

## PhD Project Advertisement

**Project title:** The importance of sleep: using AI (video-based motion capture systems) to improve the health, resilience and productivity of dairy cows.

**Project No:** FBS2024-041-McBride-as

**Lead supervisor:** Sebastian McBride, Department of Life Sciences, Aberystwyth University

**Email:** sdm@aber.ac.uk

**Co-supervisor/s:**

Matthew Parker, University of Surrey

Vikki Revell, University of Surrey

Manod Williams, Aberystwyth University

**Project description:**

This project focuses on sleep in dairy cows. Sleep is one of most critical and often overlooked factors affecting farm animal health and production. It is fundamental to animal well-being and chronically disrupted sleep leads to a number of issues such changes in brain function, changes in physiology and reduced resilience to stress. Optimal sleep is, therefore, critical to the well-being of animals and, in the context of farm animals, has the potential to greatly impact the animal's level of sustainability and production. Understanding and being able to improve farm animal sleep is, thus, both an ethical and economic priority.

One of the main problems of measuring sleep in animals is the complexity of equipment and the time taken to process the data. For example, both EEG (the 'gold-standard' sleep measurement) and behavioural measurement approaches to animal sleep quantification are time- and resource-intensive, and therefore often prohibit studies looking at factors that affect animal sleep. Recent developments using artificial intelligence have now created automated video analysis systems that can greatly reduce sleep quantification time in both mice and dogs. We have also started to develop similar methods for measuring sleep in horses to improve welfare and performance. Collectively, this presents the primary motivation of the project, which is to develop, refine and implement an artificial intelligence approach to quantify sleep in dairy cows. This will provide a practical solution to the measurement of sleep in dairy cows and will ultimately allow critical production-related questions to be answered such as: how does sleep change over the lactation period, what indoor and outdoor husbandry factors affect bovine sleep, how does disturbed sleep affect milk yield, what are the long and short term effects of calf separation on sleep.

There are three main stages of the project which are:

1. To collect video footage of wake and sleep states of 10 cows within a commercial indoor dairy system alongside EEG and actigraphy data;
2. To use artificial intelligence techniques to train computer vision technology to identify different sleep, wake and eating states from the videos footage by cross-referencing the behavioural, EEG and actigraphy data;
3. To validate the automated sleep video analysis system by running a sleep disturbance trial through small changes in the animal's husbandry (light and bedding).

Aberystwyth University has a commercial indoor dairy system and all video, EEG and actigraphy data will be collected on-site at this facility (Stages 1 and 3). The University of Surrey Sleep Research Centre is home to an interdisciplinary team of physiologists and hardware/software engineers and will provide the necessary expertise in video-based motion-capture machine learning to develop the automated bovine sleep video analysis system (Stage 2).

### Training opportunities:

This interdisciplinary project will equip the student with a unique specific skill set that will place them in a very strong position as an applied behavioural scientist for future work in the agrifood sector. Specifically, coding and development of neural networks for the extraction of video-capture data, sleep scoring from EEG traces, developing algorithms to extract accelerometer data, animal behavioural analysis, large animal handling, experimental and statistical design. They will also be trained in all the full skill set required for a career as an academic scientist (writing up work for publication, preparing and delivering presentations, writing funding applications). They will also acquire a critical knowledge of animal welfare and animal experimentation (including personal licence training from the Home Office) and will have their training strongly nested in the principles of the 3Rs of in vivo research. This will include using the PREPARE (Norecopa) and ARRIVE (NC3Rs) guidelines. In addition, they will be trained in the principles of Open Science, including pre-registration of studies, and providing access to experimental data sets.

### Student profile:

This project would suit a candidate with an undergraduate degree or background in computer science and/or cognitive neuroscience background or, someone who is open and has a propensity to learning artificial learning and EEG measurement techniques. The candidate should also have a strong interest in using science to solve real-world agricultural/biological problems. A full driver's licence would also be an advantage to allow the candidate to move easily between farm and non-farm campuses at Aberystwyth University.

### Stipend (Salary):

FoodBioSystems DTP students receive an annual tax free stipend (salary) that is paid in instalments throughout the year. For 2023/24 this is £18,622 and it will increase slightly each year at rate set by UKRI.

### Equality Diversity and Inclusion:

The FoodBioSystems DTP is committed to equality, diversity and inclusion (EDI), to building a doctoral researcher(DR) and staff body that reflects the diversity of society, and to encourage applications from under-represented and disadvantaged groups. Our actions to promote diversity and inclusion are detailed on the [FoodBioSystems DTP website](#).

In accordance with UKRI guidelines, our studentships are offered on a part time basis in addition to full time registration. The minimum registration is 50% FT and the studentship end date will be extended to reflect the part-time registration.

### References:

Geuther, B., Chen, M., Galante, R.J., Han, O., Lian, J., George, J., Pack, A.I., Kumar, V., 2021. High-throughput visual assessment of sleep stages in mice using machine learning. *Sleep* 45.

Putyora, E., Brocklehurst, S., Tuyttens, F., Sandilands, V., 2023. The Effects of Mild Disturbances on Sleep Behaviour in Laying Hens. *Animals* 13.

Ternman, E., Hänninen, L., Pastell, M., Agenäs, S., Nielsen, P.P., 2012. Sleep in dairy cows recorded with a non-invasive EEG technique. *Applied Animal Behaviour Science* 140, 25-32.

**For up to date information on funding eligibility, studentship rates and part time registration, please visit the [FoodBioSystems website](#).**