Towards imaging cell metabolism in the retina

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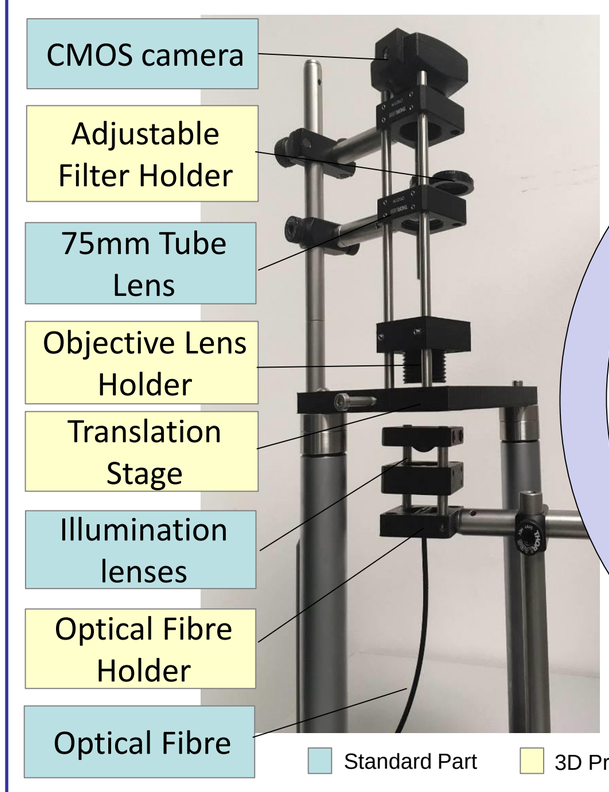
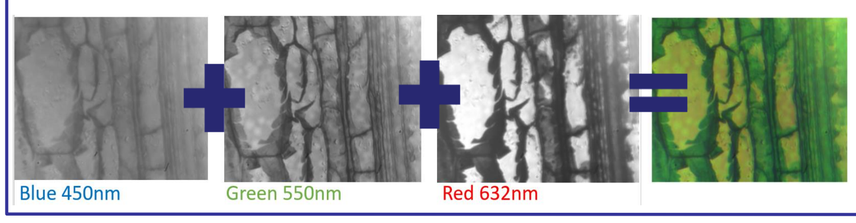
CDT Year 1 Highlights

Semester 1

Building a Microscope



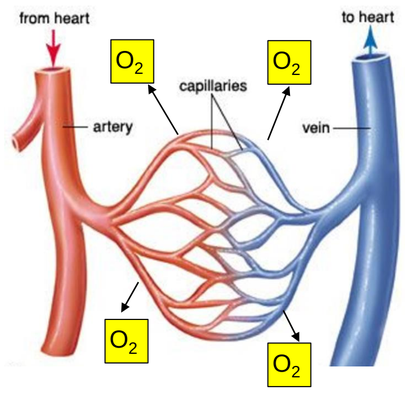
Multi-spectral Imaging



Literature Review

Retinal Oximetry

- Oxygenation is an important marker of good cell health
- Haemoglobin absorption spectrum is conventional method used to measure oxygen saturation



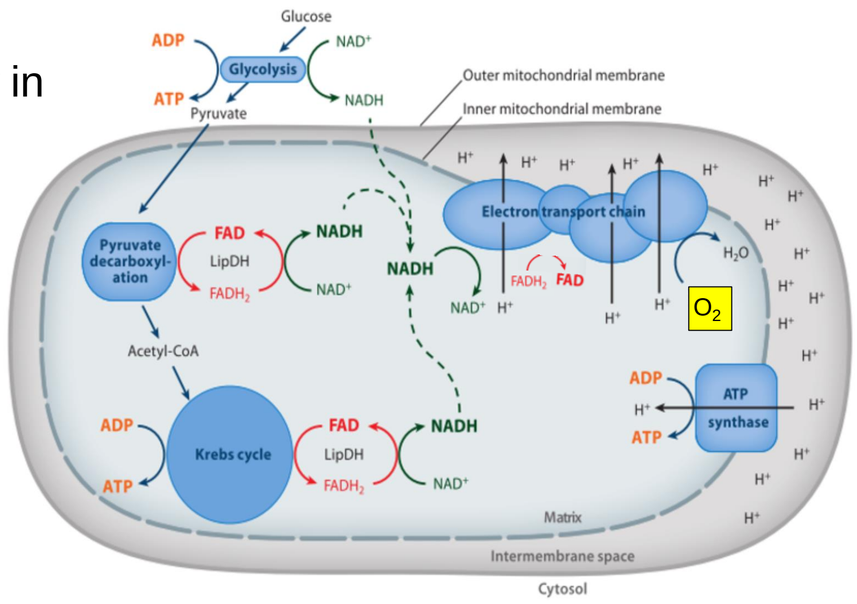
Indirect measurement

Auto-Fluorescent Markers: FAD - Flavin adenine dinucleotide; NADH – Nicotinamide adenine dinucleotide

