

Institute for Agri-Food Research and Innovation – Studentship Proposal Form

Please complete all sections. Information from this form will be used in the advertising process and on Newcastle and Fera websites to advertise your studentship idea. ALL studentships for IAFRI will be on a three year basis, please contact steven.hall@newcastle.ac.uk in the first instance if your proposal would require longer.

<p>Title of Studentship (please keep as concise as possible)</p>	<p>Automated monitoring of lameness in dairy cattle using facial expression analysis</p>
<p>Project Title and Summary (max 50 words) (this will be for advertising via postgradstudentship.co.uk, Jobs.ac.uk and others)</p>	<p>Effective on-farm health and welfare surveillance techniques are integral to sustainable food production. Lameness is a critical production disease with considerable welfare consequences. Using cutting edge interdisciplinary research, this project will test the effectiveness of facial expressions for assessing lameness in dairy cattle and develop an automated on-farm surveillance system.</p>
<p>IAFRI Theme (please input the call theme to which this project best aligns)</p>	<p><u>Theme:</u> Measurement to Management in Crop and Animal Health</p> <p><u>Sub-theme:</u> Detection Technology: Multi Sensor Data Capture and Analysis – utilising either new technology (devices), or novel uses of existing technology.</p>
<p>Full Project Description (min 1 side A4) (please give a more detailed overview of project and provide details of candidate involvement to include:</p> <ul style="list-style-type: none"> • Hypotheses they will be investigating • Theoretical underpinnings • Methodology • Training provided • location of training and research) 	<p>The proposal falls under the Institute priority of ‘Detection Technology’ as its overall aim is to develop an early warning system for lameness detection in cattle. Safeguarding livestock health and welfare is vital for food security by ensuring sustainability and meeting consumer ethical standards. The drive to increase milk yield has led to an increase in the prevalence of lameness (~35% incidence in UK herds), which is a serious economic and welfare problem. The subjective and time-consuming nature of current diagnostic methods is a major limiting factor contributing to this high incidence. This impact is likely to intensify with the increase in average herd size and associated reduction in human input, making effective monitoring of individual animal health increasingly difficult. Successful management of lameness could be</p>

improved by utilising more effective and reliable computational surveillance techniques. The primary hypotheses are: [1] Cow facial expressions can be used as an early warning indicator of lameness. [2] Expressions can be automatically detected with novel image processing techniques.

In phase 1 (months 1-12), we aim to establish whether facial expressions can be used effectively to diagnose lameness through a series of observations and straightforward interventions. Initially, the student will receive training in conventional methods of lameness detection. Animals at Newcastle University and other associated farms showing lameness will then be scored using established diagnostic techniques (such as gait scoring), and then will undergo routine treatment by a professional (e.g. hoof trimming) to reduce the degree of lameness. Non-lame control animals will undergo the same handling/restraint associated with treatment. High definition video sequences will be recorded before and after treatment and between lame and non-lame animals. Using these sequences, changes in facial expressions (Action Units or AUs) associated with lameness will be identified. This technique is routinely used to detect pain in humans and animals. We have already identified a number of potential candidate Action Units from a pilot study comparing cows in various degrees of lameness. Early in this phase the student will spend 1 month on Zoetis-linked farms to appreciate the incidence of lameness and the issues associated with its detection.

In phase 2 (months 12-24), an automated means of scoring the AUs identified in phase 1 will be developed. This will primarily involve the development of segmentation techniques that automatically locate cow faces in video streams recorded on farm, identify and map facial landmarks, and define a taxonomy of facial expressions associated with these landmarks. With such an analysis approach we will then associate automatically detected variations in facial expressions to objective lameness scorings. The sensitivity, specificity and repeatability of the algorithms will be tested during this phase. This phase will be based at

