Visualisation in the Social Sciences Workshop

Advanced Visualisation and Virtual Reality in the Social Sciences.

Weetwood Hall, University of Leeds,

9-11 September 1998

Introduction

Chair - Dave Unwin, Birkbeck College London

Introduction to Visualisation in the Social Sciences - Dan Dorling

Dan Dorling presented a summary of a review of visualisation in the Social Sciences carried out by himself, Scott Orford and Richard Harris. The cover of this report shows a complex graphic developed by German researchers to demonstrate world trade links. In fact, the graphic is so complex, that it is difficult to extract any useful information from it. This was used to highlight the authors' feeling that there is 'too much visualisation and not enough social science'.

What is social science? The authors accepted that definitions of which subjects made up the Social Sciences could be varied, with the subjects usually assigned to social science faculties in British universities including economics, geography, politics and sociology. For the purposes of the report they included several additional subjects areas, and gave some example uses of visualisation:

- Geography - maps, GIS
- Planning - CAD, VR
- Psychology - graphics and VR within experiments
- History - time geography
- Politics, Economics and Sociology - graphics (e.g., from SPSS and SAS), visualisation of networks
- Social Statistics - visualisation for data analysis

The full report contains a bibliography of over 2500 articles, with many recent papers being available over the WWW. The number of papers now available over the WWW is significant, and it is becoming the dominant form of research dissemination. Of these papers, the majority have been contributed by geographers, because there has been a diffusion of visualisation techniques from the sciences through to social sciences, with those subjects that had the closest links to the sciences, such as geography, making most use of visualisation. Other subject areas are now making more use of graphical and visualisation techniques.

The authors found that there was much overlap and repeated work because researchers were not aware of work that had already been done or which is currently being undertaken. Because there is no 'central core' to the research, they felt there was a clear need for organisations such as AGOCG and interdisciplinary meetings within the social sciences.

Current Visualisation Practice - Paul Ell and Humphrey Southall

Paul Ell and Humphrey Southall presented the results of their survey of visualisation tools in the social sciences. The survey was conducted by means of a questionnaire, multiple copies of which were sent to the heads of department of all social science units in third level teaching institutions in the UK, 780 in total, to be forwarded to interested staff. The questionnaires were also available on the WWW (http://www.qub.ac.uk/ss/esh/visual)in Word, ASCII or HTML, and email questionnaires were also sent.

In order to encourage a wide a response as possible, including users who might be using computer graphics without being aware they were using visualisation tools, responses were specifically invited from users of:

- Spreadsheets - e.g., Excel, Quattro Pro
- Statistical software - e.g., Minitab, SAS, SPSS
- Image processing software - e.g., Photoshop, Lview
- Computer graphics software - e.g., CorelDraw, UNIRAS
- Cartographic software - e.g., GIMMS
- GIS software - e.g., ARCINFO

Over 200 completed questionnaires were returned, mostly using the online form. Only 76 people responded to the written letters that were sent to departments. The limited response rate may have been due to a number of factors including:

- Some of those contacted did not considered themselves to be within Social Sciences
- Requests were not asked for from people not using visualisation tools, though this might have given useful information into the number of people using visualisation in the social sciences
- The questionnaire was fairly long

Results

Feedback was received on 57 different software packages used in over 30 subject areas. The greatest number of replies were received from geography departments, followed by sociology, then politics, economics and archaeology. The most common tools used in geography are GIS tools, particularly ARCINFO and ARCVIEW. Outside geography the most common tools were SPSS and Microsoft Excel. However, it was felt that in many cases those tools were being used for data storage and quantitative analysis rather than for their visualisation or graphics capabilities, indicating that visualisation was not generally used in the social sciences outside geography, except for simple graphs. A number of reasons were suggested for this:

- The cost of software
- Problems of running new software on older machines
- A lack of appropriate software
- Lack of time for people to learn and explore new techniques and tools

Visualisation in the Social Sciences Workshop

Visualization Environments

Chair - Peter Fisher, University of Leicester In this session a selection of the computing environments that are being used for advanced visualisation in social sciences and humanities were explored.

IRIS Explorer - Jason Wood

Iris Explorer was originally develop by Silicon Graphics, but is now available on several platforms, including SUN, HP, Digital and IBM Workstations and Windows NT. It is a toolkit for visualisation, traditionally used in numeric sciences such as physics. It uses a graphical interface in which users select elements and add them to a graphically represented 'pipeline' or map. All the elements are reusable modules, e.g., data reading, data selection, graphing and rendering. A large library of modules is provided with Explorer, but if the required module is not already available, new modules can be written in Fortran 77, C, C++ and possibly Java in the future.

- Advanced features of Explorer include:
- Distributed execution - modules can be run on remote machines
- Encapsulation of maps - for application building
- Support for collaboration

AVS and extensions - Steve Larkin

View slides

XLISP STAT - Chris Brunsdon

LiveMap is a freely available spatial data system which has been built on top of Xlisp, a variant of the Lisp programming language.. It can be used for : exploratory data graphics, e.g., two linked graphics, a scatter plot and a map, where highlighting points on the scatter plot automatically highlights the appropriate region on the map. computational spatial analysis - it allows computations to be coded

It combines visualisation and formal modelling.

In addition to the standard objects provided by Lisp, other objects include: points, lines (e.g., for rivers, roads), zones (e.g., census wards)

Xlisp Stat is available from: http://stat.umn.edu/~rcode/xlispstat-resources.html

Tcl/TK - Jason Dykes

One of the most important aspects of visualisation is the users ability to interact with and explore the data, and increases in computer power have made this possible with much larger data sets.

Tcl is a free scripting language. Scripting languages are easier to use than other programming languages such as C, but ease of use is traded with performance Tk is the companion graphical user interface toolkit to Tcl. Tcl/Tk allows data to be easily explored, for example creating different, linked graphs. Tcl/Tk applications can be encapsulated as stand alone programs.

Tcl/Tk is available from http://www.scriptics.com

VR/VRML - Ken Brodlie

Java - Jo Wood

Visualisation in the Social Sciences Workshop

Advanced Computing Environments - AVS/Express

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Advanced Computing Environments AVS/Express

Steve Larkin

Advanced Visual Systems

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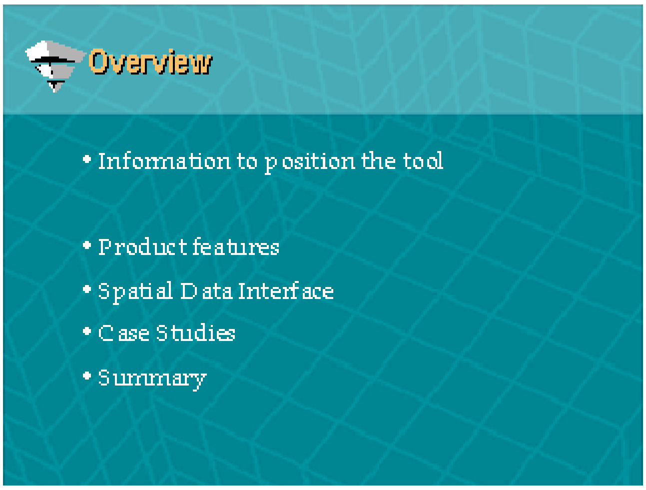

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Overview

- Information to position the tool

- Product features
- Spatial Data Interface
- Case Studies
- Summary

Visualisation in the Social Sciences Workshop: Visualization Environments

Advanced Computing Environments - AVS/Express

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Complete Product Family

End-User

Insight from Data

Developer

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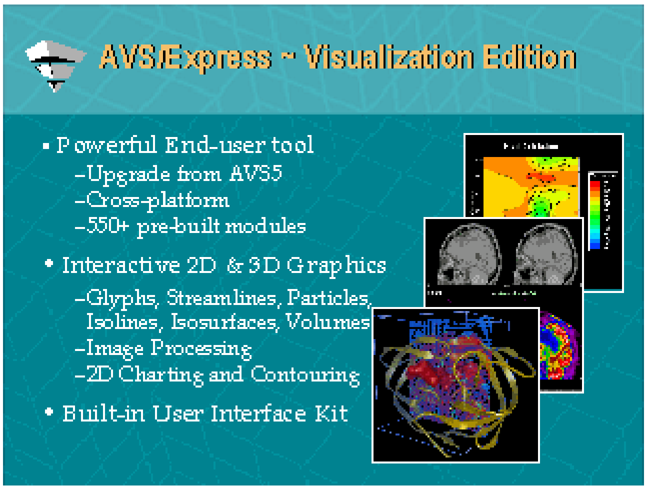

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AVS/Express ~ Visualization Edition

- **Powerful End-user tool**
  - Upgrade from AVS5
  - Cross-platform
  - 550+ pre-built modules
- **Interactive 2D & 3D Graphics**
  - Glyphs, Streamlines, Particles, Isolines, Isosurfaces, Volumes
  - Image Processing
  - 2D Charting and Contouring
- **Built-in User Interface Kit**

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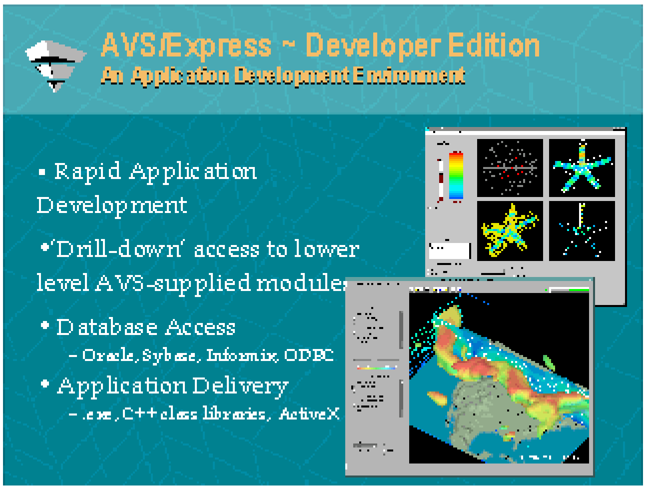

