

Creating a 4D atlas of body composition and gait with 3D cameras and deep learning to inform next generation cattle health and welfare developments

Supervisory team:

Lead supervisors: Prof Andrew Dowsey (University of Bristol) and Prof Mark Hansen (University of the West of England; UWE)

Dr Tilo Burghardt (University of Bristol), Prof Lyndon Smith (UWE), Dr Neill Campbell (University of Bristol)

Collaborators: Prof Siobhan Mullan (University College Dublin)

Host institution: University of Bristol / University of the West of England; UWE

Submit applications for this project to University of Bristol

Project description:

High animal welfare and health practices are more important than ever to satisfy societal demands for the livestock sector. The use of precision monitoring instrumentation for dairy cattle is key to optimising animal health and welfare. During a successful ongoing collaboration between Bristol Robotics Laboratory (University of the West of England) and the John Oldacre Centre farm research platform at Bristol Veterinary School, we have established a new intensive monitoring testbed of six 3D depth cameras which each day provides unobtrusive stress-free recording of the dynamic 3D structure of each cow in our herd. Together with this, we have developed novel deep learning methods for identifying each individual purely through their distinctive body shape (<https://arxiv.org/abs/2404.00172>).

In this PhD project, the student will harness the massive amount of data our testbed produces over long time periods (>1 year) for each of our 180 cows to develop a deep learning powered 3D atlas over time that learns the main modes of variation in their body composition and gait as the cows mature as well as go through pregnancy and milk production. Particular attention will be paid to both measuring and biomechanically modelling dynamic gait as they walk through the testbed in order to capture both healthy mobility as well as the early signs of disease such as lameness. The resulting model will be used as a research tool to develop further disease understanding and welfare interventions, and we will also investigate how the approach can be translated into commercial farm environments. For the later, it is expected that novel methods fitting the atlas to limited and low-cost camera configurations will be investigated.

The studentship would suit either a mathematical or computational student interested in sustainable food production, or someone with veterinary or biosciences expertise who wishes to build up artificial intelligence skills – in either case a tailored training package will be developed to suit. The student will be based 50%/50% at two leading, geographically close institutes, and will benefit from a broad cross-disciplinary supervision team, led by Prof Mark Hansen (Machine Vision) and Prof Andrew Dowsey (One Health Data Science), who have published and commercialised (HerdVision) state-of-the-art work in this area, and supported by welfare expert Prof Siobhan Mullan (University College Dublin).

Please note: This project is in collaboration with the University of Bristol and the University of the West of England (UWE) and subject to a **joint degree award**. Successful applicants will be registered at both these institutions, and graduates will be awarded a joint degree from these two institutions upon successful completion of the PhD programme.

Our aim as the SWBio DTP is to support students from a range of backgrounds and circumstances. Where needed, we will work with you to take into consideration reasonable project adaptations (for example to support caring responsibilities, disabilities, other significant personal circumstances) as well as flexible working and part-time study requests, to enable greater access to a PhD. All our supervisors support us with this aim, so please feel comfortable in discussing further with the listed PhD project supervisor to see what is feasible.