SEAHA EPSRC CENTRE FOR DOCTORAL TRAINING SCIENCE AND ENGINEERING IN ARTS HERITAGE AND ARCHAEOLOGY

Hyperspectral Imaging of a 6 Metre Medieval Genealogical Roll

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Introduction

Hyperspectral images contain high resolution spectral information but relatively low resolution spatial information. Many items of cultural heritage have a large surface area which is challenging to capture in detail. This work develops a mosaicking pipeline for hyperspectral images taken using a scan mirror assembly, enabling high resolution hyperspectral imaging to capture large heritage surfaces. Below is an image showing the first section of a 6 metre genealogical roll relating King Edward IV back to Adam and Eve. This image was taken on a mobile phone in panorama mode and shows that current stitching techniques have limitations.

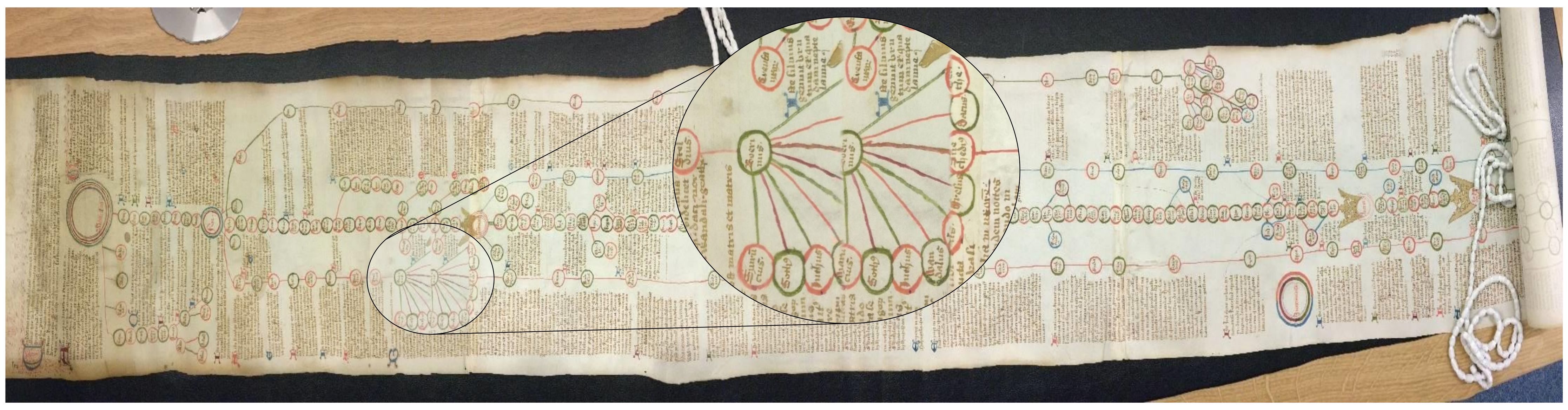

Fig. 1 - Genealogical roll showing the lineage of the kings of England, taken on a mobile phone in panorama mode. Inset highlighting one of multiple stitching errors.

Research Questions

- How can hyperspectral images be accurately and efficiently mosaicked?
- How can spectral information be accurately represented across seams in mosaicked images?

Method

Acquisition

60 scans taken at 10cm intervals.

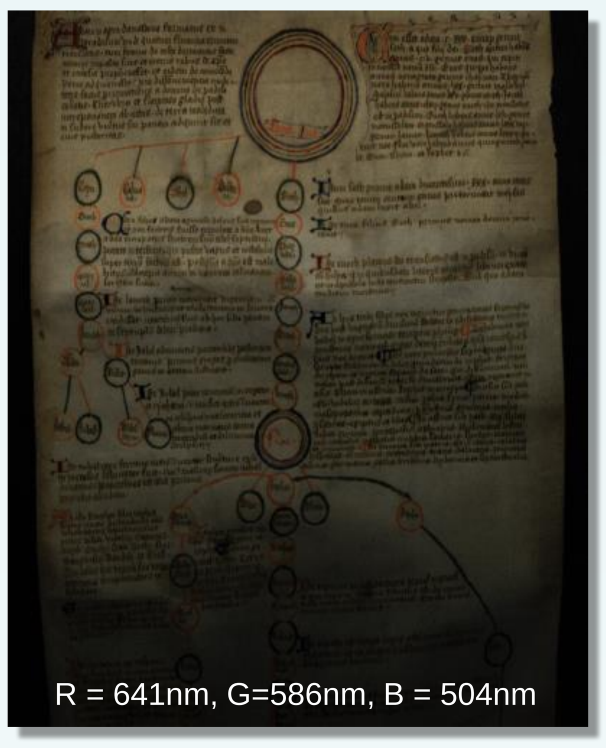

Fig. 2 – A composite RGB image to display the unprocessed hyperspectral image.

Correction

Spectral correction & flat fielding using Spectralon® tile. Scan mirror distortion corrected using a fourth-order polynomial. [1]

Fig. 3 – A composite RGB image to display the corrected hyperspectral image.

