Graphics, Visualization and the Social Sciences

Workshop
8 & 9 May 1997

Burleigh Court
Loughborough University

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Section 2 (only available in paper version)

Executive Summary and Recommendations

A workshop to discuss "Graphics, Visualization and the Social Sciences" was held on 8th and 9th of May at Burleigh Court, Loughborough University. It was attended by 24 people from 16 institutions, was funded by JISC through the Advisory Group On Computer Graphics (AGOCG) and organised by Dr Anne Mumford. The programme was put together by Anne with Professor Mike Batty (UCL) and Professor David Unwin (Birkbeck).

The aims of the meeting were:

- ¸to survey current work in social science making use of graphical computing and visualization techniques.
- ¸to evaluate the potential of the available technology to enhance teaching and research in social science.
- ¸to explore the pictorial data requirements of the social sciences.
- ¸to make recommendations to AGOCG on the infrastructure necessary to support these developments.

Although there was a bias towards geography and planning, also present were sociologists, statisticians and service providers. Although concern was primarily for the social sciences, many of the themes discussed and the recommendations have wider application.

Issues Discussed

The discussions at the workshop took place in both plenary sessions and parallel groups with all participants making presentations and participating in group discussions. Some of the issues which emerged included:

- ¸graphics and visualization tools can enable assimilation of data and aid in understanding processes. Relative to their potential, these tools are currently underused in the social sciences.
- ¸social science data are different to scientific and engineering data - the data are often qualitative or categorical and are seldom measured on a continuous scale. This means that different techniques and representations are needed.
- ¸in the social sciences, pictures can provide input data into the research process.
- ¸access to pictures, images and graphical presentations in a digital form online is not widespread (though initiatives such as the JISC Electronic Libraries programme (eLib) and the Knowledge Gallery may provide useful resources in the future). Image libraries must be accompanied by full details through metadata if they are to provide a good research tool.
- ¸the WWW is an important tool for researchers. It provides access to resources. It also provides the potential for assisting decision support through online surveys. Systems are available to allow discussion and exchange of views and these may also be of interest to supporting debate, for example in social theory.
- ¸graphics and visualization tools give us the potential for different and individually authored views on information. Windows showing different information (perhaps a map and the accompanying statistical information from the census) can be linked and graphically manipulated to assist in understanding underlying processes.

- there is a need for social scientists to be more aware of, and comfortable with, the technology so that the techniques available become a tool to assist in understanding social processes and not a barrier. Too much energy is spent on overcoming the technology and not in gaining understanding.

Case studies of the use of graphics and visualization in the social sciences were presented at the workshop and are detailed in the papers in section 2 of this report.

Recommendations

It is a tradition that AGOCG workshops emerge with some firm recommendations for action, and this event was no exception. This helps to steer the work of AGOCG and through them enables recommendations to other funding bodies who may be able to allocate resources to address the proposals made. The major recommendations from the workshop are as follows:

Strategic

It is important to raise the status of graphics and visualization in the social sciences and to ensure researchers and teachers are aware of the potential of technologies for data representation and understanding, data collection and decision support. This could be addressed through the relevant CTI Centres and the ESRC Resource, Programme and Research Centres.

The special nature of social science data needs to be recognised.

Review

A review of current work in the use of graphics and visualization in the social sciences throughout the world should be undertaken.

A review (based on social science data requirements) of tools within the current statistical and visualization packages should be conducted.

Training and Awareness

A training course on the use of visualization techniques within the social sciences should be run and widely promoted.

We need to ensure that there is high awareness of resources and services available now (SOSIG, Data Archive, QUALIDATA, AHDS, Knowledge Gallery etc) and encourage funding bodies to take account of the needs of social scientists in their service development.

Networking

A follow-up workshop should be held which examines the "Role of the Visual" in various strands of social science which would be discussed in parallel sessions covering topics such as: understanding the past; social processes; economic processes; decision making.

A series of case studies reflecting the potential and use of visual techniques should be put together to reflect good practice. These should be available online and on paper.

Background to the Workshop — Anne Mumford

The Advisory Group On Computer Graphics (AGOCG) is an initiative of JISC and the Research Councils. It is concerned to underpin the use of graphics, visualization, multimedia and virtual reality for teachers and researchers. In doing this it built good relationships with the community, other initiatives and the funding agencies. Its major focus is training and awareness and it has played a useful technology watch role for the community offering pragmatic and timely advice through an excellent report series and online information.

