

Activities of the DOUGLAS BOMFORD TRUST

An update

Reports of technical projects that received funding support from The Trust

An extract from a project report submitted to The Trust is given below - further details can be obtained from our office.

VALIDATION OF A MOTION SENSOR FOR AUTOMATIC DETECTION OF LAMENESS IN PIGS

- work conducted at Newcastle University

The aim of this project was to take the first step in developing an automated system for detecting lameness in growing pigs.

The main objective was to validate a commercially available motion sensor (Microsoft Kinect) against a marker-based 3D system by undertaking a pilot study to confirm the validity of this readily available, low-cost motion sensor to measure key parameters of animal movement which have been identified as being reliable indicators of gait.

Lameness is a major problem affecting pigs and its detection on commercial farms is challenging due to the reliance on subjective scoring systems and large group sizes which can make it difficult to see individual pigs.

Using advanced objective kinematic gait analysis techniques such as the Vicon system, lameness in pigs has been associated with abnormality in the movement of the axial body during walking. In a previous PhD research programme, vertical displacement of the head and neck was found to be most affected and increased in lame pigs compared to normal animals.

However, simpler and more cost-effective technology is required to automate lameness detection for commercial application.

In the current study, the walking trajectories of mid-line dorsal body regions of normal pigs varying in size were captured repeatedly, within capture day and between days, on two or three occasions within a week. Pigs were trained to walk at a steady pace along a walkway. Trajectories of the body regions were tracked simultaneously using both a 6-camera Vicon motion capture system, with the cameras set up in an array flanking the walkway to detect reflective markers placed along the axial body, and a Microsoft Kinect motion sensor which was mounted above the walkway (see photograph).

Four pigs wore a large reflective marker in the mid-neck region, detectable by both systems on two capture occasions.



The experimental set-up of the apparatus used in the project: Vicon cameras flank the walkway whilst the Kinect sensor is mounted above the walkway

Compensatory movements in the mid-neck region during lameness episodes may be expected and this region can be tracked more reliably in the Kinect depth data.

Two custom-written computer algorithms using the Kinect developer toolkit were produced to follow the large neck marker and enable marker-free tracking of other body regions. Reversed depth data from the Kinect sensor and vertical position data from the Vicon system were used to assess the level of agreement in tracking movement of selected body regions between the two systems.

Correlation and limits of agreement of Vicon and Kinect vertical trajectory means and descriptive statistics of continuous trajectory differences were evaluated.

The results showed that there was a high positive correlation between the Kinect and Vicon vertical trajectory means of the large neck marker. The Kinect neck marker vertical trajectory mean was generally higher than that of the Vicon trajectory

mean. There was no pig effect on differences, but a pig effect on absolute trajectory mean which reflected the size of the pig. The mean of vertical amplitudes, i.e. difference between local extremes on curves, was 5 ± 2.8 mm, and hence a minimum difference of +15 mm in vertical amplitude in lame animals should be detectable in more than 99% of cases.

In contrast, the trajectories of the neck, back and pelvis body regions generated by a marker-free Kinect application showed less similarity with the corresponding Vicon trajectories.

On the basis of these findings, we suggest that the Kinect sensor has the potential to distinguish clinically lame pigs from sound animals, based on the extent of elevation of the neck region during walking. However, marker-free tracking algorithms need refinement and further development to become sensitive and reliable for commercial application.

Studentships

The Douglas Bomford Trust has awarded scholarships to six engineering students at Harper Adams University for the current academic year.

The scholarship winners, selected after a competitive application and interview process were presented with their awards at an event held at the University on 11th February - see *photograph*.

Agricultural Engineering student, **FINLAY WHITEHEAD**, from Newton Abbot, Devon, said, "To have been selected as a Douglas Bomford Trust scholar is a very privileged position to be in and I am extremely grateful to the Trust for granting me such support in my fifth and final year of study.

"The Trust has had huge, positive impact on my engineering studies at Harper Adams, contributing significantly to the new Agricultural Engineering Innovation Centre, which is now an amazing study area where I, as an MEng student, have dedicated desk space; contributing to a previous trip arranged by myself and some fellow students to

Agritechnica 2013; and now granting me a scholarship. I cannot thank them enough for their input to my studies."

HYWEL PHILLIPS, from Haverfordwest, Wales, said, "It is excellent to be associated with the Douglas Bomford Trust as they provide the Harper Adams engineering department with tremendous support.

"The trust pays for all engineering students to be members of the IAgRE, which allows us to attend very interesting and informative meetings and presentations relevant to our course.

"I would like to thank the panel for the interview experience and the Trust for its kind support. The financial support from this scholarship is going to be very beneficial towards paying my tuition fees for this academic year. I was pleased that my interest in organising trips to manufacturers either next term or in my fourth year, was of interest to the Trust."

ALISON SKEA, a second year BEng (Hons) Agricultural Engineering student from Fortar, Scotland, said, "I am

extremely grateful to the committee for choosing me to be their scholar. I have spent the last few years working in France and Austria trying to gather as much knowledge and experience as possible to help towards my degree.

"I would like to thank the trust for their support and encouragement. I'm not sure how I will use the money but I do know that as much as I can, I will invest in myself, to learn new skills or languages or engage in new experiences."

Receiving his fourth Douglas Bomford Trust Scholarship was **JACOB SMITH** from Market Rasen, Lincolnshire (not able to attend the Awards Presentation).

Jacob, a fifth year MEng Agricultural Engineering student, said, "The assistance the Douglas Bomford Trust has provided me will be a huge help to my professional development. It will allow me to develop skills that are sought after by many employers, and I would like to say a huge thank you for this."

ADAM MONTGOMERY, a fourth year MEng Agricultural Engineering student from Monaghan, Republic of Ireland, said, "I am extremely honoured to receive the Douglas Bomford Trust scholarship. This scholarship will allow me to concentrate on my studies and to achieve a distinction level degree.

"I would like to thank the Douglas Bomford Trust and Development Trust for their support."

MAX THORNE from Dunstable is a fifth year off-road vehicle design student. He said, "I am very grateful to receive this scholarship which will allow me to purchase additional resources for me to continue to excel at Harper Adams."

Max completed his placement with Niftylift. "I was working as a design engineer on a number of exciting projects. I was on the Monitored Professional Development Scheme (MPDS) scheme, allowing me to work towards becoming a chartered engineer. I plan to return to industry immediately upon graduation to allow me to develop skills and work towards becoming a chartered engineer. Ultimately I would like to set up an engineering business on the home farm."



The group of recipients of Douglas Bomford Trust scholarships at Harper Adams University pictured with trustee Jonathan Bomford and Trust secretary Paul Miller.

Back row (left to right): Hywel Phillips, Adam Montgomery, Finlay Whitehead and Max Thorne. Front row (left to right): Jonathan Bomford, Alison Skea and Paul Miller.