DEVELOPMENT OF A WIRELESS SENSOR NETWORK FOR UNDERSTANDING ANIMAL BEHAVIOUR

G.J. BISHOP-HURLEY[A], D.L. SWAIN[A], P. SIKKA[B] and P. CORKE[B]

[A]CSIRO Livestock Industries, JM Rendel Laboratory, Rockhampton QLD 4702
[B]CSIRO ICT Centre, Queensland Centre for Advanced Technologies, P O Box 883, Kenmore Qld 4069

A continuous record of animal activity could enhance our understanding of animal behaviour (Rutter *et al.* 1997). Collection of behavioural data has traditionally relied on manual observations which are time consuming, expensive and may not represent the full range of animal behaviours. Recent advances in technology have enabled automated collection of behavioural data, for example bite meters (Rutter *et al.* 1997) but the devices are stand alone. This paper describes a wireless sensor network (WSN) and explores the feasibility of using it to collect data and gain an understanding of the behaviour of animals in extensive grazing systems.

A large heterogeneous WSN has been deployed at Belmont Research Station (150º 13´E, 23º8´S), located 20 km NW of Rockhampton in Queensland (Sikka *et al.* 2004). This network is solar powered and has been running for over 9 months. The current deployment consists of 11 sensors that provide soil moisture profiles to a depth of 1 m, sensors that measure weight and are used to compute the quantity of supplement and water consumed by animals, electronic tag readers, up to 40 sensors that can be used to track animal movement (GPS, 3-axis magnetometers and accelerometers) and 20 sensor/actuators that can be used to apply audio, visual and tactile stimuli to animals. The static part of the network is designed for continuous day and night operation and is connected to the Internet via a dedicated high-gain radio link, also solar powered. The network has been used recently to investigate animal behaviour. For example, 5 steers weighing 280 kg were placed in a 1.5 ha paddock for 4 days and their location was recorded every 10 seconds.

The data collected provided information on the spatial preference of animals plus clustering or herding behaviour. Confined to a 1.5 ha paddock, a steer seemed to prefer the pasture in some areas more than in others (Figure 1a). Some of this congregation was related to physical features such as water, tracks and shade in the environment but the animal appeared also to follow a diurnal pattern of behaviour. The distance of individuals from the herd centroid varied with time of day as shown by root mean square (RMS) distance in Figure 1b. The changes in the herd aggregation throughout the day were linked to some of the paddock selection drivers.

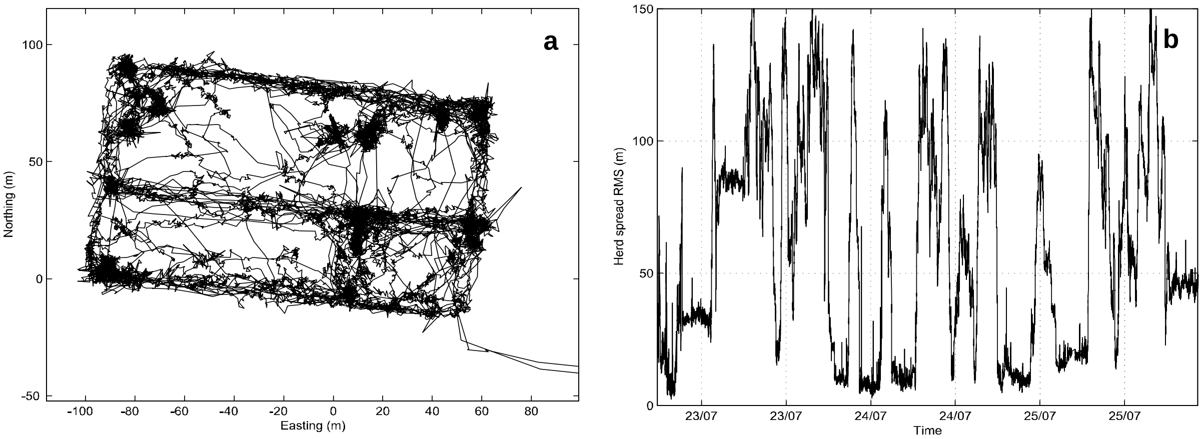

Figure 1. Path of one steer over a 4 day period (a) and herd spread root mean square (RMS), distance of individuals from herd centroid (b)

This example suggests that wireless sensor networks can provide new research opportunities for livestock sciences and, in the long term, may lead to new industry applications. The research being conducted at Belmont using the WSN is providing a detailed automated monitoring and actuator platform for control in large-scale extensive grazing systems. The information gained will give scientists a better understanding of animal behaviour and allow them to provide guidelines to producers on how to manage livestock for increased production and environmental and economic sustainability.

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Email: greg.bishop-hurley@csiro.au