AGOCG has run a series of workshops to engage with the community and, through output recommendations, to steer its programme of work. Although many of the workshops have focused on areas of technology, there have been activities which have focused on broad areas of subject interest, most notably art and design. This workshop focused attention on the use of graphics and visualization in the social sciences. The aims of the workshop were:

- ¸to survey current activities in the use of graphics and visualization tools in the social sciences
- ¸to evaluate the potential of such techniques to the social sciences
- ¸to examine and report on the requirements of the social sciences for suitable tools and for support in taking on new technologies
- ¸to make recommendations through AGOCG for followup action to meet the needs of social scientists

This workshop was funded by JISC (Joint Information Systems Committee of the Funding Bodies — HEFCE, SHEFC, HEFCW and DENI) through its grant to AGOCG. Such activity is very much a part of the remit of JISC as recognised in the recently published JISC Strategy in which an aim of JISC is:

> "to exercise vision and leadership in bringing about benefits to the HE sector by the exploitation of information systems"

Following the workshop recommendations will be forwarded by AGOCG to relevant bodies which are expected to include JISC (including its various initiatives and services), the ESRC, through its Research Resources Board, and the CTI (Computers in Teaching Initiative) and TLTP (Teaching and Learning Technology Programme) Co-ordinators.

Graphics Visualization and the Social Sciences —David Unwin

Traditionally, 'pictures' such as maps, diagrams, paintings and graphs have been used to communicate the results of an investigation and their use as a direct method of analysis has not been common. Pictures are a polysemic means of communication, do not compress data into 'laws' or 'law like statements', and are anyhow hard to draw. However, the current 'data explosion', coupled with the increased use of non-linear dynamic models and the potentials for graphical output afforded by modern computer systems, are beginning to change this view. Visualisation is increasingly being used as an analytic strategy, similar in spirit to that of Dr. John Snow's famous 1854 discovery by mapping of the link between cholera and infected water supplies. Visualisation software developed for use in the natural sciences is of only limited use in the social sciences whose data frequently are very different from those assumed by these systems.

Introduction to the Themes

The themes discussed at the workshop reflected the input papers and did not aim to cover the workshop topic in a comprehensive way. The broad themes which emerged from papers were:

- ¸the use of maps
- ¸visualization of statistics and large and/or complex data sets
- ¸the use of models and simulations
- ¸the potential of new technologies to support research in social sciences

Having been introduced in plenar, each of these topics was discussed in parallel groups. The first three topics were discussed in parallel on the first day of the workshop. The underlying technologies were discussed by four parallel discussion groups on the second day.

Each of these topics is discussed in turn in this report. The papers presented under each topic are outlined in the main body of the report and full papers are given in Section 2 of this report.

Maps

Presentations

The Handling of Maps in a Visual Archive for the Social Sciences —
Ifan D H Shepherd

Visual information of many kinds (drawings, sketches, cartoons, photographs, maps, film and video) is increasingly being used as a significant information source by social scientists. This is happening at a time when an increasing amount of visual information is becoming available in digital form on CD-ROMs and the Internet, and many academic networks are increasing their bandwidth specifically to handle graphical information in digital form. In this context, there would appear to be a major need for a visual information archive in the social sciences. This paper considers the role of map information in such an archive, and considers two propositions: that in any visual information archive, the distinctive characteristics of maps will require special consideration; and that in attempting to meet the needs of social scientists, it may not be appropriate to distribute (map) images alone.

Visualisation of Fuzzy Boundaries of Geographic Objects — Bin Jiang and Mike Batty

The linguistic notions such as very low, low, not low, low or medium are commonly used to name classes in currently geographic information system (GIS). This sort of linguistic notions are frequently utilised in the human sciences as well. There is little doubt that the human sciences require formal and even mathematical framework for handling graded categories with blurred boundaries. In the past decades, much effort has been made to model the kind of fuzziness (or possibility) from the field of mathematics. Geographers and GIS professionals have started to treat this issue in the last ten years. The presentation provided detailed discussions with a case study on how to visualise the sort of fuzziness, involving colour surfaces, coloured contour lines, and 3D simulation. The authors argued that effective visualisation of fuzzy boundaries might facilitate the understanding of geographic objects with indeterminate boundaries.

Visualising Past Geographies: The use of animated cartograms to represent long-run demographic change in Britain — Humphrey Southall and Ben White

Some social processes are directly experienced, but the effects of demographic change are often slow and imperceptible. Further, in a country such as the UK there is much geographical variation and many of the extremes are found among urban populations concentrated into small areas which barely figure on conventional maps. Cartograms — maps in which areas are made proportional to some other variable such as population — help solve this second problem while animation deals with the first. The paper presents early results of research based on combining a large historical GIS for Britain, constructed at QMW and containing both a large volume of census and vital registration data from 1851 onwards and the *changing* boundaries of the various reporting units, and an algorithm developed by Daniel Dorling (Bristol) for the automatic computation of cartograms. Each district is represented by a circle whose changing radius shows population growth or decline; processes contributing to that growth, such as net migration, are shown by changing shading. The animated cartograms we create cannot be conventionally published but can be distributed on CD or viewed over the World-Wide Web.

Visualising Urban Environments for Planning and Design — Martin Dodge, Andy Smith & Simon Doyle

The ability to represent, model and evaluate changes to the built environment within a computer environment on the 'desktop' or over the Internet offers the opportunity to enhance the urban planning and design process. Furthermore the application of computer based visualisation techniques allows ideas to be communicated effectively whilst also facilitating Internet based public participation.