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AVS/Express ~ Developer Edition An Application Development Environment

- **Rapid Application Development**
- **'Drill-down' access to lower level AVS-supplied modules**
- **Database Access**
  - Oracle, Sybase, Informix, ODBC
- **Application Delivery**
  - .exe, C++ class libraries, ActiveX

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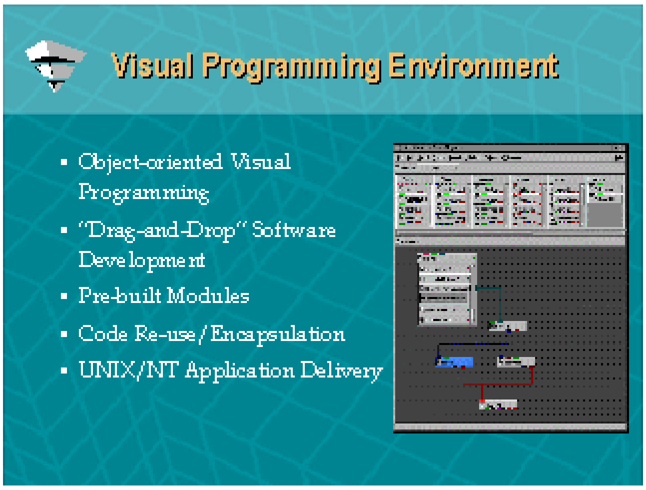

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Visual Programming Environment

- Object-oriented Visual Programming
- “Drag-and-Drop” Software Development
- Pre-built Modules
- Code Re-use/Encapsulation
- UNIX/NT Application Delivery

Graphics Multimedia Virtual Environments Visualisation Contents

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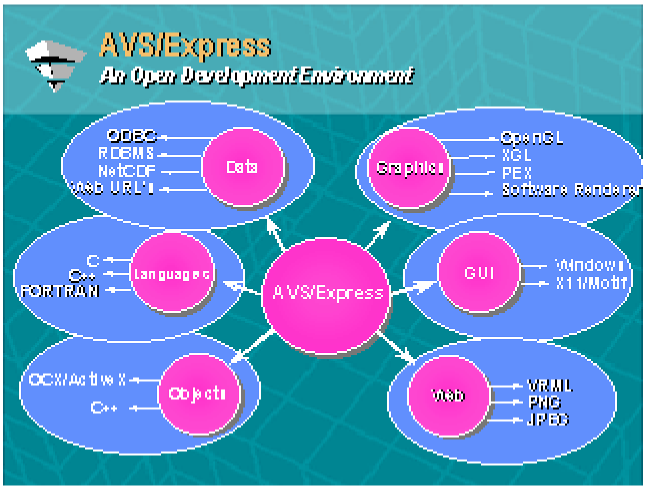

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AVS/Express An Open Development Environment

VRML

PNG

JPEG

AVS/Express

Graphics

OpenGL

XGL

PEX

Software Renderer

ODBC

RDBMS

NetCDF

Web URL's

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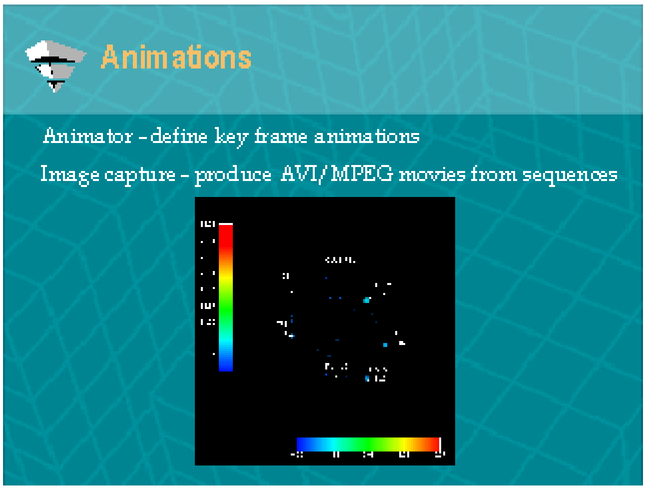

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Animations

Animator - define key frame animations

Image capture - produce AVI/MPEG movies from sequences

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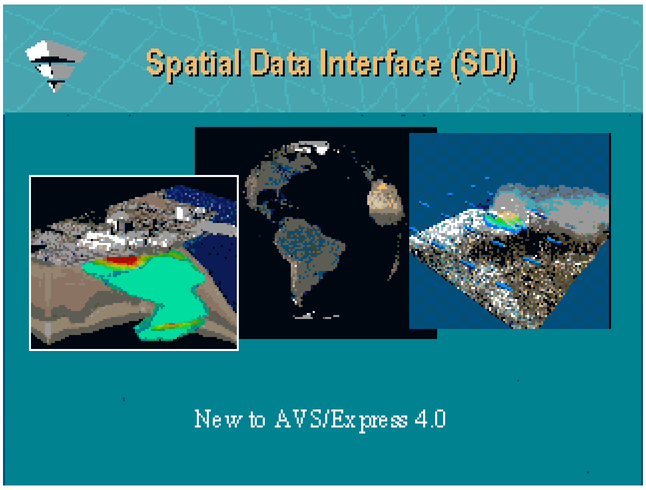

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Spatial Data Interface (SDI)

New to AVS/Express 4.0

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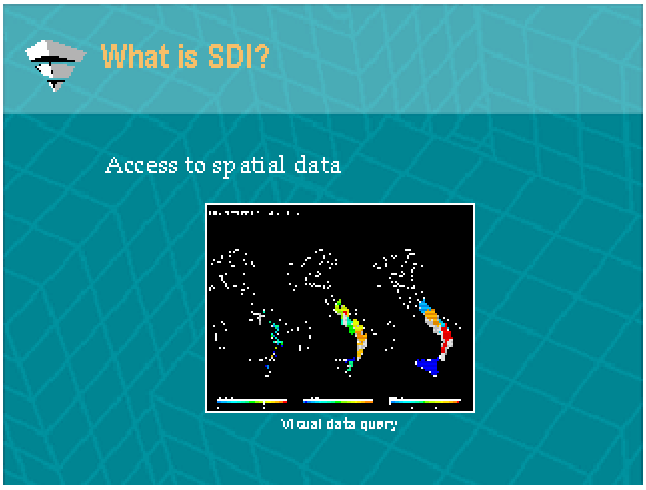

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What is SDI?

Access to spatial data

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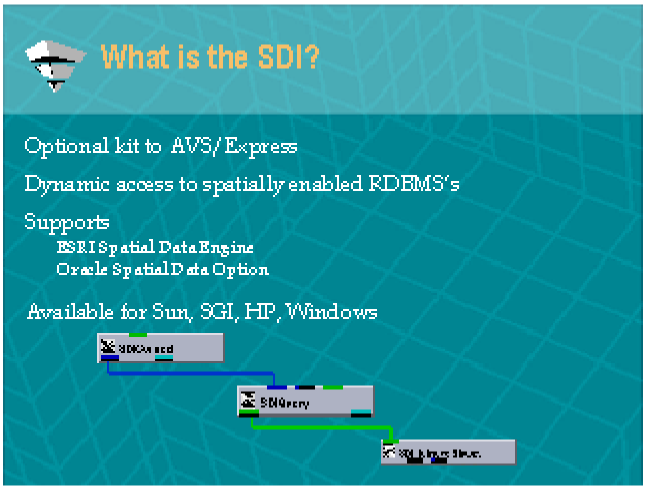

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What is the SDI?

Optional kit to AVS/Express

Dynamic access to spatially enabled RDBMS's

Supports

- ESRI Spatial Data Engine
- Oracle Spatial Data Option

Available for Sun, SGI, HP, Windows

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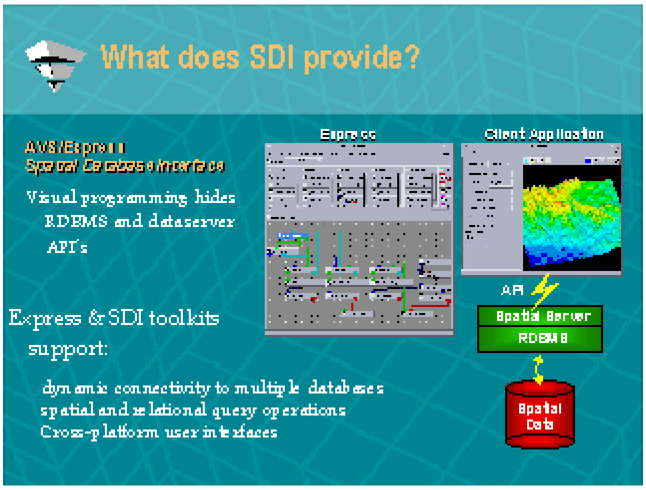
Advanced Computing Environments - AVS/Express



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What does SDI provide?

