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Section 2 – *Project Information*

Project Title	Physics-Informed AI for Multi-Modal Cardiac Imaging and Prognostic Phenotyping

Project Summary

Cardiovascular diseases (CVDs) are the leading cause of death worldwide, responsible for about one-third of all global deaths. Beyond mortality, CVDs often lead to long-term disability and place a huge burden on healthcare systems. One major challenge is that heart disease is not the same for everyone—patients show a wide range of symptoms and responses to treatment. This complexity means that traditional “one-size-fits-all” therapies often fail.

This PhD project aims to tackle this challenge by combining advanced Cardiovascular Magnetic Resonance (CMR) imaging with cutting-edge Artificial Intelligence (AI) techniques. CMR provides detailed information about heart structure, function, blood flow, and tissue health. By integrating these rich data streams, we can uncover hidden patterns in patient populations. However, standard machine learning methods often struggle to find clinically meaningful sub-groups. To overcome this, we will develop Physics-Informed AI models—an approach that blends machine learning (including generative AI models) with the fundamental laws of cardiovascular physiology. By making these models "Physics-Informed", we will incorporate known physiological laws of cardiac function and constraints (derived directly from the comprehensive CMR metrics) into the model's objective function. These models will not only identify distinct patient phenotypes but also ensure that the findings make sense biologically and clinically.

What you will gain:

- The opportunity to work across two leading academic units: the College of Life Sciences (CLS) and the School of Computing and Mathematical Sciences (CSE)
- Expertise in medical imaging and cardiovascular physiology
- Advanced skills in AI and machine learning, including generative models
- Training offered by the University of Leicester
- Experience working at the intersection of healthcare and data science
- The opportunity to contribute to research that could transform personalized medicine for heart disease

This project is fully funded by the newly established British Heart Foundation (BHF) Cardiovascular Research Excellence Centre (CRE), offering an outstanding environment for training and collaboration with leading experts in cardiovascular medicine and AI.

Ideal candidate:
We are looking for highly motivated candidates with backgrounds in computer science -- especially AI and Data Science -- physics, applied mathematics, and/or biomedical sciences, and a keen interest in cardiac sciences. Curiosity, commitment, and the ability to work across domains such as medical imaging, physiology, and data science are essential. Prior experience in programming and machine learning is helpful.

References

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