Current research at the Centre for Advanced Spatial Analysis (CASA) at UCL is focusing upon aspects of computer modelling and visualisation relevant to the planning and design of urban environments. This paper outlines how Geographical Information Systems (GIS) and World Wide Web (WWW) based virtual reality techniques are being applied to aid visualization within urban planning and design at national and local levels.

Discussions

There are real technical problems underpinning work in social sciences and these tend to take lots of energy when the researcher really needs to be concerned with social processes. There is need for training and awareness and for support if the tools are to become easier to use.

There was some concern that we continue to use zones and boundaries where these may not be appropriate. In order to create the demography we have used zones but animated cartograms provide a better solution. Having said this, anything which can be done in the research lab now will be commonplace in the near future as machines become quicker and cheaper and algorithms improve or become irrelevant as more computer power becomes available.

Fuzzy boundaries are of considerable interest to researchers. This covers a range of data — statistical, spatial, temporal.

It is the underlying data behind the map which is important. It needs to be tailored for the readers needs — the tourist, the researcher, the planner, the government office. The social scientist should be the "auteur" — the continuing challenge of delivering resources for end user authoring.

With a wide potential audience technology standards are an important consideration.

Conclusions and Recommendations

We need to bring together disparate strands of research, for example those working on fuzzy data.

We need to re-focus research on end-users:

- ¸what is the audience for social science data?
- ¸what programmes of re-education are needed to change the data visualization mindset?

- ¸what is gained/lost by using WWW to reach a mass audience?

Visualization of Statistics

Presentations

Visualization Software, Complex Datasets and the Social Sciences — Brian Francis and John Pritchard

This paper examined the issues and complexities in using scientific visualisation systems for the graphical examination of complex social science data, specifically concentrating on individual work and life histories. Previous approaches to graphing such event history data have been unsatisfactory, providing graphs which are static and non-interactive, with difficulty in representing more than a few individuals in one display. A new approach (Francis and Fuller, 1996) is to use a scientific visualisation system such as AVS to display an event history as a multi-faceted pencil-like object in three-dimensional space, with changes of state within a variable being represented by changes in colour, shading and height on each of the faces of the pencil. Viewing a single object allows a detailed history which concentrates on the relationships between the changes of state in many variables to be examined, using the zooming, fly-through, selection and clipping provided by AVS. To view collections of individuals, we can extend the idea of Lexis diagrams (Keiding, 1990) into three dimensions, placing the pencils according to the date of the start event and age. This allows patterns in event histories to be examined. Dissemination of such work can be provided by writing VRML files which can be posted on the web. An example of the relationship between male unemployment and female participation in the labour force was demonstrated, showing that new insights can be obtained into such data by the use of these 'lexis pencils'.

Developing a Visualization Gateway to Census Data at MIDAS — Jackie Carter

The new post of Data Visualization Support Officer has recently been created at MIDAS (Manchester Information Datasets and Associated Services). This role has been created to allow the integration of software tools, developed under JISC (Joint Information Systems Committee) initiatives, to develop an intelligent, highly interactive on-line mapping visualization gateway to the 1991 Census and associated digitised boundary data held on MIDAS. One of these software tools is a cartographic data visualizer, **cdv**, which is the subject of this article. **cdv** has been developed to provide a toolkit for teaching and learning in the spatial sciences. It was written using the Tcl/Tk scripting language, from Sun Microsystems, which enables applications to be built rapidly.

cdv allows a user to produce different views of the same dataset. For example, a user may choose to look at a single attribute, such as cars per capita, for a county, and this can be displayed in a variety of ways, by means of a choropleth, a proportional circle map, or a cartogram. Furthermore, **cdv** can display all these views concurrently to allow a user to see the effects of using different cartographic representations to display data. Up to three variables at a time can be displayed using **cdv**. Colour symbolism is used effectively to allow the variables to be viewed concurrently. In addition, boxplots and scatter plots can be used to help a user determine the existence of relationships between the variables, and to allow classification to take place. **cdv** is highly interactive allowing the user to highlight any symbol in one map view and immediately see it in any other linked view. Such a technique enables a user to explore their data sets very rapidly, and investigate patterns and outliers that might, without visualization, be difficult to detect. Whilst **cdv** may not provide all the answers, it enables a user to ask questions of their dataset, and facilitates the provision of the production of 'soft maps' to allow exploratory spatial data analysis to be carried out.

Current work involves enabling users to access the cartographic data visualizer at MIDAS. Promoting the use of **cdv** in teaching and research is seen as an important task if visualization techniques in the use of census data are to be fully exploited.