Visual programming hides RDBMS and data server API's

Express & SDI toolkits support:

dynamic connectivity to multiple databases
spatial and relational query operations
Cross-platform user interfaces

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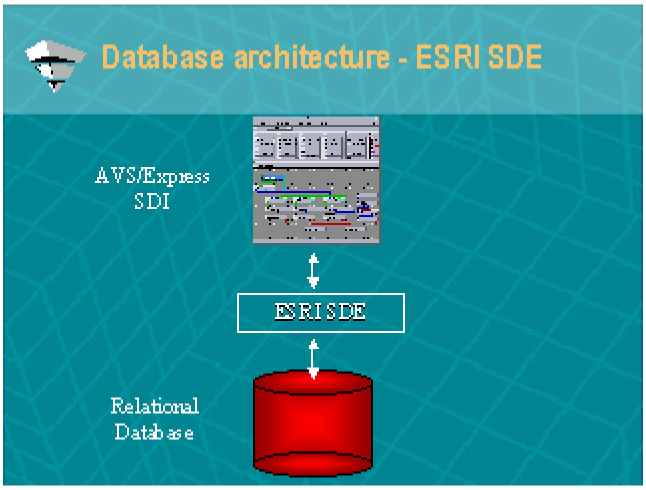
Advanced Computing Environments - AVS/Express



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Database architecture - ESRI SDE

ESRI SDE

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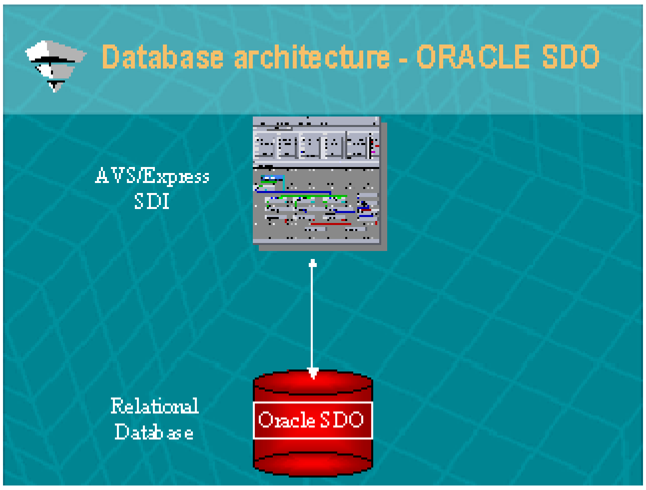

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Database architecture - ORACLE SDO

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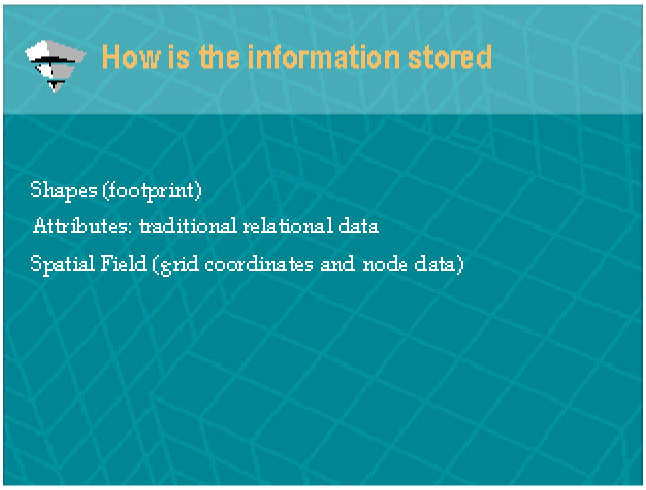

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How is the information stored

Shapes (footprint)

Attributes: traditional relational data

Spatial Field (grid coordinates and node data)

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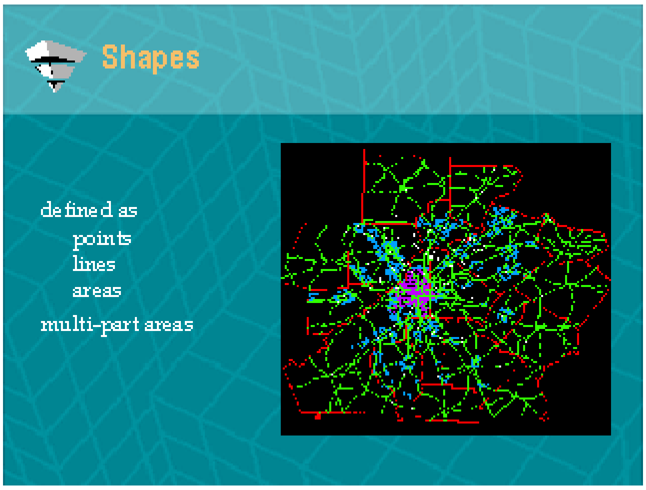

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Shapes

defined as

points

lines
areas

multi-part areas

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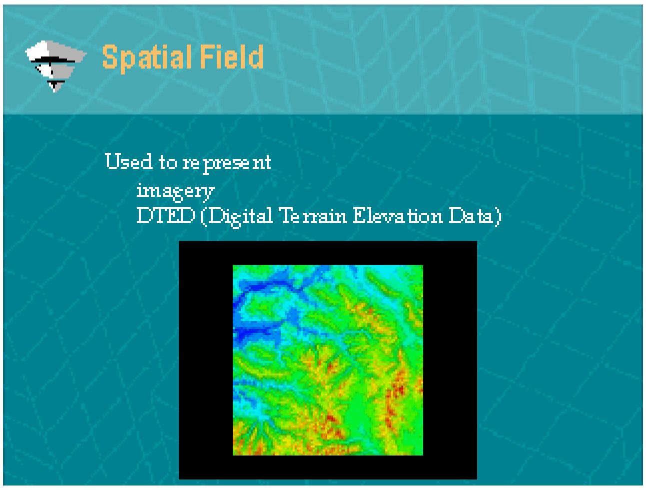

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Spatial Field

Used to represent

imagery

DTED (Digital Terrain Elevation Data)

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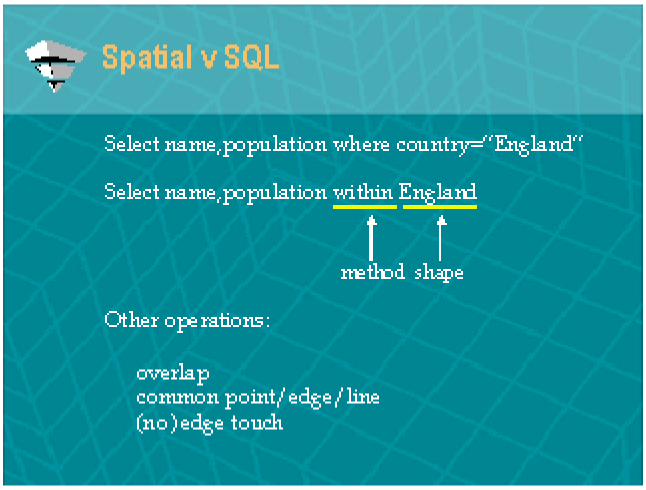

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Spatial v SQL

Select name,population where country=“England”

Select name,population within England

Other operations:
overlap
common point/edge/line
(no) edge touch

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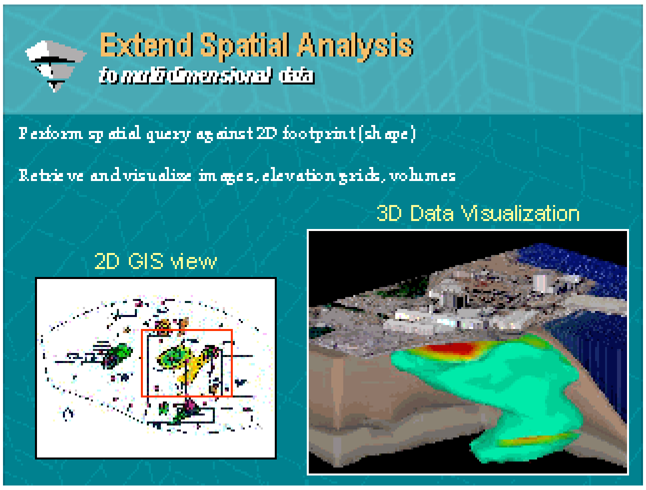
Advanced Computing Environments - AVS/Express



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Extend Spatial Analysis to multidimensional data

Perform spatial query against 2D footprint (shape)

Retrieve and visualize images, elevation grids, volumes

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Advanced Computing Environments - AVS/Express

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How to obtain SDI

Available for AVS/Express - Developers Edition

Need a license for SDO/SDE option

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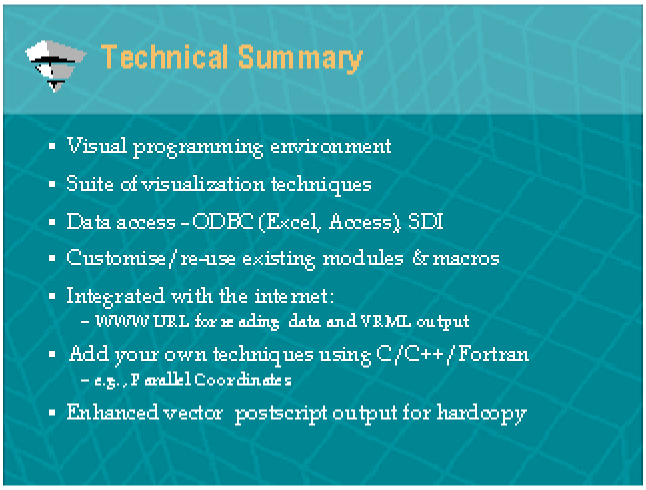

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Technical Summary

- Visual programming environment
- Suite of visualization techniques
- Data access - ODBC (Excel, Access), SDI
- Customise/re-use existing modules & macros
- Integrated with the internet:
  - WWW URL for reading data and VRML output
- Add your own techniques using C/C++/Fortran
  - e.g., Parallel Coordinates
- Enhanced vector postscript output for hardcopy

Visualisation in the Social Sciences Workshop: Visualization Environments

Advanced Computing Environments - AVS/Express

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More information

www.iavsc.org
International AVS Centre
Manchester Visualization Centre
University of Manchester

www.avs.com

Visualisation in the Social Sciences Workshop

Show and Tell

Prior to the workshop participants were asked to submit and original graphic with some text explaining:

- The research or teaching problem it addresses.
- How it helps solve this problem, and
- The tools used in its creation.

