FoodBioSystems DTP - PhD Project Advertisement

Project title:

FBS2021-66-Rezwan: Utilizing data-driven approaches to develop genetic models in predicting feed efficiency complex in dairy cattle

Lead supervisor:
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Project description:

Feed efficiency (FE) complex in animals, defined as the production of the same quantity of dairy product using fewer feeding resources. It is estimated that ~60% of the total cost of dairy production is generally spent for feeding. Therefore, to maximise the efficiency of the industry, an efficient balance between feed intake and dairy products from cattle is crucial. Improving FE complex is a well-established goal in many species, as well as in cattle, and is highly relevant given current international concerns regarding greenhouse gas emissions, nutrient losses, and water quality.

Though traditional statistical methods are easier to perform, they have less statistical power and accuracy to predict FE complex in dairy cattle than more comprehensive approaches, like machine learning. FE complex is also affected by many factors, including pedigree, physiological, environmental, and genetic variations. Moreover, little research has been carried out to understand the biology behind FE complex and therefore, obtaining reliable and accurate predictive biomarkers for FE complex is of paramount interest.

This project will utilise a data-driven approach by using cutting-age machine learning technology to identifying the most important factors that influence FE complex and use these factors in developing a predictive model that can accurately predict the FE complex. This model will produce a new, improved, and robust FE complex measure.

In this project, high precision datasets, collected at Agri-Food and Bioscience Institute's (AFBI) cutting edge facilities (Hillsborough, Northern Ireland) over last 20 years, will be used. These datasets, captured within a specially constructed database, contain pedigree, physiological and environmental information along with genome-wide genotype data of ~2500 dairy cow samples. These datasets will present a unique opportunity to explore phenotypic, genomic and genetic factors in better understanding the FE complex.

The main research objectives of this project include: (1) Exploring high precision datasets at AFBI and apply feature selection method to select the most important variables related to FE complex. (2) Developing a FE complex measure from machine learning regression models (using Support Vector Machine and Random Forest) from the selected features. (3)

Perform genome-wide association studies (GWAS) to understand genomic basis of FE complex using deep learning method to identify predictive genetic markers. (4) Integrating genetic markers with the variables from feature selection to develop genetic models predicting improved FE complex measures.

Training opportunities:
This is an exciting cross-disciplinary project involving elements of bioinformatics, machine learning, animal genetics, data modelling and data analysis based on high resolution datasets. This is a unique opportunity for the student to work with researchers in Cranfield University (CU), Queen's University Belfast (QUB), and Agri-Food and Biosciences Institute (AFBI) and will learn cross-disciplinary transferable skills to enhance student's future career prospects.

The student will have opportunity to attend CU and DTP accredited modules and will be benefitted from the placements at QUB and AFBI. At CU, the student will be provided training in computational methods and bioinformatics, according to their background and current skill set. QUB and AFBI will provide training on quantitative genetics, genome analysis, animal breeding, sustainable livestock farming, and animal nutrition related training on feed composition analytical methods and background knowledge required to understand the biology behind feed efficiency complex.

The student will have opportunity attending external courses, including: BBSRC SysMIC (Introduction in Quantitative Skills for Bioscience) and CDT-AIMLAC courses (on machine learning and data analysis), and attend national and international conferences in appropriate subject area.

As a CASE studentship, this project will provide the student a unique opportunity to work directly with AFBI and learn about the needs and research gaps of agri-food, and learn how to address these needs through both governmental (e.g. DAERA) and commercial avenues.

Student profile:
Students should hold a minimum BSc (2:1) and/or MSc in Mathematical Sciences, Biological Sciences, Data Sciences, Computer Science or similar with good data analysis and modeling skills. Previous work experience in bioinformatics and machine learning is desirable but not essential.

Funding particulars:
This is a CASE project with in-kind support from AFBI, an Arms-Length Non-Departmental Public Body with DAERA as its sponsor Department. AFBI's work can be summarised as Leading Improvements in the Agriculture Industry, Enhancing the natural and marine environments and Protecting animal, plant and human health

This project is part of the FoodBioSystems BBSRC Doctoral Training Partnership (DTP), it will be funded subject to a competition to identify the strongest applicants.
The studentship is open to UK and international students (including EU countries) however due to funding rules, no more than 30% of the projects can be allocated to international students.
The funding will include a tax free stipend (minimum £15, 285 per year), support for tuition fees at the standard UK rate (currently £4,407 per year) and a contribution towards research costs. **Please note** that the host universities have not yet confirmed the level of fees charged to international students funded by the DTP. Fee levels may vary across the institutions. This information will be shared on the FoodBioSystems DTP website as soon as it becomes available.

To apply
Please go to FoodBioSystems DTP website for information on how to apply for this studentship. The closing date for applications will be 8 February 2021.