Research Group on Manuscript Evidence

THE PARKER LIBRARY
CORPUS CHRISTI COLLEGE
UNIVERSITY OF CAMBRIDGE
CAMBRIDGE, ENGLAND

写本共同研究所

Image Processing as an Aid for Manuscript Studies

A Workshop

Organised by: Mildred Budny

Image Processing

as an Aid for

Manuscript Studies

A one-day workshop held on 15 January 1994 at the Parker Library, Corpus Christi College, Cambridge, by the Research Group on Manuscript Evidence

Summary

Organised by Dr Budny jointly with Dr French, with the assistance of Dr Woan and Mr Parker, this workshop focused upon imaging techniques as aids for manuscript studies. It considered developments in imaging through photographic and computerised methods. The workshop provided a forum for information and feedback about techniques of image processing, both existing and planned: applications, capabilities, limitations, desiderata, and future potential. Participants included experts in manuscript studies, conservation, photography, imaging aids, computing, radio astronomy, engineering, forensics and medical imaging.

Programme

Manuscripts as a Focus for Image Processing
Dr M.O. Budny, Co-Director, Research Group on Manuscript Evidence

Image Processing at the Parker Library
Dr L.J. French, Research Consultant, Research Group on Manuscript Evidence

Imaging Equipment for Manuscripts and Documents
Mr A.C. Parker, Conservation Officer, Collection and Preservation Directorate, British Library

Modern Forensic Developments and Forensic Limitations in Imaging
Dr A.G. Filby, Head of Questioned Documents Section, Metropolitan Police Forensics Laboratory

Developments in Photographic Equipment and Film Emulsion Technology
Mr M. Dennett, Keith Johnson & Pelling Ltd

Advances in Lighting Equipment for Manuscript Photography
Mr C. Bacon, Bowens Product Manager, Keith Johnson & Pelling Ltd

Radio-Astronomical Techniques Applied to Manuscript Studies
Dr G. Woan, Cavendish Laboratory, Cambridge University

Image Processing at the Engineering Department, Cambridge University
Dr W.J. Fitzgerald, Engineering Department, Cambridge University

Techniques of Image Enhancement, Present and Future
Dr J. Lasenby and Mr A.R. Huggett, Engineering Department, Cambridge University

Digitisation, Restoration and Dissemination of Manuscripts
Dr A. Prescott, Department of Manuscripts, British Library; and Prof. K. Kiernan, University of Kentucky at Lexington.

Laproscopic Techniques for Manuscript Studies
Mr P. Greenhouse, Consultant for Sexual Health, Ipswich Hospital

Exhibition of Photographs and Computer Images
Dr Budny, Dr French and Mr Parker

Preliminary Report

Drs Budny and French gave a joint introduction reporting their initial explorations at the Parker Library, and described some specific questions and approaches.

Manuscripts as a Focus for Image Processing

Dr Budny reported the concerns to explore imaging aids by both the Leverhulme Trust Research Project on 'The Archaeology of Anglo-Saxon Manuscripts' and the larger Research Group on Manuscript Evidence, based at the Parker Library. She surveyed examples of problem passages which call for image enhancement: erasures; palimpsests, with one text written over another; burnt portions; liquid damage (notably ink lakes and liquid immersion); passages damaged by rust-burn marks and holes from binding mounts; pages obscured by exposure and rubbing while unbound; passages obscured by the application of chemical reagents; elements added or altered in different inks, sometimes spanning many centuries; drypoint glosses (especially occurring in superimposed layers); passages affected by corroded pigments or show-through from the opposite side of the leaf; offsets of ink and pigments from pages now lost; and multiple damage through a combination of features. The account considered examples from Corpus Christi College MSS 12, 23, 44, 111, 173, 201 and 422; and British Library Cotton MS Otho C. v.

Image Processing at the Parker Library

Dr French reported the Research Group explorations of image-processing using contrast-enhancement and line-sharpening techniques. These included the results of his work of scanning and processing Dr Budny's photographs of MSS 41 and 352; British Library photographs of the badly burnt Cotton MS Otho A. viii; and photographs of a set of fourteenth-century wax-tablets found at York. The processed images of MS 41 had been transmitted electronically to Binghamton University in New York, and published there; images of MS 352 were manipulated interactively to show a new range of possibilities for imaging problems, as with show-through and offsets of lost portions; images of the wax-tablets were manipulated with different contast levels and magnifications, yielding some improved readings; and images of the Cotton fragment were subjected to linear contrast alterations, with basic image-processing algorithms to record the series of manipulations. Dr French also reported his most recent work in applying Fourier-transform techniques to distinguish large-scale (low-frequency) features on a page from higher-frequency components representing script.

Imaging Equipment for Manuscripts and Documents

Mr Parker surveyed the history and applications of examination equipment for deciphering manuscripts and documents available at the Manuscripts Conservation Studio of the Collection and Preservation Directorate of the British Library, and elsewhere. These include microscopy, boroscopy, Infra Red and Ultraviolet lighting, fibre-optic lighting, the Video Spectral Comparator (VSC) screen, electro-luminescent screens (or glow-panels), Electro-Static Detection Apparatus (ESDA) and colour closed circuit television fittable to the optical devices, to produce photographs or video recordings.

