Micro Scale Photogrammetry of Skin Lesions

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Introduction

The recording and subsequent analysis of melanoma has traditionally relied on high-quality colour photography and Epiluminescence microscopy images. These techniques fail to exploit the distinguishing characteristics found on the actual surface shape of lesions. Furthermore, it would be useful to record and archive structural models as a medical diagnosis tool. In this approach we use extremely close-up stereo photogrammetry to capture micro scale 3D structure. This provides an extra modality for segmentation and classification, as well as enabling enhanced visualisation.

Figure 1: Micro scale stereo camera rig.

Subject Capture

In collaboration with Dimensional Imaging, we have extended their PSP™ technology. The benefits over previous medical skin research that uses laser scanning are:

- Instantaneous capture with no artifacts due to subject movement.
- Extremely dense data calculated at every image pixel.
- True 1:1 colour registration unaffected by any structured lighting.
- Non-invasive and complete safety using standard photographic equipment.

We assist capture over a narrow depth-of-field with a guiding aperture set to a fixed focal distance. We also employ a ring flash for consistent lighting of the subject and a Macbeth colour chart in every shot (Figure 1).

Model Reconstruction

We recover an extremely detailed model of the subject, from which the image colour and range data can be reprojected as a 3D model (Figure 2). The inter-pixel spacing is $\approx 25\ pixel/mm$ and depth accuracy is about $0.05mm$.

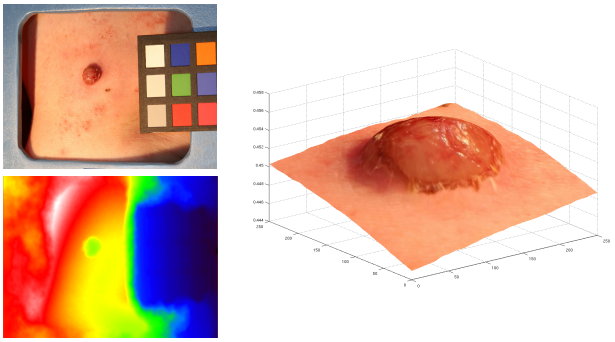

Figure 2: Subject colour and range data, with reconstructed lesion.

Post Processing

Enhancement of the initial capture uses a specialised interface allowing selection of the particular region in question. It also performs colour correction in order to normalise the data across all captures. We can also accommodate the global orientation of the surface via depth correction to an underlying fitted geometric surface (Figure 3).

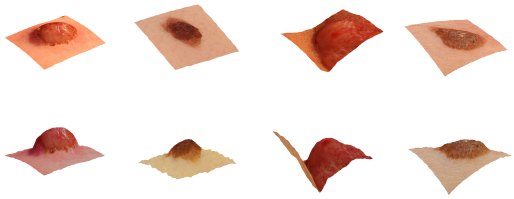

Figure 3: Original (top) and colour/surface corrected data (bottom).

Segmentation and Extraction

Using the corrected data, we can exploit the additional depth information to help in segmenting the lesion, in combination with colour data. Analysis of the surface geometry also leads to further features that may be extracted for classification purposes. In particular, the local variation in depth gives an indication of roughness which is a factor used in actual diagnosis (Figure 4).

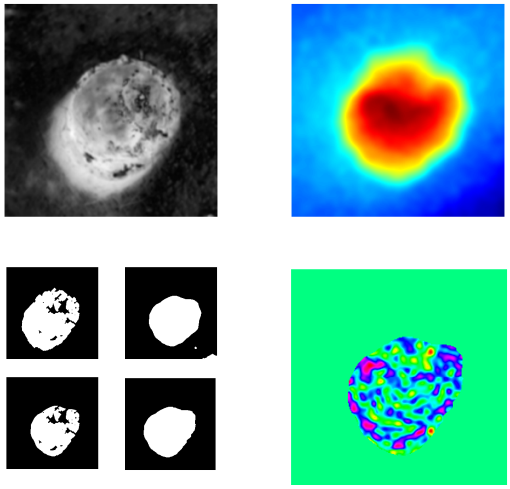

Figure 4: Image + depth segmentation and surface gradients.

Future Directions

With the Department of Dermatology at the University of Edinburgh, we have recently installed this system in a working clinic. This allows us to collect a comprehensive variety of lesion examples to further investigate automatic classification and visualisation tools for improved recognition of malignant melanoma. This will directly help toward early diagnosis, which can lead to 99% successful treatment if caught early enough.

IMAGING FARADAY partnership

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