**Optical pathlength estimation within functional Near Infrared Spectroscopy**

**Leading team:**

* **Felipe Orihuela-Espina (Supervisor)**
* **Robert Ward**

Blood flow is an important biomarker for tissue health. Diffuse Correlation Spectroscopy (DCS) is a popular method to non-invasively measure blood flow at a shallow depth. A key component of DCS involves an autocorrelator to compute the autocorrelation function of the detected photons. These are typically hardware based and are costly and inflexible. Software based autocorrelators have been designed and validated using different methods; these involve multiTau software[1] and fast Fourier transform (FFT)[2].

Understanding the fundamentals of DCS is not necessary for the project but would be useful; instead, the main prerequisite will be a strong mathematical foundation, and understanding of how to plan out a new software system able to integrate into experimental and data analysis pipelines. The choice of method is up to the student, but reading of the literature and justifications are required. The autocorrelator will need verification with simulated data; this will begin as simple as possible, using simulated sinusoids before potentially moving to simulations of DCS.

The working language of the lab is slowly moving from Matlab to Python and so implementing this project in Python would be ideal, and would also enable an easy transition to implementation.

Depending on the speed at which the project is going there is the possibility to involve implementing the software on a raspberry pi; this may involve optimisation methods.

This project will involve:

* An understanding of the autocorrelation function
* Deciding which methodology to follow, with justifications
* Implementing a software based autocorrelation board
* Verification of the system
* *Given time: implementation on a low cost processor*

Students are more than welcome to discuss this project with either Felipe or Robert, and if interested in the broader field of image analysis within optics are encouraged to explore the other projects available.

[1] D. Magatti and F. Ferri, “Fast multi-tau real-time software correlator for dynamic light scattering,” *Appl Opt*, vol. 40, no. 24, p. 4011, Aug. 2001, doi: 10.1364/AO.40.004011.

[2] J. Dong, R. Bi, J. H. Ho, P. S. P. Thong, K.-C. Soo, and K. Lee, “Diffuse correlation spectroscopy with a fast Fourier transform-based software autocorrelator,” *J Biomed Opt*, vol. 17, no. 9, p. 0970041, Sep. 2012, doi: 10.1117/1.JBO.17.9.097004.