OPTICAL SETUP FOR SPECROSCOPY-BASED MONITORING OF BLOOD PARAMETERS DURING HAEMODIALYSIS

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In this work, the development of a spectroscopy-based optical setup for monitoring hematic parameters of blood is presented. Integration with machine learning techniques makes this device suitable for effective use during haemodialysis treatments.
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1. Introduction

During dialysis, waste is continuously filtered from the blood in a process called ultra-filtration. This process must be constantly monitored, in order to achieve a more effective treatment [1]. This paper discusses the development of an optical setup for the development of a spectroscopy-based device able to monitor hematic parameters of blood during haemodialysis. The implemented setup is described in its fundamental parts and the approach used to extract blood parameters is briefly summarized.

2. Setup design and results

The optical setup developed in this work is intended to be integrated with a haemodialysis machine, which consists on a peristaltic pump and a dialyzer connected by a series of hematic tubes where the blood flows. A sketch is illustrated in Fig. 1. The system is non-invasive, because the device is not in contact with human blood and provides real-time monitoring through absorbance spectroscopy [2].

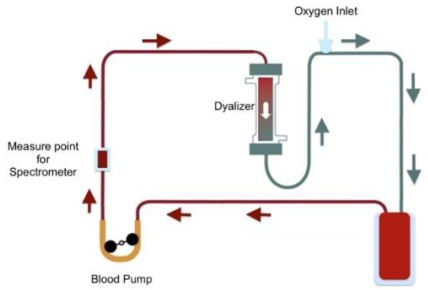

Fig. 1 Sketch of the implemented setup for blood analysis during haemodialysis treatments.

The setup includes a micro-spectrometer (C12880MA developed by Hamamatsu [3]), a light source and the optical window, where the blood flows. The spectrometer works as a high sensitive sensor in the 340 nm up to 850 nm wavelength range, with a resolution of 15 nm. A LED illuminates the blood flowing through a properly designed cuvette and the light transmitted by the sample, collected using a multimode fiber, is then processed by the spectrometer. The sensor of the spectrometer is driven by a microcontroller and the spectra are recorded on a laptop for post processing. Machine learning techniques have been used to predict hematic parameters from visible spectrum. A model was trained using over 250 spectra of bovine blood. This database was then used to train a deep learning model, which is able to predict haematocrit and oxygen saturation through the visible spectrum of blood with high precision [4].

3. Conclusions

Spectroscopy can be used to predict blood parameters during haemodialysis. Integration with machine learning techniques lead to the development of an efficient device able to measure both haematocrit and oxygen saturation. This system is currently under test and validation on human patients.

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