The visualisation of area-based geographical data using SAGE - Steve Wise, Jingsheng Ma and Bob Haining

Much social science data is available for geographical areas, such as wards or counties and software for visualization and analysis of such data is potentially useful in a number of academic disciplines. However, existing visualization software, rooted in the needs of the physical and environmental sciences, do not contain many of the necessary tools for the visualization of such data. We have therefore developed a software package called SAGE (Spatial Analysis in a GIS Environment) which provides a range of tools for the analysis of area-based data. A number of the features of the software relate directly to the special nature of such data and of the analytical questions which are of interest. Firstly, the spatial element of the data is important since it is often of interest to identify spatial trends and outliers. Visualization can assist in this when a map can be linked to other statistical views of the data, such that values for areas of interest can be identified, or the location of distributional outliers shown. Secondly, the linking of different views of the same data has a more general utility in exploring relationships between variables, and in assessing the results of fitting statistical models. Thirdly, many variables can only be defined in relation to a set of areal units (the population density of a point is a meaningless concept) and hence there is a direct dependence between the units used and the results of analysis. This means there is a need for tools to assess the sensitivity of findings to changes in areal units, and to design purpose built areal frameworks. These are provided in SAGE by a set of regionalisation methods. (There may also be a direct analogy here with the analysis of temporal data, in which some variables are defined in terms of fixed temporal frameworks). Fourthly, spatial data often invalidates the assumptions of classical statistical methods, and requires special methods which can account for this. The software is based on existing, low cost packages wherever possible (public domain graphics code, and the ARC/INFO GIS which is widely available to the UK academic community). However, the writing of SAGE would have been greatly assisted by the availability of commercial graphical widgets and GUI building tools.

Adding colour to the 1997 General election — Graham Upton

The display of socio-political data, consisting of compositional variables aggregated at the constituency level, requires diagrams of types that are not available in standard graphics packages. This paper presents cartograms to show geographic variations, ternary diagrams to show inter-election change and an unwrapped torus to show the relation between vote, household tenure and social class.

Facilitating the use of Visualisation by Social Scientists — Robert Inder

Social Scientists make extensive use of statistical packages, for analysing data and presenting and justifying results. Differences between these packages mean users tend to become locked in to one or other of them, and thus into the set of statistical operations and display options it provides. This can impede collaboration and obstruct the exploiting published collections of data, and can limit the analyses that individuals consider. Most researchers can exploit new techniques only after they are available in their package of choice. We believe it is desirable, and feasible, to address this situation by using knowledge-based techniques to create a front-end system to allow users to "mix and match" between the facilities of the various packages. By combining meta-data and knowledge about the available software, the system would automatically sequence and parameterise library programs to convert data between formats, and use specific capabilities of the various packages to analyse the data, or create relevant presentations for users. The resulting system would provide a rich environment for supporting the use of the underlying tools.

Discussions

These discussion points and the conclusions and recommendations which follow came out of 2 groups (see the agenda at the end of Section 1 of this report for details of the presentations within groups).

Group 1

Social scientists have to deal with: spatial, temporal and spatio-temporal data. Techniques such as linked windows (spatial and statistical information as in cdv) work well for spatial data and those such as lexis pencils, animation and glyphs work for temporal data, but we need techniques for the display of spatio-temporal data. Studies relating to social networks changing through time, economic data, survey panel and migration data all could benefit by the use of such visualizations.

Group 2

There are a range of emerging techniques which look of particular interest in using visualization tools in the social sciences. cdv presents the user with a range of tools. SPSS and other statistics and database packages offer other tools. These need to be investigated — many people do not know what they can do for them. A possible "statisticians workbench" was discussed which might have a common interface to a range of underlying statistical and other techniques and tools coming from different packages which the user does not need to know about. This was considered to be an attractive idea.

Issues which emerged were:

- how do we make the techniques and tools available to the "novice user", give people knowledge about what is available and persuade them visualization is worth considering?
- exchange issues are important in relation to input, output, metadata.
- colour fidelity and use of colour need to be considered (AGOCG have addressed this issue in some earlier work).
- we need guidelines for graphics (good/bad practice).
- social scientists have special needs: their data are often multivariate, temporal, qualitative, categorical and may also have discontinuities
- are there useful general displays for social science data? tenary, parallel plots, lexis pencils?
- should we be delivering the data or standard graphical representations? There is a lot of support for displays to be authored on demand.
- visual techniques have a lot of potential in validating data, increasing understanding, showing behaviour, scenario building and the communication of complexity.
- however, poor graphics will confuse/mislead and have a capacity for time wasting.
- the requirements include: PC solutions, training/dissemination, "open" systems/standards or interfaces, the integration of visualization and statistics packages, case studies.

Conclusions and Recommendations

Group 1

Rhere is a need for:

- awareness and training programmes for both computer literate and those with little/no familiarity with IT to introduce graphics and visualization techniques.

- promotion of the benefits of visualization in gaining understanding of complex datasets.
- the development of techniques for temporal and spatio-temporal statistics. If possible, these should be generic.
- encouragement of the use of visual interfaces to data.
- the discovery or development of easy to use software.

Group 2

There is a need for:

- a review of existing graphics in statistics and database packages as well as visualization packages.
- identification of good practice and the development of guidelines.
- raising the status of visualization in the social sciences.
- a case study booklet/WWW site.
- a course on the use of visual techniques in the social sciences .
- a trawl for similar/relevant work elsewhere (through SOSIG?)

