were successful with our bid on 28<sup>th</sup> August 2014.

A. Mason has got to the Interview stage for an ERC Starter Grant on 9<sup>th</sup> October 2014 with a proposal 'SMART Livestock Net'. This is for 5 years of substantial funding.

Daniel Spencer got a 6 month contract with RFID Direct as a result of participating in the EBLEX project.

## Full Report

### Q1: Financial reporting –

	Yes	No	N/a
Was the project expenditure in line with the agreed budget?	√		
Was the agreed split of the project budget between activities appropriate?	√		
<b>If you answered no to any of the questions above please provide further details:</b>			

### Q2: Milestones – were the agreed milestones completed on time? Yes

Project milestones	Proposed completion date	Actual completion date
April 2013 RFID/accelerometry project began	August 2014	August 2014
April 2013 Video/Water Sol CHO project began	August 2014	August 2014
June 29 <sup>th</sup> 2013 field visit L Genever	Same day	
June July 2013 Water Sol CHO and survey work On pastures	Survey work June/July 2013 CHO analysis done by 31st August 2013	
April – July Sourcing of equipment and development of all technologies in lab and field environments	July 2013	
July August 2013 and 2014 further work on video/water soluble CHO project	August 2014	
September 24 <sup>th</sup> 2014 Field visit by EBLEX staff to see research	Same day	

# Annual Project Report 2014



If any of the milestones above are incomplete/delayed, please provide further details: n/a

**Q3: Results – what did the work find? Detail is to be found in the accompanying summary report and in the associated conference papers**



Summer levels of water soluble carbohydrate in sward did not differ significantly ( $p < 0.8$ ) between morning and evening sampling times unlike corresponding levels in November-December 2011 ( $p < 0.01$ ). While winter levels of water soluble carbohydrate in pasture were thought to direct foraging choice, monitored by placing a GPS unit on the sheep, water soluble carbohydrate levels in summer sward could not be associated with the previously established high intensity grazing bouts at dawn and dusk. These two grazing bouts were a common feature throughout the year but were larger in summer than winter as sheep spent 50% of their time grazing in summer and 30% in winter.

Acoustic data validated by video observations could be used to monitor foraging activity on a bio-diverse sward in a range of breeds and size of ewe. Background noise did not impinge on the power of the acoustic data to make these discriminations. Browsing dry or fresh leaf material from trees or shrubs gave a softer sound profile than grazing rye grass and fescue.

The Wireless sensor network system communicating via Radio frequency ID and accelerometer data can be used to fix the position and head movement of ewes during foraging.

**Q4: Discussion – what do the results mean for levy payers?**

- We are on the road to developing a system which will allow farmers to trace the location and foraging activity of their sheep from their offices which could be applied from paddock to landscape scales. This is an unique tool for management of pasture resources and management of animal nutrition and health
- We have already secured funding for a project to further develop the combined technologies in association with an acoustic stimulus for a 'virtual fencing' project to keep sheep away from waterways and trees in upland Wales sponsored by DEFRA

**Q5: New knowledge – what key bit of new knowledge that has come out of this project?**

- The software for programming the wireless sensor network is a new invention
- Combining the accelerometer, video and RFID technology with a desk portal for farmers (once developed) is novel

# Annual Project Report 2014



## Q6: Gaps in knowledge – what gaps in knowledge did this project identify?

- We need to develop a desk portal for farmers
- We need to develop our system (incorporating a virtual fencing element) for the agricultural industry
- Sward nutrient status can be interrogated by using video material tuned for the hyper-spectral range when reflectance properties of chlorophylls can be followed in real time to indicate nitrogen status or senescence.

## Q7: Cost:benefit – what is value of this project?

A huge saving in labour costs as the technologies provide an unique management tool. They enable a farmer to track sheep on a real time basis Signals from sheep foraging in the wrong place or from immobile animals can be picked up early and appropriate steps taken. This is particularly relevant to farmers farming in more extensive agricultural systems'

## Q8: Additional deliverables – what activity is planned with the results from this project?

Activity	What is planned?	When likely to happen?
<b>Events</b>	Visit by EBLEX staff to see research Sept 24 <sup>th</sup> 2014	
<b>Press articles</b>		
<b>Conference presentations, papers or posters</b>	3 <sup>rd</sup> September 2014 International Conference for sensor Technology, Liverpool paper presentation J Sneddon	
<b>Scientific papers</b>	A paper on the full acoustic data set and water soluble carbohydrate data in <i>Applied Animal Behaviour Science</i> The supplementary report in the email accompanying this summary has made a start.	Already published RFID and first part of acoustic technology research – plan to get a fuller paper submitted by the end of 2014
<b>Other</b>	Grant application to EU	Interview Oct 9 <sup>th</sup> 2014

# Annual Project Report 2014



<b>Other</b>	Grant application to DEFRA for phase two funding on a Virtual Fencing project. Phase one secured February – July 2014	We hear during the week 25-29 <sup>th</sup> August 2014
--------------	---	---