Project Title: Identifying patient invariant parameters for diagnosis using terahertz sensing

Supervisor: Emma MacPherson (Department of Physics)
Co-Supervisor: Fayyaz Minhas (Department of Computer Science)

Are you interested in applying maths and physics to situations that could benefit medical diagnosis?

Terahertz (10^{12} Hz, THz) pulsed imaging is a new technique with high resolution (about 20 µm) and has only emerged recently as a potential new clinical tool for medical imaging. It is a totally non-destructive and non-ionising imaging modality as the average power of the pulse for producing the radiation is as small as 100 nW. The radiation produced is focused onto the sample of interest and then detected coherently. A point measurement is analogous to an ultrasound A-scan. Reflections off different layers are used to determine the structure at various depths. THz light is very sensitive to hydrogen bonds. By Fourier transforming the time-domain data, useful spectroscopic information can also be revealed. Potential applications range from security imaging to medical diagnosis, but the analysis and instrumentation needs to be tailored for each application investigated. THz light can be generated and detected using photoconductive antennas. The useable frequency range of a THz system depends on the photoconductive devices as well as other factors such as optical alignment.

Fig. 1. Photograph of our *in vivo* THz probe being used to measure the volar forearm.

As recently reported by Sky International News, we have developed a handheld THz probe that is now being used in the first clinical trials of their kind at the University hospital in Coventry. The aim of this project is to take and analyse patient and volunteer data a view to developing classification algorithms for skin conditions. For example, it may be possible to use THz imaging to detect early stages of skin cancer, or the lateral extent of tumours that are beneath the skin's surface, and not yet visible. Applicants do not need a medical background, more importantly, they need an interest in applying maths, programming to real world applications.

Prof MacPherson joined Warwick University in 2017 and received a Wolfson Merit award to support her research in the UK. The following links give more information about the Ultrafast THz Photonics group at Warwick and Prof MacPherson's research group. This PhD project is part of the £8M EPSRC programme grant, Terabotics which spans Warwick, Leeds and Exeter universities. For further information do not hesitate to contact Prof MacPherson directly on e.macpherson@warwick.ac.uk.

Dr. Fayyaz Minhas is an associate professor at Warwick Department of Computer Science and the Warwick Tissue Image Analysis Centre. He works on solving problems in biology and medicine using machine learning methods as well as the development of bespoke machine learning algorithms in the domains of biomedical informatics and computational pathology.

Webpage: https://warwick.ac.uk/fac/sci/dcs/people/fayyaz_minhas/

This is a fully funded-PhD studentship at standard UK Research Council rates, available with a flexible start date from October 2023 onwards for a 3.5 year period. The studentship covers university fees a nd a living stipend, and is available to UK and potentially international students. For more information please see http://go.warwick.ac.uk/PhysicsPG.