For the morning session the workshop was divided into three groups to allow participants to expand on their original text and graphic submissions and demonstrate their software.

- Brendan Halpin
- Sarah Pink
- Dr. Scott Orford
- Bin Jiang
- Ben White
- Professor A. Stewart Fotheringham, Mr. Martin Charlton and Dr. Chris Brunsdon
- Philip Atkinson
- Diego Jiménez & Dave Chapman
- Mr S.M.Wise and Prof. R.P.Haining
- Jason Dykes
- Debbie Crisp
- James Macgill
- Peter Jones
- Jackie Carter
- Kate Moore

Discussion

Chair: Dave Unwin

A plenary discussion followed the 'Show and Tell' sessions to discuss the problems and solutions that had been highlighted by the previous session. Prof. Unwin started the session by listing some of the general issues in visualisation in the social sciences:

Generality
: to what extent are visualisation devices capable of being used generally

Difficult domains
: Most of the visualisation is not of 2 dimensional data, but includes time or space data, and mixed time and space data.

Qualitative
: qualitative and categorical scales are often used to record social sciences data, and these are not handled well by standard visualisation software.

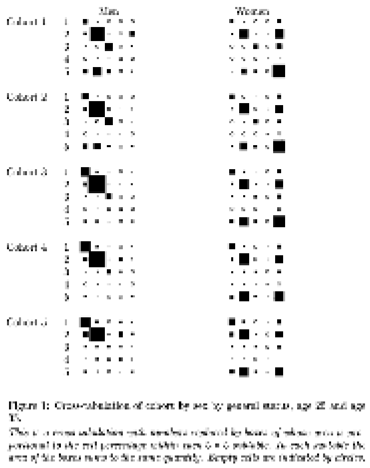
Highly multivariate data
: there is a need to be able to display multiple dimensions simultaneously or provide methods to reduce the data.

Each of the groups then reported back on the problems and solutions that had come to light through the Show and Tell session.

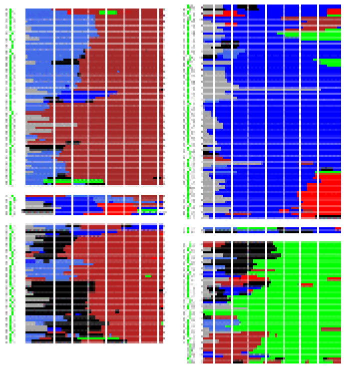
Visualisation in the Social Sciences Workshop

Show and Tell

Brendan Halpin



This graphic is an attempt to present tabular data so that its structure is rapidly apparent. The key idea is to represent the cells as squares whose area is proportional to their value. In this case a four dimensional table -- before and after on a 5-category variable, by sex and cohort (5 categories) -- is presented. The main structure of interest is the before--after relationship and how it is affected by cohort and sex, so the area of the squares sums to 100% within each 5 by 5 panel. It is immediately apparent that there is a very strong before--after association, and that it differs strongly across the sexes and less radically across the cohorts. Squares are chosen, rather than e.g. vertical bars, because of the range of the cell values: with 1-dimensional bars the smaller values would all be near invisible. This was done with Emacs and LaTeX. The postscript file was submitted.



This represents a clustering of sequence data, where the sequences represent individuals moving through an 8-state space over 80 time-units. The sequences have been clustered using optimal matching analysis, and this representation allows us to examine the contents of the clusters visually. Each block represents a main cluster, and within the blocks each line represents an individual's career, each of the 8 states having its own colour. This page is a subset of the approximately 1000 sequences which were clustered. We can readily see the intra-cluster similarities, and the presence of distinct subclusters. The optimal matching and clustering software is PileUp, part of a molecular biology package, but similar things can be done with TDA and standard clustering software. The colorisation was achieved with Emacs, though probably most wordprocessors could be made to do it too. This is attached as a colour PostScript file.

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Visualisation in the Social Sciences Workshop

Show and Tell

Sarah Pink

The work consists of two CD Roms produced at the University of Derby. These were developed for use by researchers and as learning tools for students of qualitative research methods and they focus respectively on the use of photography and video in ethnographic research. The CD Roms contain written academic text, learing exercises and activities for students, video clips and photographs from original ethnographic research in Europe and Africa.

1. The research or teaching problem addressed

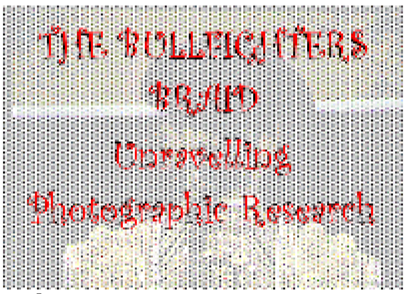
The two CD Roms address a problem that is common to both the representation and teaching of ethnographic work: in the linear presentation of a lecture or an ethographic text it is difficult to acknowledge both the visual domain of research and the multilinear aspects of carrying out research. Moreover it has been argued that students tend to learn in multilinear ways, rather than through the linear progression of knoweldge that is presented to them in the narrative of a lecture series.

2. How it helps solve this problem

Because of its multilinearity and its capacity to store a range of different visual, written and aural texts, the CD Rom helps to solve this prblem in the following ways. First, it allows students to engage with both written, oral and visual aspects of the research process (for example by using video clips, photographs, diary entries from the fieldwork as well as more formal academic texts and learning exercises). It allows students or researchers to do this in such a way that, through hypertext links, they may explore the research process by creating their own routes through the multistranded text, rather than having to follow the single linear narrative of the lecturer.

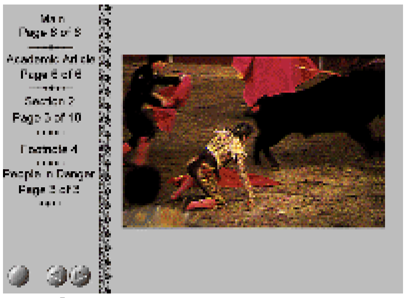
3) The two CD Roms were produced at the University of Derby using authorware software.

Sample screen snapshots from the CD



Title Page

Main navigation page



People in Danger

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Visualisation in the Social Sciences Workshop

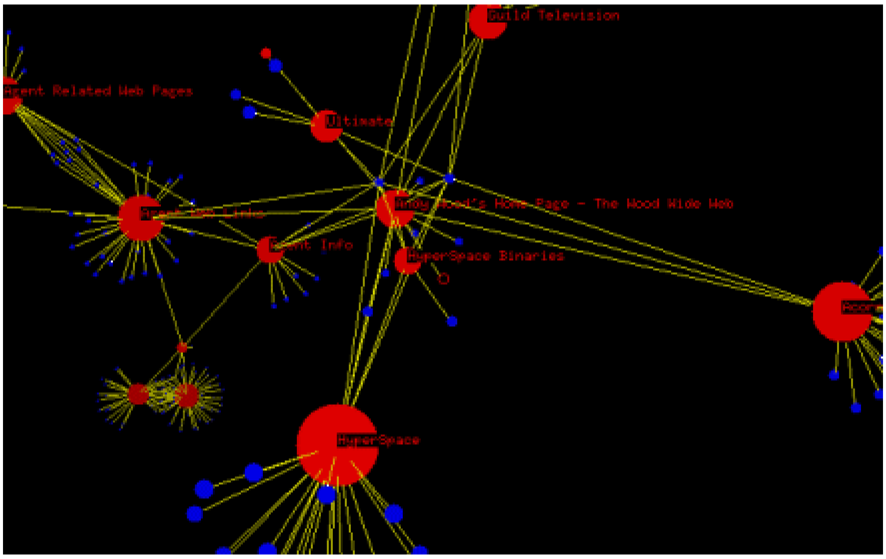
Show and Tell

Dr Scott Orford

Due to its highly graphical nature and its multimedia content, a consensus exists that the World Wide Web is an ideal medium for conducting visualization research, and for the dissemination of its findings. Many advanced forms of data visualization and graphical interaction can now be used, or at least demonstrated via the web. Therefore, as part of the AGOCG review on the State of the Art, a comprehensive list of websites that act as 'gateways' to social science visualisation research was compiled. Such gateways are important. Clicking one's way through the web can be very disorientating, commonly leading to dead-ends or irrelevant information. This 'show and tell' presentation will discuss the 'Top 10' websites in this list, illustrating some of the problems faced when viewing and interacting with visualization based websites. These include websites relating to specific visualization research projects, home pages of specific individuals who have undertaken visualization research and companies and government organisations developing visualization tools and technologies.

These websites also act as gateways to a vast amount of graphical and visualization software, and also teaching materials, which can often be downloaded free of charge. However, the range in quality of the software available at these sites is huge, with a significant amount produced to satisfy a specific research project. The problems of using such free software for research projects other than those it was designed for shall be discussed.

The graphic accompanying this presentation illustrates an attempt by researchers at the Geometry Center (http://www.geom.umn.edu/docs/research/webviz/) to visualise the Web in three dimensions using hyperbolic visualization techniques. The Web is far too large to see all at once, but 3D graphical representations can be built into sections of it (known as Weblets), and viewed in a 3D Web browser. Such browsers are becoming more common with the growing availability of VRML, and may influence the future use of the web for visualization research.



