Enhanced Raman-Based Cancer Diagnosis Using Hyperspectral Tissue Pre-Characterisation and Optimised Cluster Analysis Techniques

Anneliese Jarman[1], Richard Cook[2], Susan Cox[3]

[1,2] King's College London, Centre for Oral Clinical and Translational Sciences, Floor 17, Tower Wing, Guy's Hospital, Great Maze Pond, London Bridge, SE1 9RT
[1](anneliese.jarman@kcl.ac.uk), [2] (richard_james.cook@kcl.ac.uk)
[3] King's College London, Randall Centre for Cell & Molecular Biophysics, New Hunt's House, Guy's Campus, London, SE1 1UL (susan.cox@kcl.ac.uk)

Over the past decade, the incidence of oral cancer has been one of the fastest increasing of all cancers [1]. It is often detected late due to reliance on self-referral, and metastasis is found at first inspection in 32.5% of cases [2] meaning that prognosis tends to be poor. The diagnosis gold standard is biopsy followed by histopathological examination which has poor repeatability, particularly in marginal cases such as precancers [3], due in part to the qualitative nature of the diagnosis. A quantitative technique for a second "opinion" in difficult cases could lead to improved repeatability.

Raman spectroscopy is a highly accurate diagnostic tool [4] however, as a low scattering cross section and point-scanning technique, it is too time consuming to be a viable clinical aid. Therefore, a rapid pre-screening technique to locate small regions of clinical interest for further investigation with Raman spectroscopy has been developed to facilitate a compromise between speed and diagnostic sensitivity. This pre-screening technique utilises spectral scanning hyperspectral transmission microscopy and produces high spatial resolution image hypercubes with contrast provided by absorption and, predominantly, scattering.

Unstained human oral tissue is very complex, therefore data from simpler biological samples have also been collected for this work, including saliva droplets and mouse tissue. Novel analysis utilising "spectral texture" has been developed and is used in combination with in-house cluster analysis software to segment the hyperspectral and the Raman data. The non-trivial problem of co-registering these two imaging modalities and H&E stained tissue sections segmented by histopathologists is addressed and preliminary data is forthcoming.

References

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