

Title: Tumour detection and staging through multimodal fibre-probe spectroscopy

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Abstract:

The aim of this study is to discriminate normal bladder tissues from urothelial tumours, and to identify the different stages of the disease, by means of combined auto-fluorescence, diffuse reflectance and Raman spectroscopy. A compact and transportable setup for fibre-probe spectroscopy was used for studying fresh biopsies of urothelial carcinoma (UC) and healthy bladder collected from 13 patients undergoing Transurethral Resection of Bladder Tumours (TURBT). Fluorescence, reflectance and Raman spectra were analysed using both a ratiometric approach (i.e. by calculating the ratio between fluorescence intensity emitted at two wavelengths) and Principal Component Analysis (PCA) for obtaining a classification algorithm based on the spectral information provided by the three techniques. The analysis of fluorescence and reflectance spectra allowed discriminating – with high specificity and sensitivity – between healthy and diseased tissues. Moreover, applying PCA to the study of the recorded Raman spectra allowed identifying and classifying three tumour stages: T_a, T₁ and T₂. Although the number of samples has to be increased for providing statistical significance to our results, our findings indicate that multimodal spectroscopy may provide discriminating capability similar to gold standard histology, but in a fast and label-free way. Moreover, the presented strategy could be implemented for *in vivo* detection of bladder tumour as well as for clinical differentiation of tumour stages.