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Visualisation in the Social Sciences Workshop

Show and Tell

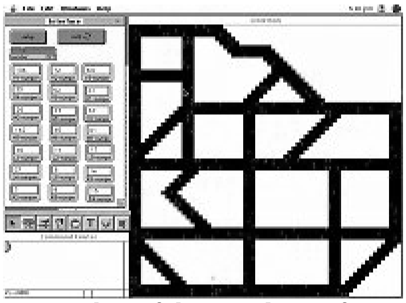
Bin Jiang

Advanced Visualisation and Virtual Reality for Exploring Complex Social Phenomena

Summary

This demo is trying to show how advanced visualisation and virtual reality are used for exploring the complex social phenomena, i.e. using multi-agent simulation to simulate human social activities in urban systems. The basic hypothesis behind the simulation is that whether urban morphological structure has some impact on human social activities. It has been proven in space syntax (Hillier and Hanson 1984) that there is a relationship between urban morphological structure and the social activities. Here with advanced visualisation and virtual reality, the hypothesis is re-examined in a virtual urban environment. In this submission, we show a snapshot of the simulation and a short explanation, but we will bring our computer for a live demo in the 'show and tell' session.

Graphics


A snapshot of the simulation for pedestrian crowds

Multi-agent simulation

Drogoul and Ferber (1994) have summarised multi-agent simulation as a set of the following elements: agents, behaviours, objects, environment and communications. Four of them are described by the quadruplet:
>*agents, objects, environment, communications*<
where *agents* is the set of all the simulated individuals, and behaviours are properties of agents; *objects* is the set of all represented passive entities that do not react to stimuli(e.g. buildings, street furniture in urban environments); *environment* is the topological space where agents and objects are located, where they can move and act, and where signals (sounds, smell, etc.) propagate; and *communications* is the set of all communication categories, such as voice, written materials, signs, etc.

An example

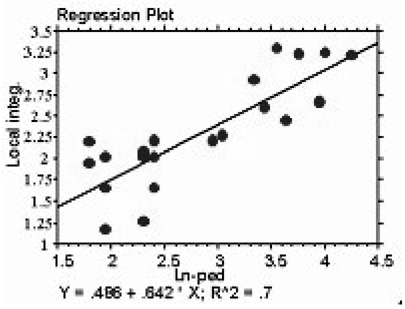
A virtual urban environment is constructed with the four classes of objects: agents are named as red people with the behaviour of speed, heading and movement; objects are churches, hotels, monuments, post offices etc.; the physical urban space looks rather regular consisting 21 streets whose morphological properties are described by space syntax (Hillier and Hanson 1984);

Table 1: Instances set in the example

Classes	**Instances**
Agents	red people behaviour: speed (up | down) heading (0 - 360) movement (forward | backward)
Objects	church, hotel, monument, post office, school, library, park etc.
Environments	urban space with 21 streets as in figure 1
Communications	between red people between red people and the urban space

The simulation consists of two parts, as you can see in the above figure. The right hand is an urban space, within which pedestrians are pictured as red. The left hand is the control panel. The setup button creates the number (as shown in scale bar named as number) of red people walking in the urban space. The walk button keeps all red people continuously moving around, and counts the number of pedestrians per time unit in each street, as shown in the monitor tools.

The result



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Visualisation in the Social Sciences Workshop

Show and Tell

Ben White

Building a prototype electronic atlas using Tcl/Tk

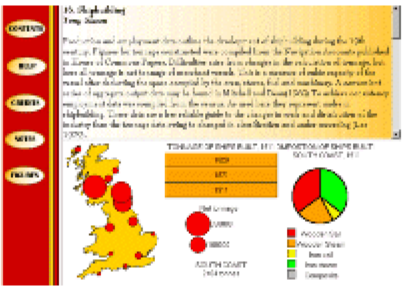
For the last two years I have been working on a JISC JTAP funded project titled 'Authoring methods for low-cost electronic atlases of change and the past'. In broad terms this work has involved a review of potential file formats for electronic atlases, ranging from static bitmaps, through animated movie formats, like MPEG, to fully interactive dynamic mapping using Tcl/Tk and Java. The potential of these formats has been tested in a prototype electronic atlas. This atlas was based upon an existing paper atlas, the Atlas of Industrialising Britain (Langton and Morris 1986). It was hoped that by replacing existing maps with our own visualisations but leaving the existing text we would be able to test potential file formats on real students during their normal learning experience.

BACKGROUND

This work stems from the realisation that there is no effective means for publishing map based research. The traditional publication form, paper atlases, have become too expensive to produce. Major commercial atlases, such as, the Times Atlas of the World costs £85.00. In the academic market, attempts to keep costs and price low have resulted in small page, black and white atlases being produced. In practice colour has all but disappeared from the medium of the academic cartographers. GIS based atlases have been suggested as an alternative. GISs however, are too expensive, they require a higher degree of user skill and require the distribution of boundary and attribute data to the user (with all its associated copyright implications). This centered our research on low cost alternatives, most obviously the web.

SUBMITTED GRAPHIC

My submitted graphic is actually the prototype electronic Atlas of Industrialising Britain. Although, this is significantly more than one graphic it represents a clear problem and research conclusion. In particular the chapter on Shipbuilding extensively uses Tcl/Tk to enhance the map based information.



Click on the image to see a full size screen snapshot of the site, or follow the link below to the actual site.

http://www.geog.qmw.ac.uk/aib/chap16/format16.html

(Please note: the Tcl/Tk plug-in will be needed to view the site)

This page loads the standard user interface of the electronic atlas. Visible are three frames, the left frame is used for basic navigation through the atlas. The top frame contains the original text of the atlas. This has been enhanced by hyper-linking the figure numbers to load the corresponding figure into the bottom frame.

When the page is loaded the first map referred to in the text is loaded into the map window (This represents my one graphic submitted). In this case the map is of shipbuilding production, 1820-1911. The user can select the year they wish to view by clicking the mouse on the dated buttons. This automatically changes the circle sizes on the map and updates the map legend. As the user moves the mouse over the circles on the map the name of the place and the exact tonnage built is displayed in the tclet. If the user clicks on any of the circles a pie chart showing the type composition of the ships built is displayed. (N.B. In 1820 all the ships built were wooden sailing ships and consequently all the pie charts are completely red.)

This work is an adaptation of the cdv work of Jason Dykes (Project Argus). Our work differs from cdv in two major ways. Firstly, we are providing a teaching resource not a visualisation toolkit. Secondly, our work is designed to be made available over the web. These two differences necessarily required us to simplify the number of options available to the user, in the first instance to improve usability for untrained students, in the second instance to reduce the amount of code in the example and consequently, the size of the file that has to be transferred across the internet.

This example represents the tip of our research covering visualisation of historical (time series) data, electronic atlases and the effective dissemination of map based visualisation research in the academic community.

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Visualisation in the Social Sciences Workshop

Show and Tell

Professor A. Stewart Fotheringham, Mr. Martin Charlton and Dr. Chris Brunsdon

Two suggested topics to be presented at the Advanced Visualisation and Virtual Reality in the Social Sciences Conference

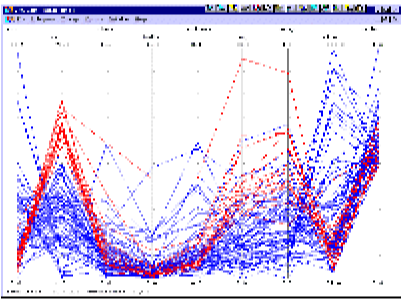
Topic 1: A 'Spatial Microscope' using GWR

(graphic will be prepared for the conference)

Geographically Weighted Regression (GWR) is a statistical technique developed by the authors to allow spatial variations in relationships to be mapped as surfaces. Ordinary regression using spatial data allows the estimation of one set of parameter estimates with each estimate being an average value representing an assumed uniform relationship over space. This is the starting point of the spatial microscope because the surface represented by this parameter estimate is a flat plain with no features. It is akin to looking down a microscope which is completely out-of-focus and no detail can be seen on any spatial differentiation of the surface. GWR proceeds by estimating regression relationships 'around' each point on the surface so that n parameter estimates are obtained for any relationship where n is the number of points defined at which the regression is undertaken. The flexibility of GWR, and the utility for the graphical display proposed here, is that the definition of 'around' can be altered to show increasing amounts of detail. If very broad spatial kernels are selected around each point, the surface of parameter estimates that results has relatively little detail on it. As the kernel becomes smaller around each point, equivalent to focusing the microscope, increasing amounts of detail on the spatial non-stationarity of the parameter surface becomes obvious.

Our graphic will demonstrate the spatial microscope using primary school performance data for 3,687 schools in Northern England. We will examine the determinants of school performance in terms of various socio-economic factors of school catchment areas. The spatial microscope will operate with a slider bar indicate the size of the spatial kernel and the resulting amount of detail on the surface. We will demonstrate the increasing amounts of detail present in the spatial parameter surface as the microscope is 'focused'.

Topic 2: A demonstration of parallel co-ordinates



An alternative exploration of the school performance data described above is provided by the display of the data on parallel co-ordinates. The attached graphic demonstrates the relationship between school performance for 84 highly performing schools and eight possible explanatory variables. The graphic will be described and demonstrations of how aspects of the data can be selected and highlighted to tease out relationships. The display will be done interactively to demonstrate the full capabilities (and the problems) with this visualisation technique. Further details of parallel co-ordinate displays are presented in the Visualisation report from Fotheringham, Charlton and Brunsdon as part of the previous AGOCG funding round and which is being discussed by Professors Unwin and Fisher at this conference.

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Visualisation in the Social Sciences Workshop

Show and Tell

Philip Atkinson

Visualising the distribution of infectious diseases: an example using density estimation to examine the pattern of hepatitis A

The Problem

Epidemiologists are trained to ask three questions; who, what and where (Last 1988). The where question can reveal unusual clusters, helps to evaluate locality based interventions, and often forms the basis of risk associated hypotheses. The value of this geographical analysis has been clearly demonstrated in the work of Snow (1855), De Kruif (1926), and Burkitt (1970).