Models and Simulations

Presentations

The Use of Visualization for Modelling and Simulation — Michael Batty

To set the context for exploring visualization for social science modelling, this paper examined first different types of models identifying iconic/pictorial, data-driven, and mathematical/simulation as those of significance to visualization. In fact, sometimes icons such as 3D digital structures of cities, and data-driven systems based on 2D additions of data are often called models but without denigrating the place of these, this paper concentrated upon mathematical/simulation models which we felt were of more concern to the social sciences per se. Such models can be classified according to whether or not they have a natural spatial-visual structure, this biasing visualization potential to geographic-built form-natural environment views of social systems. Natural spatial- visual models, non-spatial-visual models with some spatial components from which visualization can be exploited, visual abstractions from non-spatial models, and visual abstractions from spatial models were the four types identified. To this questions of temporal and model process dynamics which imply related types of visualization were added. Visualization itself was discussed in terms of dimensionality of the model, the extent to which abstract/real 'maps' might be constructed, abstract/real charts/graphs might be constructed and the extent to which new pictorial media might be added. Linking visualizations and data through hotlinking was discussed and then visualization in models was talked of in terms of inputs, outputs, model processes and mechanics and finally user interfaces for model-building and for communication. These ideas were to frame the subsequent discussion in the meeting.

Urban visualization projects at Cardiff — Christopher J Webster and Fulong Wu

This paper discussed two urban visualisation projects undertaken at Cardiff. The first, raises issues relating to computing requirements for computationally intensive 2D visualisation experiments. The principal aim of this project, now completed, was to develop methods for measuring detailed micro-urban form using pattern-recognition techniques; an aim originally motivated by the quest for automated feature recognition and learning in intelligent urban GIS but also relevant to the formal measurement of urban morphology. The project entailed coding a vast suite of pattern recognition algorithms within a framework suitable for conducting experiments on urban satellite imagery and co-referenced GIS layers. At the time no commercial package offered quite the range of approach and flexibility of measurement design required and the programmes were coded in Pascal. Visualisation was achieved with UNIRAS and the two programmes were loosely coupled via ASCII file exchange. The main computational problems encountered were the huge CPU time and space requirements which, at the time, exhausted the capacity of Cardiff's most powerful computer; the inefficiency of loose coupling between analytical and visualisation environments; and UNIRAS' inflexibility as a graphics package. Wider issues arising from this experience and discussed during the workshop include:

(a) the usefulness of 2D visualisation in designing urban morphological measures, demonstrated for example, by the creation of UNIRAS images of the vector outputs of NAG's 2D fourier transform routines in order to explore urban morphological regularities in Fourier space;

(b) the inevitability of having to put together bespoke programming environments to support this kind of work and the need to recognise this in research council grant applications;

(c) the need for super computing facilities in the social sciences; and

(d) the need for resources to ensure that the results of extensive programming effort are captured for the wider community.

The second project presented develops the theoretical and methodological specification for experiments that use a cellular automative model to explore the impact of alternative systems of pollution property rights on urban form and structure. Cities are grown in cellular space under the assumptions of profit maximising developers and welfare maximising households. Profit functions and externality functions are specified and both made a dynamic function of local neighbourhood conditions and sub-regional conditions in the cellular space. Equilibrium conditions are specified that relate to alternative regulative regimes. These generate profit maps which guide the simulation under Monte Carlo rules. The use of cellular automata allows investigation of the sequencing and spatial dimensions of the social efficiency questions embodied in the economic models. This presentation illustrated just how vital visualisation is to generative modelling of this kind in which interesting global patterns arise from probabilistic models of the local behaviour of elementary actors. In the experiment reported, clear spatial patterns (linear industrial zones) emerge from an essentially aspatial economic model of externalitiy internalisation. The patterns that form the outcome of the simulations can only be understood by visualisation.

Seeing Structures and colouring up theories — Bill Hillier

The aim of this paper is to show that visualisation, as a dimension of 'configurational analysis', can be used not just as an aid to communication or understanding but to discover and demonstrate objective 'deep structures' in real phenomena. The field of phenomena are architectural and urban systems, alias the built environment, seen as organised forms and spaces. The idea of configurational analysis is first explained, then a simple example is shown of how cultural patterns in domestic space can be detected and visualised, followed by a complex example showing how deep spatial structures in urban systems can be detected and explained by a process involving visual representation.

Discussions

Software for Visualizing Models

Should we be writing or customizing software? There are lots of benefits in using standard software solutions in terms of putting research energy into understanding processes and not into programming. There is considerable ignorance of the capabilities of the software.

Interaction within the Social Sciences

The workshop offered the opportunity to present ideas to other social sciences in different subject areas. This is useful to develop thoughts and exchange information

Visualization Research in Modelling

There is a need for advocacy to the ESRC to encourage visualization research in modelling — priority of domains concerning cities, human geography, built environment. This needs to be set in the context of priorities for other social science research.

Impact of Network Computing

Working across the WWW will have an impact on social science research and modelling. We need to investigate the technologies, e.g. Java and make people aware of the research applications possible. Collaborative research, sharing of data etc are all of potential benefit.

