**Simulation pipeline for fNIRS**

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When modelling real life phenomena a limiting factor is the number of physical experiments that can be ran. The use of simulations is necessary in modern labs, but efficient pipelines are often overlooked in favour of developing the algorithms. Within the Computer Science medical imaging lab the focus of research is on Near-Infrared Spectroscopy; probing optical properties of tissue and the physiological changes that induce them. Two popular methods of simulating the transport of light through tissue are Monte Carlo simulations[1], and Finite Element Modelling (FEM), with projects being offered on transporting the MATLAB based NIRFAST[2] software (FEM) to python.

With multiple advanced light transport methods existing it is beneficial to understand the use cases of each one, and the timeline involved all the way from planning the use of the simulation to further processing of the produced data. This project will involve learning the basic mathematic principles behind the most common simulation methods, how to use each one, and decide on the best way to structure a pipeline for researchers to follow. This may involve implementing chosen file types, with research within NIRS moving towards the NIRS/SNIRF file types. The best case would be new software that links the simulation to the data processing but is very open for the student to explore their own ideas (justification of these ideas being imperative).

This project will involve:

* Learning the foundation of common simulation methods
* Understanding the data structures used and how to transition between software, potentially over multiple languages
* Presenting ideas to a team of researchers, being confident that your pipeline is a suitable one to follow
* Allowing for future changes within the simulation software, as other projects may even be updating simulations as this is carried out

It is worth bearing in mind that this project is much more open than many and allows you to explore many ideas of computer science that will have been touched on within group work and projects.

[1] I. Lux and L. Koblinger, *Monte Carlo particle transport methods : neutron and photon calculations*. Boca Raton: CRC Press, 1991.

[2] H. Dehghani *et al.*, “Near infrared optical tomography using NIRFAST: Algorithm for numerical model and image reconstruction,” *Commun Numer Methods Eng*, vol. 25, no. 6, pp. 711–732, Jun. 2009, doi: 10.1002/cnm.1162.