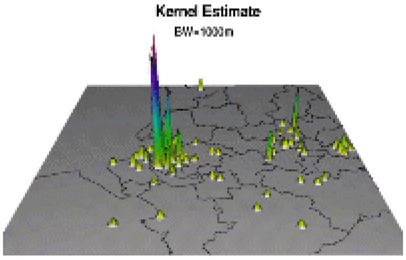
The Royal Mail Address Manager (Post Office 1985) provides a 100m Ordnance Survey grid reference for each postcode in England and Wales (Raper et al. 1992), and allows epidemiologists to geo-reference disease cases in a quick and simple manner. By placing a symbol at the location of diseased individual, the spatial distribution can be examined. Unfortunately there are problems associated with the visualisation of individual based symbol distributions.

Firstly, each postcode uses one grid reference to describe the spatial location of a group of households. Each case in the group of households will have the same location, appearing as just one map symbol. The reader cannot determine if one symbol describes one case or multiple cases. Secondly, the distance between symbols in high disease incidence areas can be so small to make them appear as one. It becomes extremely difficult to visualise the degree of disease intensity in areas of high infection.

These visualisation problems are common to all individual based symbol distributions. This paper is concerned with infectious diseases, in particular hepatitis A. Infectious diseases by their very nature have a tendency to cluster, making the problems of multiple representation and high symbol density particularly troublesome.

The Solution

One solution to these problems are the techniques of density estimation (Silverman 1986, Bithell 1990, Diggle 1990, Brunsdon 1991). These attempt to measure the density of a point distribution at a series of sample points across the area of interest. These sample points are located so that they describe a two dimensional density surface representing spatial variation in the intensity of the spatial process that is assumed to operate. Surface "height" will vary with local disease incidence even if cases are located at the same geographical point. Visualisation of the density surface thus provides good indicators of the overall variation in true disease density and detail in areas of high density.



The density surface can be viewed in either 2 or 3 dimensions. In two dimensions, either choropleth shading, contouring or bubble plots can be used. This approach fits current convention in health service mapping, and allows recognisable features to be easily drawn on top of the surface to assist the reader locate the map in real space.

While two dimensional visualisation may be sufficient for the majority of density surfaces, infectious disease surfaces cause a particular problem. The clusters inherent in infectious disease surfaces lead to extremely "spikey" surfaces, with large density variations over small geographical areas. Using two dimensional visualisation methods it is difficult to determine the degree of variation in places with high disease incidence; places of particular interest to epidemiologists.

The graphic associated with this paper shows the distribution of hepatitis A in NW England based on data from the National hepatitis A case-control study in 1990-91 (Atkinson and Unwin 1997). The spikey distribution of the density surface meant that 2D visualisation proved inadequate. Three dimensions allows the reader to determine variations in density in high incidence areas, for example within the city of Liverpool, and encourages further exploratory data analysis as the surface can be rotated and viewed from many different angles.

The tools

The different density estimation programs were written in the MapInfo programming language MapBasic. The results were exported to the public domain GIS package GRASS with the Silican Graphics SG3D extension for visualisation and exploratory data analysis.

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Visualisation in the Social Sciences Workshop

Show and Tell

Diego Jiménez and Dave Chapman

Visualizing 3D spatial patterns of archaeological assemblages

Abstract

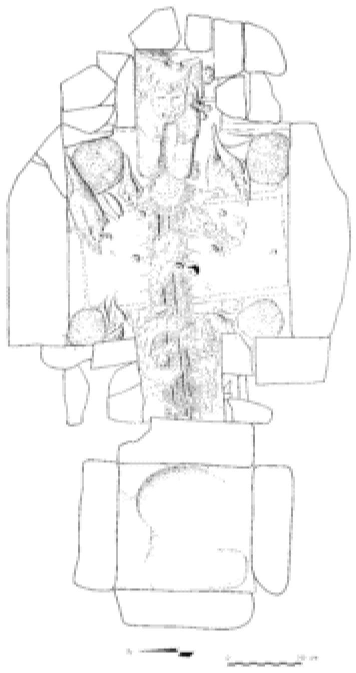
Recognising spatial patterns between artifacts is one of the major challenges in archaeological research. The task includes both the identification of meaningful spatial relationships and a clear visualisation of such connections. The traditional approach to the problem involves the application of nearest neighbour analysis or other statistical techniques for defining clusters, as well as the production of dendograms for displaying results. However, such procedure has not always been totally successful for isolating meaningful relationships.

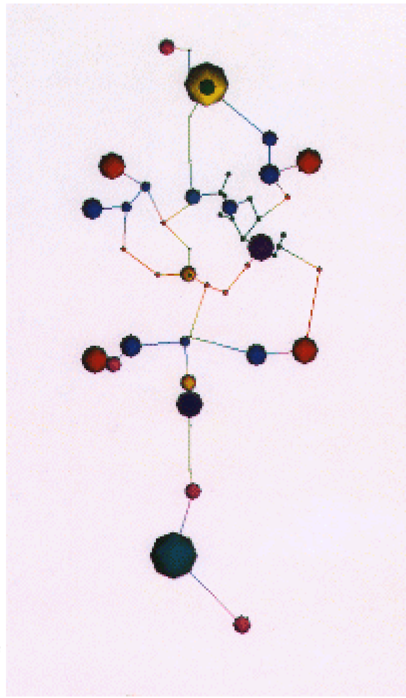
In this paper we will present a new alternative solution. Firstly, we extract three dimensional spatial relationships between artifacts using the so called Proximity Graphs (Gabriel Graph, Relative Neighbourhood Graph, Beta-Skeleton, etc.). Secondly, we implement generic tools to visualise the patterns interactively using IRIS Explorer.

Proximity graphs were developed in Computational Geometry to solve connectivity-related problems. They allow the identification of links between objects through the analysis of their topology at different levels of resolution. Therefore, they are useful for analysing the characteristic "shape" or structure of a set of points. Since the analysis is based on points, and points can represent many different things, the solution offered in this paper has many applications in other scientific fields.

As study case we have chosen a group of 120 archaeological offerings from the Templo Mayor of Tenochtitlan (Mexico).

Mexica offerings have been described as collections of artefacts whose topology is highly relevant to descipher their meaning. It has been said that the semantic value of every artefact depends not only on the symbolism of the object itself but also on its position and connections to other objects. In contexts like this, the identification and especially the visualisation of all possible meaningful relationships become a critic condition for a successful interpretation.





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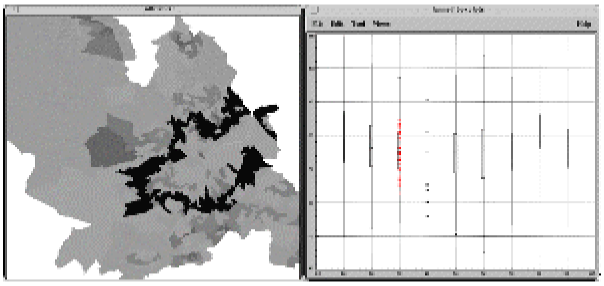
Visualisation in the Social Sciences Workshop

Show and Tell

Mr S.M.Wise and Prof. R.P.Haining

Example of Visualization of Social Science Data



Our work has focused on methods and tools for the analysis of area-based data, particularly in connection with GIS. The image is a screen shot from a piece of software called SAGE (Spatial Analysis in a GIS Environment) developed by us with funding from an ESRC grant.

Widely available software for analysing spatial data falls generally falls under one of two categories:

- GIS, which are good for display and for certain types of analysis (typically based on spatial queries and map manipulation)
- Statistical or specialist software, which provide good numerical analysis techniques, but are generally weak in display and visualization methods.

SAGE was written to bring together the strengths of both types of software, by linking a purpose written suite of spatial analysis tools with a GIS (ARC/INFO). An important element of SAGE is the provision of tools for supporting visualization, since such tools are extremely important in undertaking exploratory spatial data analysis, and in assessing some elements of model fit in confirmatory approaches.

The image shows a map of Sheffield on the left, divided into 200 regions. Within each region information is available on the proportion of women who have used the breast cancer screening service offered by the local health authority. All women over 30 are eligible to use this service, but the proportion who choose to do so varies widely across the city. One possible explanation is the time taken to reach the only screening unit, located just west of the city centre, from different parts of the city. In order to explore this hypothesis, SAGE has been used to look at the variation in uptake rate of the service with distance from the unit. Each of the boxplots on the right is a summary of the rates in regions at increasing spatial lags from the region containing the unit - the first is for immediate neighbours, the second for second order neightbours etc. The third boxplot has been selected in the graphics window - since the two windows are linked, this causes all the regions to which this boxplot relates to be highlighted on the map. This is a means of checking that lag order is a reasonable approximation of distance from the unit. The graph itself indicates that there is no clear relationship between lag order and uptake, suggesting that distance from the centre is not a major factor in women's decision whether to attend for a scan.

This is a simple illustration of how a visual technique can provide useful insight into spatial patterns and illustrates the following features of SAGE:

- SAGE has a regionalisation module which was used to group the original 1150 Enumeration Districts into 200 regions, in such a way that the regions are homogeneous in terms of levels of material deprivation, have equal numbers of women eligible for screening and are compact in shape.
- The ability to produce general statistical graphs (histograms, scatter plots, boxplots) and map views of the data
- A client server architecture which links the graphical windows with the map window drawn by ARC/INFO. Highlighting items in one window, causes the relvant items in all other graphical windows to be highlighted.

- Information from the GIS about the spatial contiguity of the areas is used to produce the lagged boxplots.