Issues in Modelling

There is an emergence of microbased data. Our understanding is changed if we have finer grained data. Models can provide greater understanding of patterns and processes with use of suitable techniques and data. There is a large underworked area in looking at networks (e.g. social networks) using visualization techniques.

Qualitative Data

What are the possibilities for using visualization in qualitative data analysis — perhaps video clips in ethnographic studies?

Conclusions and Recommendations

ESRC is encouraged to recognise the importance of visualization research in modelling.

There is a need to raise awareness amongst researcher of the potential of visualization software tools.

There is a need for a study to research the current use of visualization technology worldwide.

We need to illustrate potential use of tools using case studies. A workbook illustrating generic graphics for social scientists would be useful.

Technology

Presentations

coMentor. A Collaborative WWW-Based Virtual Environment to Support Social Science Students — Graham Gibbs, Catherine Skinner, Andrew Teal

The coMentor project is producing a multi-user discussion system for the World Wide Web (WWW) which provides both a collaborative virtual environment where students can take part in discussions on theoretical issues related to the social sciences and humanities, and a set of software learning tools to support their debates. The project has developed software tools using HTML and Java to support access to a MOO (an object oriented multi-user discussion system) using standard WWW browsers such as Navigator and Internet Explorer. This provides a visual, cross-platform and familiar interface to students and allows the use of standard HTML features such as menus, buttons and text boxes to facilitate interaction and easy access to external resources. Enhancements to the learning environment are provided by Java applets some of which will support graphical "learning tools" such as concept mapping and structured argumentation tools, to support the students' learning processes.

Hypermedia Representations of an Ethnography Opening Pandoras box? — Beverley Holbrook, Bella Dicks, Amanda Coffey and Paul Atkinson

Over recent years there have been many innovations in the application of information technology in the social sciences. However, use of information technology has been mostly in improving specific component tasks in the research process such as data analysis, coding of transcripts, word processing or presenting data and information. The development of hypermedia techniques, ie., hypertext and hot buttons creating linkages to sound, video clips and photograpic information has the potential to radically change the nature of the research process, facilitating the collection of a wider range of materials *in the field*. The use of hypertext means that it is possible to create multiple linkages and trails that that constitute complex and flexible pathways through the research material and between written papers and additional information. Thus hypermedia techniques can support new and exciting opportunities for more diverse and innovative representations of the research process. The incorporation of multi-media techniques in the research process can facilitate more open and transparent representations of research. Such representations can also reveal more of the often difficult process of analysis of raw material that is necessary to produce academic texts. This paper described the work about to be undertaken under an ESRC funded project to investigate the ways in which mult-media techniques can be used to represent an ethnography.

Using (Geo) graphical environments on the WWW to improve public participation in social science research — Steve Carver

This paper reviews applications of the Internet and World Wide Web in the social sciences with reference to their graphical and visualisation content. Particular attention is given to recent developments in the use of on-line spatial decision support systems to improve public participation in social science research. Subsequent discussion focuses on (a) the (geo)graphical data requirements of such systems, (b) the potential future role of on-line participatory decision environments in reforming the democratic process, and (c) the social, cultural, political and ethical questions arising from such ideals.

The Application of Computer Aided Design and Animation in Landscape Design Teaching — Andy Clayden

This paper will briefly explore the contribution that computer modelling and animation now brings to landscape design teaching. Central to the work of landscape architecture is the graphic exploration and communication of both emerging ideas and completed design proposals. Developments in computer graphics have equipped the profession with a new set of tools that enable them to explore and present their ideas in a form that is more immediate to the designer and potentially

more accessible to the non expert client/user. The paper will go on to identify how recent developments in internet technology including VRML, Java and Video Conferencing provide an opportunity to develop shared virtual environments which could be used for cross discipline collaboration in design teaching concerned with the built environment.

Using Java to animate an exploratory spatial analysis tool — James Macgill and Stan Openshaw

An exploratory spatial analysis tool known as MAPEX (MAP Explorer) has been developed; see Openshaw and Perree (1997). MAPEX creates MPEG movies of a search for map patterns by a set of smart pattern hunting creatures based on ideas from Artificial Life. The conjecture is that non-expert users may gain some insights into the types and locations of localised patterns in the GIS database by watching computer animations of the search process. The problem was that the complexity and inefficiency of the AVS component used to generate the MPEG movies was so cumbersome that all development of MAPEX ground to a halt. This paper describes the use of Java to provide an alternative animation tool that can be used to avoid the AVS bottleneck in MAPEX and similar GIS related animation needs.

Java offers a number of advantages: it is portable and platform independent, it is fast enough to allow user interaction and interrogation during the playback of stored map animation sequences, and it facilitates distributed experiments with the readers being able to perform their own visualisation experiments. The paper describes how the AVS component in MAPEX was replaced by Java and outlines various planned developments in Java based visualisations related to GIS and the exploration of high dimensionality geocyberspaces.

