**University of Leicester**

**Future 50 PhD Scholarship**

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**Section 2 – *Project Information***

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| **Project Title** | Predicting circulatory mortality and morbidity using deep learning and retinal imaging |
| **Project Highlights:** | 1. | Utilises large scale datasets such as the UK Biobank and local EXCEED datasets |
| 2. | Interdisciplinary research with precision medicine focus |
| 3. | State-of-the art machine learning techniques aiming to solve real world challenges using multimodal data fusion methodology (replicating the clinical decision-making process – incorporating imaging, biochemical tests and other risk factors from patient records) with potential for significant clinical impact and translation.  |
| **Project Summary**  |
| Studying the neurosensory retina and vasculature offers a unique opportunity to non-invasively visualise and quantify vascular and central nervous system health. Retinal microvasculature changes have been identified as independent predictors for hypertension, diabetes, heart disease and stroke. Moreover, retinal microvascular changes can precede clinical manifestation of end organ damage. Recent data suggest that artificial intelligence (AI) enabled retinal vasculometry offers a non-invasive prognostic biomarker of vascular health that does not require blood sampling or blood pressure measurement, and potentially has greater community reach to identify individuals at medium-high risk requiring further clinical assessment. It is unclear how these models will perform on novel datasets and in populations with ethnic minorities. In this project, the student will utilise UKBiobank, EXCEED and local annotated retinal imaging datasets for the purposes of developing a machine learning model (using multimodal data fusion) to predict the risk of circulatory mortality/morbidity. This model will be compared against previously published prognostic models and traditional risk scores for vascular health. Framingham risk scores for circulatory mortality will be compared against retinal risk scores together with clinical risk factors developed using our model. Developing novel risk prediction systems and surrogate biomarkers from retinal vascular morphometric parameters has significant predictive value and provides a window for aggressive risk reduction. In Leicester, we have established a deep learning pipeline within our High-Performance Computing (HPC) cluster that enables us to derive automated retinal vascular morphology quantification. The project will utilise the research computing facility, including the £2M HPC cluster for “big data” analysis and will be linked with the local HDRUK network. The student will be hosted by the Ulverscroft Eye Unit (UEU), Cerebral Haemodynamics in Ageing and Stoke Medicine (CHiASM) group and School of Informatics. The supervisory team brings together experts in the field: Dr Thomas (Ophthalmology), Dr Minhas (Stroke and Vascular Medicine) and Dr Wang (Machine Learning). The supervisory team have an established record with publications in high-impact journals in the fields of ophthalmology, vascular medicine and machine learning. UEU and CHiASM have successfully hosted students with excellent career progression attaining external fellowship funding and multiple national and international awards.**References**1. Kuht HJ, Nishad G, **Wang S**,…**Thomas MG**. A machine learning solution to predict foveal development and visual prognosis in retinal developmental disorders. IOVS June 2021, Vol.62, 2739.2. De Silva I, **Thomas MG**, et al. Patterns of attendances to the hospital emergency eye care service: a multicentre study in England. Eye 2021 Nov 30;1-83. **Wang S**, et al., A deep network designed for segmentation and classification of leukemia using fusion of the transfer learning models. Complex Intell. Syst. (2021). 4. **Wang S**, et al., Covid-19 Classification by FGCNet with Deep Feature Fusion from Graph Convolutional Network and Convolutional Neural Network, information fusion, 68, pp. 131-148 (2021).5. Kadicheeni M, **Minhas J**, et al. Mortality in a Multiethnic Population Attending a One-Stop TIA Clinic. Cerebrovasc Dis. 2022 Sep 1;1-8.6. **Minhas J** et al. Oral antiplatelet therapy for acute ischaemic stroke. Cochrane Database Syst Rev. 2022 Jan 14;1(1). |