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Visualisation in the Social Sciences Workshop

Show and Tell

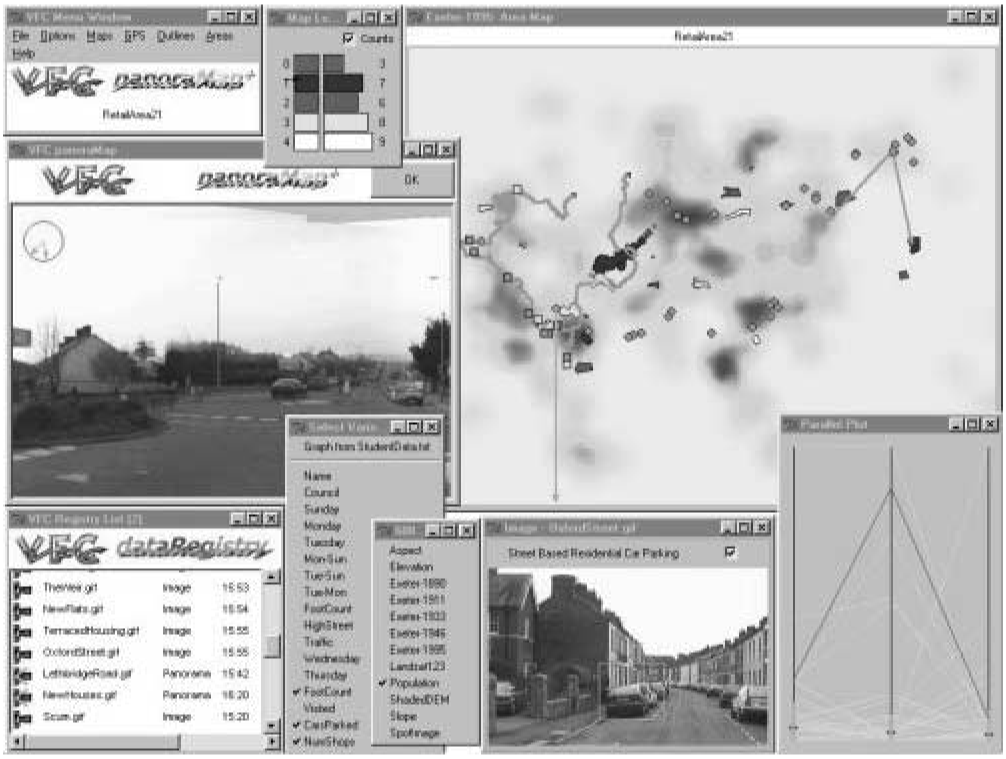
Jason Dykes

VFC panoraMap: Distribution of Retailing in Exeter

This image shows the Virtual Field Course (VFC) panoraMap software being used as part of a fieldwork teaching module o

The software employs dynamic and linked views to privide an extremely interactive spatial graphical user interface (GUI) to

Those illustrated here include rotating panoramic imagery, annotated static imagery, static raster maps, dynamic polygon ma



Click on the star for

The Research / Teaching Problem Addressed:

The VFC project is addressing the use of IT in fieldwork within the areas of visualization and virtual environments.

The project is aiming to produce generic software that can be filled with specific data and thus used to support the aims project in a variety of geographic areas.

The software is intended to be used before, during and after trips in order to prime students, enhance their work in the fi

Interactive software with which students can familiarise themselves with field areas and available secondary data sets is This provides students with a geographic context that adds value to the process of selecting and collecting primary data

Enabling students to integrate their data with secondary information is also of great value, particularly if the process is i tests have confirmed that this form of immediate visual data integration can produce improved and informed analysis an

It is also apparent that the degree of 'ownership' afforded by projects that incorporate analytical software that integrates

The image shows the 'panoraMap' software that was employed on a 1st year Field Trip to South Devon made by the Uni during the Easter Vacation, 1998.

For further information on the VFC and its software see: www.geog.le.ac.uk/vfc/

How The Probem is 'Solved':

The approach is demonstrated here by showing software with current status 'prototype'. It has however been tested with

One of these requires students to establish a categorization of retail areas in the City of Exeter. Students are then asked compare the distribution with models with which they are familiar and to determine the geographic phenomena that may also provided with the City Council's own categorization which is assessed.

Student groups are provided with a computer at the field centre and use the panoraMap GUI to familiarize themselves w

Backdrop maps, such as the population density map shown here (top right) are provided along with census data. Only o avaliable at the click of a button and are listed here (bottom centre). Outlines of the retail areas that are being assessed a software.

PanoraMap also stores multimedia information. Media objects such as the images shown here are viewed by clicking th file names in the data registry (bottom left). Each medium has a 'viewer' to display the information which has dynamic l 360º panoramas can be moved interactively (image, left) and the field of view is shown on the base map (top right). Stat annotations to be made (bottom centre). The bearing at which any image is taken is shown on the base map (orange arro on a previous days fieldwork where residential areas where assessed and 'residential profiles' produced along specified r

The students organise themselves into groups to cover the mapped area and decide what data will be collected and how. collected data and a digital camera to collect imagery. Traditional notebooks and dictaphones are provided to record info

On returning the student groups meet and produce a table of numerical information about the retail areas. This is then re and provides interactive visualization tools. Here, the polygons on the map and bar-chart legend (top centre) show a cate might also show continuous information with grey-shading. Each column in the data table can be visualized in this way can be edited from the map and new data tables can be loaded interactively for comparison. Students can thus compare t institutions and use a spreadsheet or editor to create new data combinations and load them.

The GPS retains a position continually and so student's routes can be loaded from it into the software on their return! (to comparisons between 'the field' and the map representations of it. The GPS also eases data input as students record poin with the GPS. They could then add files by clicking these mapped points and using a 'windows' GUI to add selected file the ground.

A variety of graphical analytical techniques are being developed. Students can use parallel coordinates plots (bottom rig have collected. Here the axes show 'number of High Street Chains', 'number of passing pedestrians' and 'number of car-p such plots intuitive and informative ways of differentiating between types of retail area and were excited to see their dat density surface shown here. Considerable questioning of the patterns, the models and the Council's information resulted

Tools Used in Creation:

- Programming Language: Tcl/Tk. Free from www.sunscript.com
- Peripheral Gear: GPS 12 XL from Garmin (£200ish)
- Peripheral Gear: Olympus C800L Digital Camera (cheaper one will do!)

Visualisation in the Social Sciences Workshop

Show and Tell

Debbie Crisp

The Research Problem

I am currently working on a project which involves designing a website. The Domestic Violence Data Source (dvds) is a data co-ordinating system, which will provide up-to-date information about domestic violence in England, Wales, Scotland, Northern Ireland and Ireland. It will collect, collate and monitor data on all projects relating to domestic violence within its target region, complementing and supplementing existing initiatives. It aims to build on good practice, look to assess unmet needs, and help to inform innovative future work by researchers and practitioners in the field. It will also provide information for those who either are experiencing or have experienced domestic violence.

I am undertaking a data collection exercise (a sort of huge literature review) and simultaneously trying to develop the site (see Figures 3 and 4 below). I need a mechanism that allows me to design organically as I am unsure how much information I will eventually have, or - until I know what data are available - exactly which subjects the dvds will cover. At the same time, the design process needs to be fairly structured, so that I do not have to continually re-code information as the site grows. I also need to be able to draw the relevant links between pages.

It is also important that I don't inadvertently prioritise particular subjects or the needs of any one group of users: all bits of information need to be readily available. They also need to be accessible from more than one direction (one user may want to see the overlap between the use of health services and involvement in the criminal justice process; another might wish to look at the overlap between involvement in the criminal justice process and the use of health services………). Using numbers or the alphabet could seem to do impose a hierarchy on the data on the site (the assumption would be that page A was more important than page Z etc). Further, new subjects may fall between existing categories, so that all the data eventually clustered around particular numbers. For example: if 'housing' is coded '2' and 'benefits' are coded as '3' , housing benefit might become 2.5, housing benefit for accommodation in a refuge 2.51 etc etc etc. Such a framework would not aid clarity of thought, and would lead to a muddled site.

The Solution

I have decided to use the sets of symbols available in my word processing package - which include for example '*', ‰, '∉' and '⌘'. Each symbol is allocated to a particular subject (see Figure 5 below). For example:

'ς' = REPEATED PATTERN OF BEHAVIOUR
'✗'' = PYSHOLOGICAL/OTHER NON-PHYSICAL INJURIES
'✱' = PHYSICAL ABUSE
'_' = UNACKNOWLEDGED/HIDDEN VIOLENCE
'⌉' = LESS THAN FIVE YEARS DURATION

These could be combined in any number of ways but would always be equivalent (see Figure 1 for the ways in which symbols may inter-relate):

ς✗✱_⌉   ⌉✗ς✱_   ✱ς✗_⌉   ς✱✗⌉_   _ς⌉✗✱

They would all be looking at the psychological impact of repeated physical abuse over a number of years. It is harder to think of them as the same if numbers are used instead:

12345 52134 31245 13254 41523

These symbols can be mixed in with numbers and letters and still create a non-hierarchical coding frame (because it is gibberish if you try to read it in any other way than as codes):

ς2*d˥ ˥2ς*d *ς2d˥ ς*2˥d dς˥2*

It is also very easy to work out which other sets of pages need to be linked to any new data: '*' links to any other '*' pages, '⌿' to any other '⌿' etc.