Alignment

Register images using normalised cross-correlation. [2]

Fig. 4 – A composite RGB image to display two overlapping hyperspectral images.

Seam Cutting

Calculate the difference between each overlapping pixel and represent this as a graph. Find the shortest path through the graph using Dijkstra's algorithm. [3]

Fig. 5 – A composite RGB image showing the optimal seam line through the overlapping area.

K-means Clustering

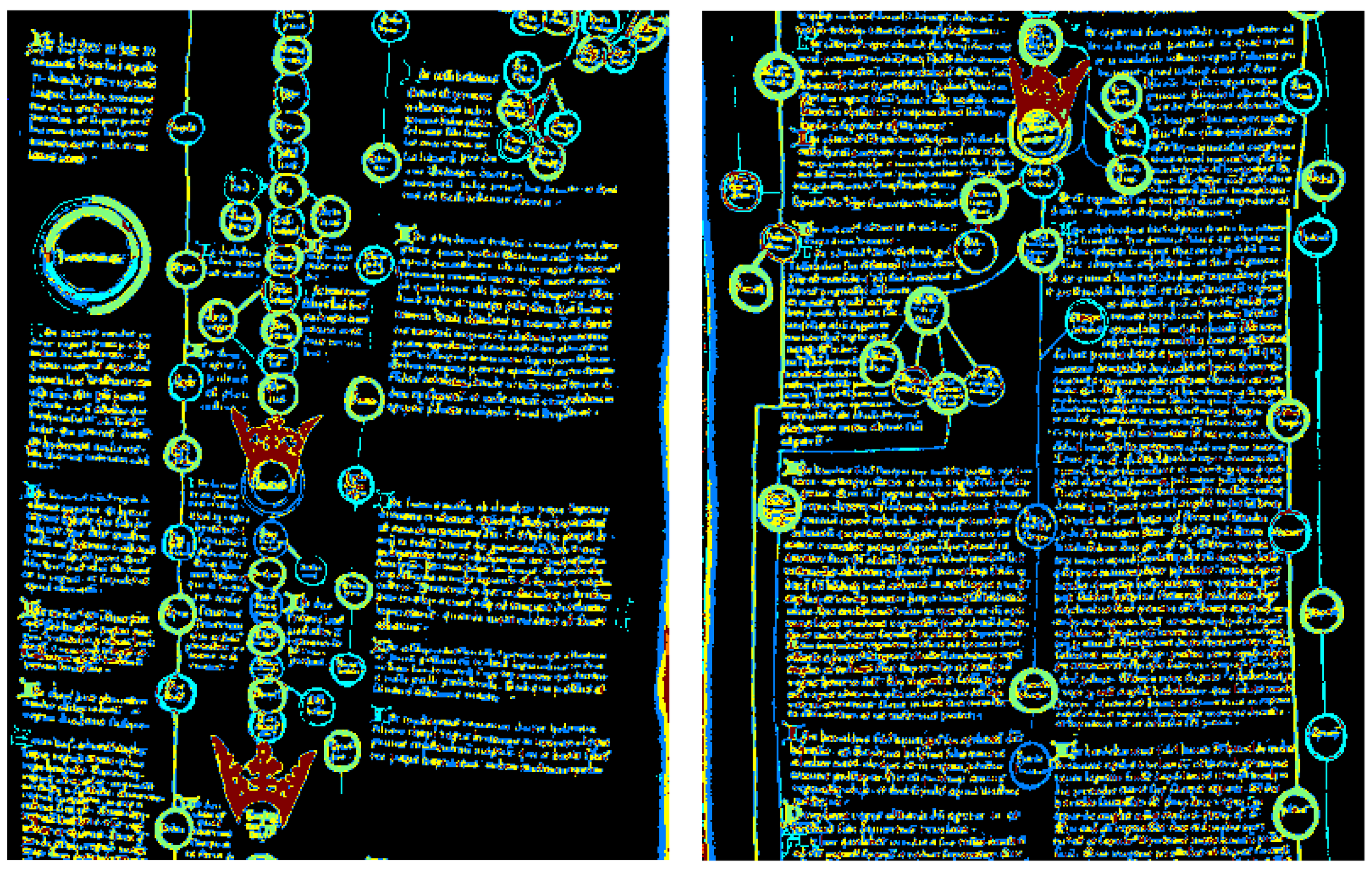

Fig. 6,7 – Sections of the result from k-means clustering along the entire length of the roll. Clustered using cosine distance between spectral profiles, different colours in these images represent different clusters.

Conclusions

The imaging pipeline described above produces a visually seamless result. The use of seam cutting ensures that spectral information is un-modified throughout the stitching process.

Future Work

This project will continue with analysis of spectra from inks along the length of the genealogical roll. Ultimately this work will lead onto a PhD project using a new high-resolution translational scanning system at UCL.

References

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2. Lewis, J.P., 1995, May. Fast normalized cross-correlation. In *Vision interface* (Vol. 10, No. 1, pp. 120-123).

3. Dijkstra, E.W. (1959). A note on two problems in connexion with graphs. Numerische Mathematik 1, 269-271.

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