

# Dynamic Tissue Surface Geometry Reconstruction for Autonomous Microscopic Tissue Scanning During Tumour Resection

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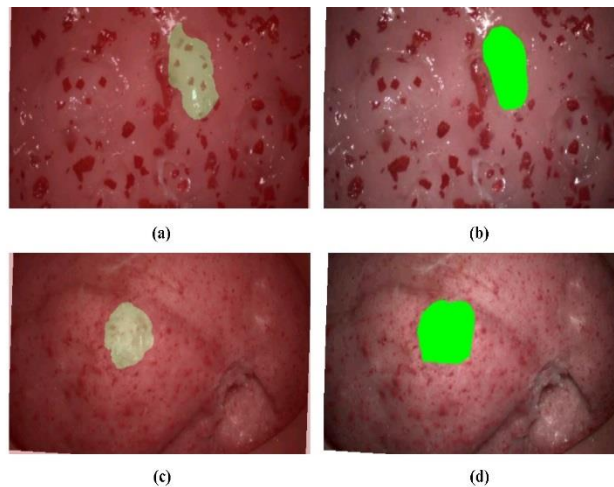
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## ABSTRACT

Biophotonics techniques such as probe-based Confocal Laser Endomicroscopy (pCLE) have enabled direct visualisation of tissue at a microscopic level, with recent studies suggesting its use for identifying residual cancer tissue and improving resection rates of brain tumours [1]. Recently, robotically controlled local tissue scanning with pCLE probes has been investigated to facilitate diagnosis providing image stabilisation [2] and field-of-view (FOV) expansion based on image mosaicing [3]. However, in situ scanning of large tissue surfaces such as cavities of few centimetres diameter, generated during endoscopic resection of intraparenchymal brain tumours, is significantly more complex and time consuming. Prior to tumour resection, it is necessary to globally examine the surgical environment, expose the tissue state and guide the surgeon to focus locally on tumour remnants. For time-optimisation during local tissue scanning with a pCLE probe, only parts of the tissue surface where tumour was recently resected need to be scanned for possible remnants between successive resections. For this purpose, geometric changes in 3D structure of the surgical environment due to tumour removal should be identified in order to guide the robotic control of the imaging probe in these areas.

The aim of this work is to present a novel approach to detect geometric changes due to tumour resection in a dynamic surgical environment. A set of appearance and geometric characteristics are combined into a Random Forest (RF) classifier and mean-field inference over the 3D structure of the surgical environment is used to estimate a spatially consistent dense labelling of the tissue surface. Performance evaluation shows the potential clinical value of the proposed framework and its superior performance compared to alternative change detection methods.



**Fig:** (a, c) Detected local geometric deformation (b, d) Ground truth segmentations on a brain and kidney phantom, respectively.

## REFERENCES

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