The Usefulness of CBR and Intelligent Visualization for the Social Sciences Domain — Leonardo Oliveira

This paper suggests an application of Artificial Intelligence (AI) for the Social Sciences domain, which holds visualisation of past experiences. Knowledge in Social Sciences is poorly structured, making it difficult to develop computer algorithms to help the decision-making process. It is a domain highly dependent on experts, who generally take decisions intuitively, with a great deal of reliance on their judgement. It seems to be the perfect scenario for the application of the Case-Based Reasoning (CBR) paradigm. CBR holds representations of past experiences which can be reused to solve problems. Even in situations where no past experiences are available, CBR may help by providing a similar case from which users could base reasoning on and provide a solution. Moreover, continuous use of the CBR, expanding the case repository, can provide a corporate knowledge able to support tasks such as learning and training.

Discussions

The Nature of the Data

Do we have firehoses of data in the social sciences compared with the natural and physical sciences?

Relevant Technologies

The following provide potentiall useful technologies: Java, VRML, AnswerWeb (some work at Edinburgh to add voice mail was noted).

Training and Awareness

There is a need for a central WWW resource for the social sciences — maybe what is needed is more information on SOSIG (not well known by participants) and other relevant services, such as the ESRC's QUALIDATA Service. We need to raise awareness of the potential of WWW related technologies, e.g. VRML, Java. CTI Centres could play an important role in promulgating techniques and tools.

The User Interface

The user can be the author of the end result and can be empowered by the provision of suitable visual interfaces to data. The interface can engage the user in collaborative work, for example in archaeology where a dig is discussed over the WWW and people collaborate in making decisions on where to dig next. There is a huge potential for creating collaborative decision environments on the WWW — intranet and more open WWW solutions.

Copyright and Confidentiality

Collaboration and open-ness may go against the traditions in some areas such as ethnography and we have to be sensitive to this. Copyright and confidentiality are big issues and go outside the scope of this event — but cannot be ignored.

Conclusions and Recommendations

These conclusions came out of 4 group discussion sessions each introduced by a paper. Groups were asked to focus on the questions highlighted below.

Why do we Need Something Different/Special for the Social Sciences?

- there is a need for special software tools and techniques to support the data common in the social sciences (categorical, multi-dimensional, polysemic, fuzzy, multiple interpretation possible, qualitative, most data are "given", society changes)
- there is less computer literacy in the social science communities
- there are no fixed laws as in physical sciences
- concepts may be more abstract
- spatial data presents different problems
- the observer and the observed are both part of some social science research, e.g. ethnography
- the nature of social theory — contested, mutable
- typically support for social sciences in using IT is under-resourced
- there are a number of audiences for the results — researchers, policy markers
- graphics can be data input as well as output (photographs, video)

What Technologies are Important?

- something cheap, easy to learn and on the desktop with a large user base

- ¸universal software applied into the social science domain
- ¸we need packages which can inter-communicate and which can accept user-created macros
- ¸ones which have support for multiple representations
- ¸software with innovative visualization techniques, e.g. pencils, concept maps
- ¸WWW related technologies — VRML, Java
- ¸WWW related tools such as AnswerWeb
- ¸AI applications for images
- ¸digital video
- ¸interactive video
- ¸collaborative systems

How can we Support Social Scientists in their use of the Technologies?

- ¸support needed from faculty/department
- ¸support needed nationally from a WWW based facility
- ¸more visualization is needed for data holdings, e.g. Data Archive as well as archived visual resources
- ¸we need to show people that visualization can help the researcher and the teacher by enabling understanding and to communicate results
- ¸need for nationally encouraged training programme
- ¸seeding of visualisers into departments
- ¸providing case studies illustrating good practice
- ¸offer easily accessing repository of visual materials — role of Data Archive, QUALIDATA?

Specific Action Points

- ¸develop a central resource on WWW (include: online demos, taxonomy of acronyms, glossary with user additions)
- ¸develop collaborative teaching environments
- ¸run a CTI Managers Workshop to promote the use of visualization in the social sciences
- ¸monitor world wide activities in the use of visualization in the social sciences
- ¸disseminate good practice
- ¸run some courses to show the benefits of visualization
- ¸produce some case studies — book, manual of practice

- develop software, e.g. routines for visualization or perhaps add-ons for commonly used packages such as Excel
- run an event on the "Role of the Visual" in a range of areas in social science
- review of software available for social sciences data
- conduct training in WWW authoring
- gain understanding of the role of the various JISC, ESRC, British Academy funded services and projects and how they can assist in the needs outlined in this workshop, e.g. Arts & Humanities Data Service, Knowledge Gallery, QUALIDATA, Data Archive, SOSIG.