Mr Parker's examples of problems and solutions included the use of Infra Red light to reveal underdrawings, faded carbon-based inks and palimpsests (as in British Library Egerton MS 289); Ultraviolet light or the combination of the VSC/Image Integrator to enhance faint images of iron-tannate-based ink (in Cotton MS Otho A. viii) or obscured ink acid burns (in Cotton charters); the combination of the VSC/Image Integrator to reveal differences in inks (as in the British Library Visitors' Book); the Electroluminescent screen or fibre-optic cables to locate underdrawings (as in Harley MS 2803); microscopy and fibre-optic lighting to identify the sequence of layering of inks and pigments (as in fifteenth-century printing with gold); fibre-optic lighting to highlight impressions of lost or lifted materials or additions (as in Royal MS 6 E. iv); borescopy to reveal spine sewing patterns or fixing methods (as in the Mappa Mundi of Hereford Cathedral); and the VSC- screen and both transmitted and raking fibre-optic lighting to assess the authenticity of a damaged Anglo-Saxon single-sheet charter (Somerset Record Office SRO/DD/SAS/PR50). Mr Parker also reported the results of the joint project, devoted to a problematic page in Cotton MS Claudius A. i, carried out at the Research Group visit to the British Library in December (see Appendix).

Modern Forensic Developments and Forensic Limitations in Imaging

Dr A.G. Filby considered modern forensic developments in imaging, as applied to documents and other materials, ranging from offsets of shoes to fingerprints. Developments include trace analysis, fluorescence/luminescence, ESDA and developing fingerprints. Dr Filby also considered the limitations of forensic work in these areas, including lack of background data, the need for records of treatment and alteration, the normal short time scale and problems of dating.

Developments in Photographic Equipment and Film Emulsion Technology

Mr M. Dennett surveyed developments in photographic equipment and film emulsion technology, and their value for manuscript photography. He demonstrated techniques of copy-photography on site. He also reported on the development of Fujichrome 50, a new professional 50 ASA-rated film by Fuji Photo Film Co, which gives comparable results to Kodachrome, using standard E6 chemistry. This permits more precise control over the film-processing to improve consistency across exposures and lighting conditions. Mr Dennett also distributed film samples and data information.

Advances in Lighting Equipment for Manuscript Photography

Mr C. Bacon reported on developments in lighting techniques for photography of manuscripts, artefacts and works of art. He demonstrated on-site various techniques for reducing Ultraviolet light emission during photographic sessions. This included a new 'soft-box,' developed in America, containing a correcting dispersion plate which both reduces UV transmission and improves illumination evenness.

Radio-Astronomical Techniques Applied to Manuscript Studies

Dr Woan gave a radio-astronomical perspective on imaging problems in manuscripts, focusing upon how lessons learned from cleaning astronomical images obtained from radio telescopes might be applied to manuscript studies. He surveyed various techniques of image reconstruction, especially through Maximum Entropy. He discussed the limitations of these methods, which assume a uniform point-source distortion across the whole of the image, and discussed the requirement for 'prior' information to enable a realistic reconstruction, which becomes especially complex in fields of humanist studies. He also pointed to the significatn potential offered for imaging manuscripts by the Automatic Plate Measuring machine, a large and powerful flatbed scanner developed to digitise Schmitt Plates containing photographs of the sky. Dr Woan demonstrated examples derived from Dr Budny's photographs of MS 173, using both this machine and other techniques at the Institute of Astronomy.

Image Processing at the Engineering Department, Cambridge University

The Signal Processing and Communications Group of the Department of Engineering at the University of Cambridge reported on its work on image restoration of degraded audio and visual materials of various kinds.

Dr W.J. Fitzgerald gave an introduction to the work of this group. This covered both final-year undergraduate projects, where a single image might be subjected to a standard set of techniques, through Ph.D student work treating sequences of images (for example degraded cinema-film stock) and post-doctoral research programmes, including the joint project with the British Library, of which Dr Lasenby is a member.

Techniques of Image Enhancement, Present and Future

Dr J. Lasenby surveyed standard techniques of image-enhancement in various fields. These include contrast-enhancement, histogram equalisation, adaptive histogram equalisation and application of filters. She also reported on plans for future techniques, applying some model-based deconvolution techniques (for example from physics), morphological filters, classification techniques and data-fusion techniques. This included projects both planned and in progress, based on, among others, examples from Parker Library manuscripts and a new project shared with the British Library (Research Division). In parallel, Mr A.R. Hugget demonstrated some of these techniques on computer, including a range of image processing techniques applied to a passage in Corpus Christi College MS 422, which had been degraded following application of an ink-enhancer (chemical reagent) in the nineteenth century.

