Project Specification: **Sensor head for diffusion imaging system**

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Main deliverable: Sensor head for optical diffusion imaging.
Secondary deliverable: Demonstration of optical diffusion imaging.
Feasibility study due: 11th November.

The starting point for this project is a research paper (Phys. Med. Biol. 45 (2000) 3765-3778) which describes a system for imaging blood vessels underneath the surface of the skin using the method of optical diffusion imaging. This is an interesting technique for producing two-dimensional images based on measurements of light scattered by tissue cells. A key feature of this apparatus is a small sensor, comprising optical source and detector in a small mechanical mount. In the cited paper the optical radiation is derived from an LED and coupled to the sensor head via a fibre-optic cable. The detector also uses a fibre-optic cable coupled to an optical power meter.

The aim in this project is to produce an equivalent sensor system without the need for an optical power meter. The new design should meet or exceed the specification of the original, apart from the input power which is negotiable. The original system used a near-infrared LED but the wavelength for this new system is also negotiable. Also the new design should provide an approximately collimated beam and a directional detector. The orientation of both source and detector should be adjustable. The design issues are:-

1. How to achieve a physically small source and detector. Fibre-optic links are one possible route but other implementations, for example the use of a laser diode, should be considered.
2. The function of an optical power meter must be met using some sort of photo-sensitive element. The stability and dynamic range of this detector is important since we are looking for small changes in radiance against a larger fixed background. The output must be in some standard form, for example 0 to 10 Volts, so that a standard instrument card in a PC can be used to form the image.

The work will involve optical/electronic design and mechanical design. Assistance from the EEE Mechanical workshop may be needed.

This project forms part of a larger initiative to develop a complete optical diffusion imaging system. The secondary deliverable will only be possible if two associated projects are successful. Nevertheless suitable time should be allocated in the project plan for system integration. A limited study of the relevant technical background to diffusion imaging will be expected. The possible medical benefits of such a system should also be considered. These studies may be done in collaboration with the other students if desired.