	<p>Newcastle University in collaboration with FERA. During this phase the student will work on the development, validation and application of computer vision and machine learning techniques to lameness detection and the methodologies for assessing their sensitivity and specificity.</p> <p>In phase 3 (months 24-36), we will validate the video analysis methods developed in phase 2 through on-farm application of lameness surveillance in commercial contexts. This will be conducted in association with Zoetis to assess the accuracy for identifying lame cattle, by comparison to the established lameness recognition and scoring techniques. This will be carried out at the commercial farms recruited through Newcastle University and Zoetis.</p> <p>This is an emerging inter-disciplinary scientific field encompassing the development and application of novel on-farm lameness diagnosis using automated image and video analysis techniques. The student will benefit from joining a multidisciplinary team of animal science, behaviour, veterinary and computer science researchers at Newcastle University. These Newcastle groups are already developing new methods for on-farm health and welfare surveillance in a range of livestock species, including the use of facial expressions and computational tools. He/she will develop skills in (supervision expertise in brackets): 1) conventional diagnosis of lameness; 2) novel assessment of lameness through facial expressions; 3) development of computer vision and machine learning techniques as methodological foundation for disease detection on farm. Association with Zoetis will allow development and validation of the work in a commercial context, and access to commercial farms.</p> <p>The student will benefit from Newcastle's postgraduate training programme, and receive specific training in husbandry, ethics and experimental design. He/she will be encouraged to present their findings to various stakeholders (e.g. Zoetis), the animal science and computer vision communities, and at international animal science and computer science conferences.</p>
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<p>Potential for Matched Funding (please give details of any potential 'matched funding' that may be available for this project)</p>	<p>Zoetis will contribute £4200 (£1400 per year for 3 years) to Newcastle University towards the costs of the project. Zoetis will also provide access to relevant farms and support by their Farm Support Team. Zoetis will cover all costs associated with student placement at their facilities and associated farms, including travel costs (the total costs is estimated at £5000). Additional contributions will be provided by Prof. Ilias Kyriazakis, and will be derived from existing BBSRC projects that aim to introduce automation in the detection of disease of farm animals (£20,000).</p>
<p>Costings Please estimate annual costs for consumables etc. associated with this project</p>	<p>Year 1 (Phase 1) Total: £4040 HD video camera (x 2): £700 Waterproof wide angle camera (x1): £600 Tripods (x2): £90 SD cards (x5): £250 Laptop: £1500 <u>Travel costs:</u> £200 (10 trips to local farms) £500 (10 trips to regional/national farms) £200 (1 Regional conference)</p> <p>Year 2 (Phase 2) Total: £1100 <u>Travel costs:</u> £500 (5 trips to FERA York) £600 (1 National conference)</p> <p>Year 3 (Phase 3) Total: £2100 <u>Travel costs:</u> £100 (5 trips to local farms) £0 (10 trips to regional/national farms – covered by Zoetis) £0 (Trips to Zoetis – covered by Zoetis) £2000 (1 International conference)</p>
<p>Name of Supervisors and Institution</p>	<p>Dr Matt Leach – School Agriculture, Food & Rural Development, Newcastle University.</p>

<p>(min. 2 - supervision must be joint between Newcastle and Fera, Jointly Appointed academics will be classed as Fera)</p>	<p>Professor Satnam Dlay - School of Electrical and Electronic Engineering, Newcastle University. Dr Andrew Cunningham, FERA Prof Ilias Kyriazakis – School Agriculture, Food & Rural Development, Newcastle University. Dr Theo Kanellos, Zoetis.</p>
<p>To be Completed if Primary location of Student is at Fera Science Ltd:</p> <p>Please give details of facilities, resources and processes that are in place so that support is available to the student whilst located at Fera. These include:</p> <ol style="list-style-type: none"> i. 10 meeting per year with academic supervisor ii. 3 meeting per year with full supervisor team iii. Systems in place for student to access NCL facilities E.G. Library iv. Plans for continued supervision if one or more current supervisors leaves their employment v. Plans for the student to engage in Newcastle activities that facilitate progression E.G. Postgraduate Conference <p>If possible provide a draft plan when these activities would take place.</p> <p>Also include details of any risk assessment that have/will take place at Fera covering the PhD.</p>	<p>n/a</p>
<p>Person Specification</p> <p>(please specify qualifications and skills required for this studentship E.g.</p> <ul style="list-style-type: none"> • Discipline area • English Language requirements <p>Additional skills)</p>	<p>Essential:</p> <ul style="list-style-type: none"> • Achieved or expect to achieve, at least a 2:1 Honours degree in a subject relating to biological sciences, computer science or a related area. • Experience of computer vision techniques and the associated programming skills. • If English is not your first language, you must have IELTS 6.5, or equivalent. <p>Desirable:</p> <ul style="list-style-type: none"> • For a candidate with a biological background, further qualification in computer vision is advantageous.

	<ul style="list-style-type: none"> For a candidate with a computer vision background, further qualification in biological sciences is advantageous.
<p>Eligibility Criteria</p> <ul style="list-style-type: none"> (please state if you wish applications from outside UK/EU or any other eligibility criteria) 	<p>Yes, we would be willing to accept applications from outside the UK/EU. This will increase the chance of recruiting the best candidate for this studentship as there will be a limited number of students who currently with the ideal set of skills.</p>
<p>Further Information</p> <p>(please list further sources of information relevant to the candidate, contact details or other potential advertising streams)</p>	<p>For further information please contact Dr Matt Leach on +44 (0)191 2085494 or matthew.leach@newcastle.ac.uk</p> <p>For further information see the website: http://www.ncl.ac.uk/afrd/</p>

Please see the [appendix](#) and select the relevant KEYWORDS for advertising

Upon completion please e-mail this form to steven.hall@newcastle.ac.uk or send printed copy to:

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