Time Resolved Spectroscopy with advanced CMOS single photon detector arrays for disease diagnosis in the distal lung

K. Ehrlich1,2, A. Kučsák1, N. Krstajić1,3, T. Craven4, R. Henderson5, R.R. Thomson2, M. G. Tanner1,2

1. EPSRC IRC "Hub" in Optical/Molecular Sensing & Imaging, MRC Centre for Inflammation Research, Queen’s Medical Research Institute, University of Edinburgh, Edinburgh, UK
2. Scottish Universities Physics Alliance (SUPA), Institute of Photonics and Quantum Science, Heriot-Watt University, Edinburgh, UK
3. Institute for Integrated Micro and Nano Systems, School of Engineering, University of Edinburgh, Edinburgh, UK
4. MRC/Centre for Inflammation Research, Queen’s Medical Research Institute, University of Edinburgh, Edinburgh, UK

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Introduction

With present diagnostic methods, identification of respiratory illnesses are inexact resulting in an often inaccurate multi-drug treatment. The Proteus project aims for a fibre-based sensing and imaging system to improve disease diagnostic in the distal lung for critically ill patients. In this poster, a fibre based sensing methodology for physiological parameters like pH through exogenous fluorophores which varying their fluorescent properties with its biological environment is presented. The system uses a line array of CMOS Single Photon Avalanche Diodes (SPAD) which enables us for single photon detection through Time-Correlated Single Photon Counting (TCSPC).

Aims

- Recording full TCSPC histograms for 256 pixel simultaneously.
- Distinguish between the tissue autofluorescence and fluorescence from fluorophores in the 'green' spectrum.
- Remove the scattering background from the optical fibre in the 'red spectrum'.
- Sensing of pH variation through changes in the fluorescence lifetime.

The Experimental Setup

- Point detection of fluorescence using an optical fibre
- Dispersive element to separate the emitted light into its wavelengths
- TCSPC technology for recording dynamical processes

Line Sensor Ra 1

- 256 x 2 pixel, each pixel 4 Single Photon Avalanche Diodes (SPADs)
- Line rate 700 Hz
- Time-to-Digital conversion 0.42ns
- Timing jitter: IRF ~1ns

Fluorescence Lifetime Spectroscopy

- measuring intrinsic tissue properties and accurate measurement of fluorescent probes in the distal lung.
- Fluorescence lifetime is an intrinsic parameter of fluorophores.
- Independent of fluorophore concentration, hence fluorescent intensity, and not affected by photobleaching.

pH Sensing

- pH as a potential marker of tissue acid-base status
- a sensing methodology in inflammatory environments

References


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