Cell Metabolism

- Oxygen essential to create energy in mitochondria
- Imaging oxygen metabolism markers lead to better understanding of diseases

Direct measurement



Metabolism in mitochondria of cells

Semester 2 Projects

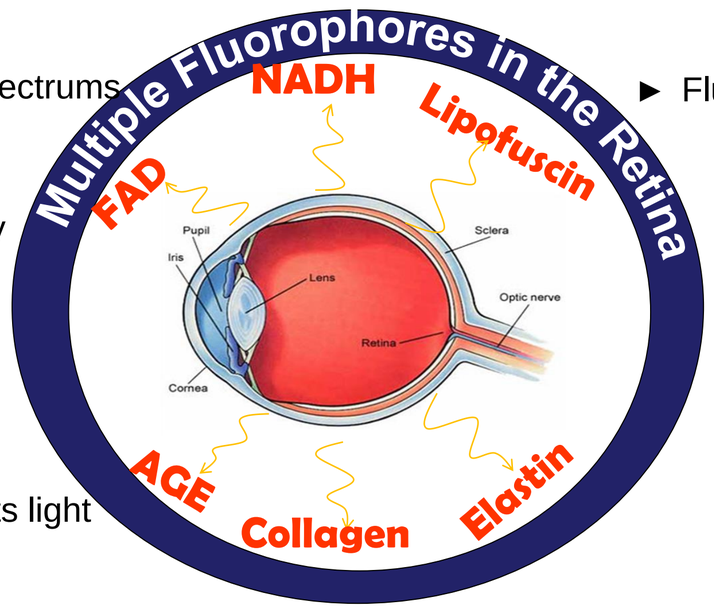
- Swallowable pill for detection of gastrointestinal bleeding
- Implantable Continuous Sensor for Cancer Detection
- Hacking a drone to search for life in disasters

Summer Project

Feasibility Study for metabolic imaging in the retina

Challenges

- Overlapping spectrums
- Stringent safety levels to ensure eye not damaged
- Ocular transmission limits light entering retina



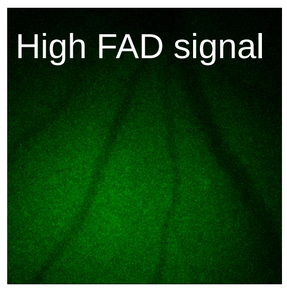
Techniques

- Fluorescent imaging -FAD powder

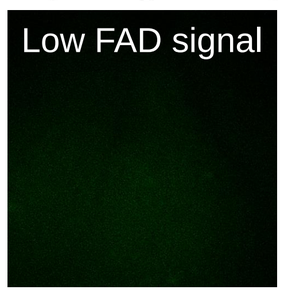
- Fundus Camera

Expected results of FAD fluorescence in the retina

Normal oxygenation levels =



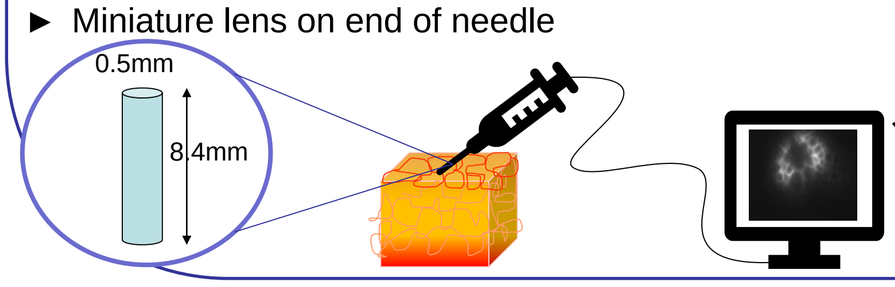
Hypoxic conditions =



Retinal Images of FAD curtesy of Cristina Maroci and the Institute of Neurology in UCL

Micro-endoscopes for in-vivo imaging

- Miniature lens on end of needle



✓ Administer drugs locally

✓ Observe effectiveness in real-time

Indicative Aims and Objectives for PhD project

- Investigate known fluorophores and current methods
- Image FAD
  Microscope → Phantom eye → Fundus Camera
- Model imaging system for retinal examination
- Image FAD in human eye
- Assess application of fluorescent metabolite imaging with micro-endoscopes

Supervisor: Prof. Andy Harvey

References

1. D. Schweitzer, S. Schenke, M. Hammer, F. Schweitzer, S. Jentsch, E. Birckner, W. Becker, and A. Bergmann, “Towards Metabolic Mapping of the Human Retina,” Microsc. Res. Tech, vol. 70, pp. 410–419, 2007.
2. I. Georgakoudi and K. P. Quinn, “Optical Imaging Using Endogenous Contrast to Assess Metabolic State,” Annu. Rev. Biomed. Eng, vol. 14, pp. 351–67, 2012.
3. “capillary | anatomy | Britannica.com.” [Online]. Available: https://www.britannica.com/science/capillary