General Discussions

The following areas of recommendation emerged from the workshop:

Strategic	• raise the status of visualization in the social sciences • start a change in culture towards accepting new tools • WWW has potential in decision making and data collection • provide national/local support • ensure people are aware of the special nature of social science data
Review	• evaluate the graphics and visualization techniques available in commonly used statistics packages • report on current worldwide activity • review of techniques available and suitable • conduct a WWW search of what is around (SOSIG?)
Training and Awareness	• show social scientists the potential benefits of using visual tools • run WWW, Java, VRML training • get image resources onto the WWW • provide glossary, acronyms — user updated • ensure there is high awareness of resources and services available now (SOSIG, Data Archive, QUALIDATA, AHDS, Knowledge Gallery etc) and encourage funding bodies to take account of the needs of social scientists in their service development.
Networking	• commission case studies of good practice • bring people together who are working in disparate strand of research, e.g. fuzzy data • run an event on the Role of the Visual in a number of areas of social science • hold a CTI Managers Workshop on visualization in the social sciences • create an online journal
Development	• develop techniques for the visualization of social science data, particularly temporal and spatio-temporal • develop suitable WWW based tools • develop add-ons for commonly used packages such as Excel

In discussion it was agreed that priority should be placed on the following:

- an event on the "Role of the Visual" with parallel sessions on different areas of social science should be held

- a WWW and paper resource should be developed to provide case studies and examples of the use of visual techniques in the social sciences

- undertaking a review of current activity — taking account of research and developments worldwide

- running an event for CTI Managers

- building WWW based resources

Agenda for the Workshop

8th May 1997

10.15	*Coffee*
10.45	The Background to the Workshop — Anne Mumford
11.00	Graphics, Visualization & the Social Sciences — David Unwin
11.20	The Themes
	11.20¸Maps — Ifan Shepherd 11.50¸Visualization of Statistics — Brian Francis 12.20¸Models/Simulation — Mike Batty
13.00	*Lunch*
14.15	Group Discussions:
	Maps
	Visualization of Statistics (2 groups)
	Models/Simulations
16.00	*Tea*
16.30	Plenary Report Back
19.45	*Dinner*

9th May 1997

09.15	The Underlying Technologies (Plenary)
	Presentations by: 09.20¸Graham Gibbs 09.40¸Beverley Holbrook
10.00	Introduction to the Groups
10.15	*Coffee*
10.45	Group Discussions (4 groups)
12.30	*Lunch*
13.45	Plenary Report Back
15.45	*Tea and Close*

Group Lists

Thursday

Maps

Leader:¸Ifan Shepherd
Notes:¸Simon Doyle
Presentations:¸Bin Jiang
¸Humphrey Southall
¸Martin Dodge
Group:¸Andy Smith
¸Ben White

Models/Simulation

Leader:¸Mike Batty
Notes:¸Andy Clayden
Presentations:¸Chris Webster
¸Bill Hillier
Group:¸Leonardo Oliveira
¸James MacGill

Visualization of Statistics (1)

Leader:¸Brian Francis
Notes:¸Steve Carver
Presentations:¸Jackie Carter
¸Steve Wise
Group:¸Jingsheng Ma

Visualization of Statistics (2)

Leader:¸Dave Unwin
Notes:¸Anne Mumford
Presentations:¸Graham Upton
¸Robert Inder
Group:¸Beverley Holbrook
¸Graham Gibbs

Friday

Group 1

Leader:¸Steve Wise
Notes:¸Jackie Carter
Presentation:¸Steve Carver
Group:¸Anne Mumford
¸Ifan Shepherd

Group 2

Leader:¸Beverley Holbrook
Notes:¸Robert Inder
Presentation:¸Andy Clayden
Group:¸Simon Doyle
¸Humphrey Southall
¸Chris Webster

Group 3

Leader:¸Graham Upton
Notes:¸Andy Smith
Presentation:¸James MacGill
Group:¸Mike Batty
¸Jingsheng Ma

Group 4

Leader:¸Graham Gibbs
Notes:¸Bin Jiang
Presentation:¸Leonardo Oliveira
Group:¸Dave Unwin
¸Brian Francis
¸Ben White

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References, Contacts and Acronyms

AGOCG & SIMA Reports via the AGOCG WWW pages, paper copies from Joanne Barradell, j.t.barradell@lboro.ac.uk

JISC Five Year Strategy, 1996-2001, available from JISC, Northavon House, Coldharbour Lane, Bristol, BS16 1QD, or at http://www.niss.ac.uk/education/jisc/strategy.html

Multimedia Presentations: Workshop Report, AGOCG Report 29, available from the AGOCG Web site or by emailing Joanne Barradell, j.t.barradell@lboro.ac.uk

AGOCG	Advisory Group On Computer Graphics	/agocg/
ALCD	Analysis of Large and Complex Datasets programme of the ESRC	http://www.esrc.ac.uk/curaward.html
CTI	Computers in Teaching Initiative	http://www.cti.ac.uk/
ESRC	Economic and Social Research Council	http://www.esrc.ac.uk/
JISC	Joint Information Systems Committee of the Funding Bodies, HEFCE, SHEFC, HEFCW, DENI	http://www.niss.ac.uk/education/jisc/
JTAP	JISC Technology Applications Programme	http://www.jtap.ac.uk/
SOSIG	Social Sciences Information Gateway	http://www.sosig.ac.uk/
TLTP	Teaching and Learning Technology Programme	http://www.icbl.hw.ac.uk/tltp
TLTSN	Teaching and Learning Technology Support Network	http://www.icbl.hw.ac.uk/tltsn