Digitisation, Restoration and Dissemination of Manuscripts

Dr Prescott and Prof. K. Kiernan reported on the digitisation, restoration and dissemination of manuscripts, notably in the project to prepare an electronic facsimile of the badly burnt *Beowulf* Manuscript (British Library, Cotton MS Vitellius A. xv).

Dr Prescott displayed some preliminary results of the digitisation for this project, and described the plans for their archival storage and access. Materials for his computer demonstration were electronically transferred on the day, with Dr French's help, from Kentucky.

Prof. Kiernan demonstrated a Hypertextual application of the *Beowulf* material. Using a Macintosh computer, he showed how images, editions, commentary and text might be linked to form educational material at various levels.

Laproscopic Techniques for Manuscript Studies

Mr P. Greenhouse reported on laproscopic techniques in medical imaging and their potential for manuscript studies. He demonstrated a video exploration of the interiors of the spines of printed books, revealing features of the backs of their quires, their sewings, their glue and their spine-liners reusing fragments of printed or manuscript leaves.

Exhibition of Photographs and Computer Images

The workshop was accompanied by an exhibition of photographs and enhanced images, including examples from both the British Library and the Parker Library. Prepared by Dr French, Dr Budny and Mr Parker, it included examples of problems and solutions to imaging manuscripts and documents in both centres.

List of Attendees

Mr C. Bacon
Keith Johnson & Pelling Ltd

Dr R. Beadle
St John's College, University of Cambridge

Mr J. Bennett
British Library

Dr M.O. Budny
Research Group on Manuscript Evidence

Dr M.A.M. Daniels
Chemistry Department, University College London

Mr M. Dennet
Keith Johnson & Pelling Ltd

Dr A.G. Filby
Questioned Documents Section, Metropolitan Police Forensics Laboratory

Dr W.J. Fitzgerald
Signal Processing and Communications Group, Engineering Department, University of Cambridge

Dr L.J. French
Research Group on Manuscript Evidence and Olivetti Research Ltd

Mr T.C. Graham
Research Group on Manuscript Evidence

Mr P. Greenhouse
Ipswich Hospital

Mr M. Gullick
The Red Gull Press

Mr A.R. Huggett
Signal Processing and Communications Group, Engineering Department, University of Cambridge

Prof. K. Kiernan
University of Kentucky at Lexington

Dr A.C. Kokohan
Signal Processing and Communications Group, Engineering Department, University of Cambridge

Dr J. Lasenby
Signal Processing and Communications Group, Engineering Department, University of Cambridge

Prof. R.I. Page
Research Group on Manuscript Evidence

Mr A. Parker
Collection and Preservation Directorate, British Library

Dr C. Porter
University College London

Dr A. Prescott
Department of Manuscripts, British Library

Dr N.E. Ramsay
Department of Manuscripts, British Library, and University of Kent at Canterbury

Mr R. Russell
Collection and Preservation Directorate, British Library

Mr J. A. Stark
Signal Processing and Communications Group, Engineering Department, University of Cambridge

Prof. P.E. Szarmach
Binghamton University and the Institute for Advanced Studies, Princeton University

Prof. T. Takamiya
Keio University, Tokyo, and St John's College, Cambridge

Dr Y. Takeuchi
Signal Processing and Communications Group, Engineering Department, University of Cambridge and Hitachi

Dr G. Woan
Radio Astronomy Department, Cavendish Laboratory, University of Cambridge

Dr Porter and Dr Daniels are members of the Leverhulme Trust Research Project on 'Non-Destructive Pigment Analysis of Medieval Manuscripts by Raman-Spectroscopy' at the Department of Chemistry, University College London.

Appendix

Organised by Dr Budny and Mr Parker, a Research Group visit to the British Library took place in December, in preparation for the workshop at the Parker Library in January. The meeting was attended by Dr French, Dr S.L. Keefer (Trent University, Ontario) and Mr R.M. Keefer (consultant spectroscopist to the Alcan corporation, Canada).

Dr Prescott demonstrated developments in the new Digitisation Project at the British Library devoted to the *Beowulf* manuscript. Mr Parker surveyed the history, development, range and uses of advanced viewing aids in the Manuscripts Conservation Studio of the Collection and Preservation Directorate of the British Library, notably as applied to the Western Manuscript collection since the early 1970s. Mr Parker demonstrated uses of microscopy, borescopy, infrared and ultra-violet lighting, fibre-optic lighting and the Video Spectral Comparator (VSC), with examples from British Library materials.

Mr Parker and Dr Budny then conducted a joint project between the British Library and the Research Group. It was devoted to a problematic page selected by Dr Budny in Cotton MS Claudius A. i, a collection of pontifical and other fragments mainly from Christ Church, Canterbury. Portions of the page, containing inscriptions, decoration and illustration, were examined under the VSC screen and under microscopy, using both indirect and transmitted lighting with cold fibre optic lighting and a glow-panel. Mr Parker took photographs of the results for display in the January workshop. Dr Budny and Dr French recorded the day's proceedings with both still and video cameras.