Faculty of Electrical Engineering & Computer Science
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Infrared Sensor System for the Analysis of Biopsies.

ABSTRACT - Masterthesis

Cancer is one of the leading cause of the death worldwide. Tumour investigation and screening by pathologists is still mainly based on visual inspection after tissue removal (biopsy) and staining process (standard histopathology analysis). Being the diagnosis based on morphological inspection of the sample and therefore subjective, discrepancies in the diagnosis can occur and have been reported. Chemical or physical based diagnostic methods would be of great importance for reducing misdiagnosis and increasing the overall survival rates of patients affected by cancer.

In the last decade, it has been proved that infrared absorption spectroscopy can be used to detect tumorous cells. In particular, anomalies in the spectral range between 3.3 µm and 3.5 µm, where molecular vibrations of CH_2 molecules occur, can be used for discrimination between healthy and cancerous cells. Van den Driesche et al proposed a cancer detection method based on the evaluation of the so called CH_2 stretch ratio, e.g. the ratio of symmetric and asymmetric CH_2 peak absorptions at wavelength of 3.51 µm and 3.42 µm, respectively. From experiments carried out both in melanoma cell lines and melanoma biopsies, it was noticed an increase of the CH_2 stretch ratio when carcinogenesis occurs.

The purpose of this project work was to design and fabricate an easy-to-use CH_2 stretch ratio sensor to be used by medical doctors to support them during the crucial phase of the histopathological analyses. A full automated infrared sensor setup, mainly including an pulsed infrared light source, a monochromator for wavelength filtering and a photodiode as detector, was therefore realised and tested over several skin biopsies. The outcomes from the infrared investigation were then compared with the results performed by standard histopathology. A strong agreement between the two investigation techniques was found. Besides demonstrating once again the validity of the CH_2 stretch ratio method as a reliable and promising label-free cancer detection tool, this thesis work demonstrated the efficiency of the designed and realised infrared sensor for clinical analyses.