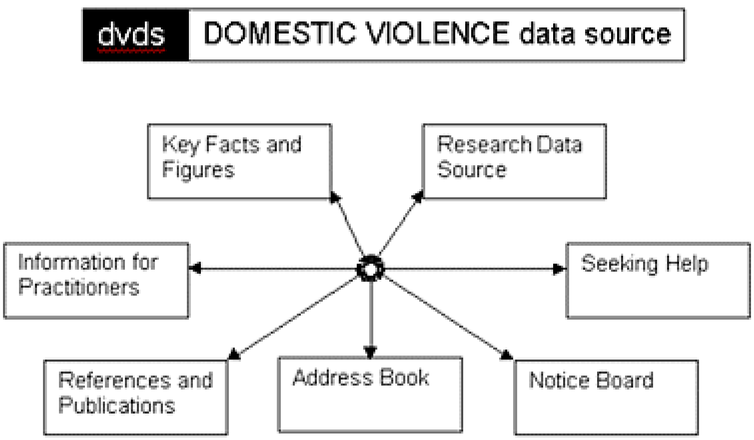
It is of course important to keep track of the symbols used, and to make sure that duplications are avoided (see Figure 2)

Tools used

I used Microsoft Word to design the coding frame. The idea came from playing patience with a pack of cards: in patience you start with cards in a completely random order, and then end up with four neat piles. With a website, you have to have your data in neat order, but it will be accessed in completely different ways by different users.

Figures

Figures 1 - 3 are available as a Microsoft Word or RTF document



The dvds website will be divided into the following spaces, all of which interlink:

Key Facts and Figures - a summary of current issues and existing material information on domestic violence

Research Data Source - information about and reviews of ongoing and recent work, this space would also include a research 'wishlist', and a selection of useful research tools

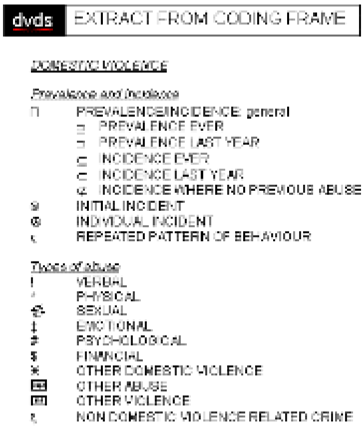
Information for Practitioners - information for those working in the field including practice guidelines

Seeking Help - advice and information aimed at those who are experiencing or have experienced domestic violence, and concerned others

References and Publications - a comprehensive and detailed bibliography, including unpublished work, legislation etc

Address Book - contact points for data appearing elsewhere on the dvds, details of existing networks and multi-agency fora, links to other relevant web-sites

Notice Board - including news about relevant conferences, events, campaigns and jobs


dvds EXTRACT FROM CODING FRAME

DOMESTIC VIOLENCE

Prevalence and Incidence
PREVALENCE/INCIDENCE: general
PREVALENCE EVER
PREVALENCE LAST YEAR
INCIDENCE EVER
INCIDENCE LAST YEAR
INCIDENCE WHERE NO PREVIOUS ABUSE
INITIAL INCIDENT
INDIVIDUAL INCIDENT
REPEATED PATTERN OF BEHAVIOUR

Types of abuse
VERBAL
PHYSICAL
SEXUAL
EMOTIONAL
PSYCHOLOGICAL
FINANCIAL
OTHER DOMESTIC VIOLENCE
OTHER ABUSE
OTHER VIOLENCE
NON DOMESTIC VIOLENCE RELATED CRIME

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Visualisation in the Social Sciences Workshop

Show and Tell

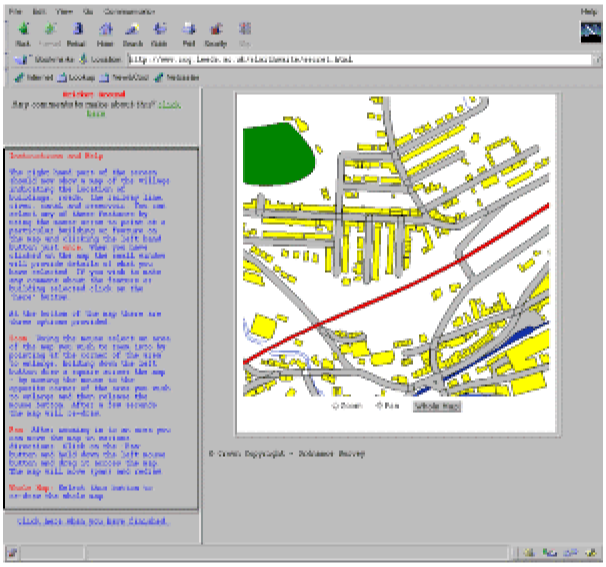
James Macgill

The research was part of a project that looked into the role GIS and the WWW will play in improving public participation in local environment decision making.

The first investigation produced an interactive on-line map of the village of Slaithwaite as part of the 'Planning for Real' initiative. Issues addressed included -

- Placing interactive maps with simple GIS functionality onto web pages.
- Designing an interface that was intuitive to non GIS/non computer literate users.
- Enabeling public participation in the decision making process.

By providing an interactive map that can be placed on web pages and by providing an interface that allows members of the public to submit comments about any part of their village. It has been tested both on-line and by taking a network of computers to Slaithwaite sports center where the system was actively used by over 300 members of the community.



Tools used:

In addition to html and cgi for form and web page design, the Slaithwaite project was put together using a Java class library known as GeoTools, which was developed here at Leeds. It provides a way to read and display vector (and now raster) maps and allows for typical shading, scaling, paning and querying operations. All of this is done in an applet on the clients web browser without any server side support. If you require any further details then please contact me.

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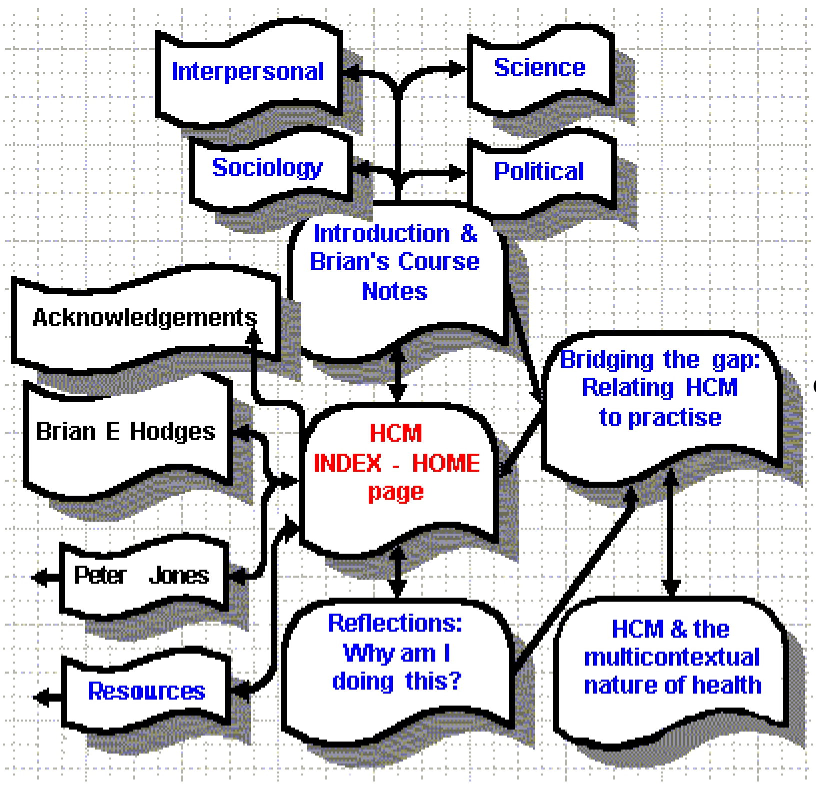
The Health Career Model

welcome

This is the start (home page) of a web site devoted to the Health Career Model (HCM) for Nursing Practice, as conceived and written by Brian E Hodges. First published on the www in April 1998 the latest version (Sept 1998) of these pages includes new material listed in the chronology below. Whether you are new to the site or have visited us before, Brian and I hope you find something of interest here. Whatever your thoughts we would be very pleased to hear from you.

HCM WEB PAGE - SITE MAP WITH LINKS and USER GUIDE:



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HOW TO USE THIS SITE: This page is the HCM index or home page. If you have graphical images selected in your browser, then this page is red in the site map above. The map does not show all possible links, your browser also allows you to travel backwards and forwards. If you have no knowledge of the HCM then it is probably best to begin with the introduction to HCM and Brian's course notes. From there you can move on to how the HCM bridges the theory-practice gap, or view each of the main subject disciplines that comprise the HCM.

From bridges a link explores the potential of Brian's approach to capture the multicontextual nature of health care (utilising several graphical images). You may wish to end with my reflections on HCM and the start of a resources page comprising some basic HCM forms and internet links.

Brief biographies of Brian Hodges and myself - Peter Jones are directly below.

A chronology for HCM 

Brian E Hodges: A Biography

BORN:
Bristol England 30 Jan 1942

QUALIFICATIONS:
Mental Handicap Nurse (RNMH)
State Registered Nurse (SRN)
Diploma of Nursing (DN London)
B.A (Hons) Open Univ.
MSc. Health Ed.(Chelsea)

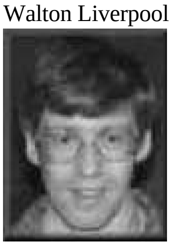
WORK EXPERIENCE - OVERVIEW:
Nurse Tutor.
Sheffield Development Project Mentally Handicapped.
Manchester Polytechnic College 1979-90.
One year off due to illness, now working one-two days per week.

CURRENTLY:
At Manchester Metropolitan Univ. (formerly the Poly.)
supervising research students on BSc. and B.A. (Hons) courses.

top

Peter Jones : A Biography

BORN:
Walton Liverpool England 18 Feb 1959



QUALIFICATIONS:
Registered Mental Nurse (RMN)
State Registered Nurse (SRN)
CPN (Cert.)
B.A. (Hons)
Post Graduate Cert. Education.

WORK EXPERIENCE - OVERVIEW:
Charge Nurse: Acute Admission (m&f);
Rehabilitation; Elderly Mentally Ill.
Community Psychiatric Nurse: Generic; E-MI.
Project Nurse: Community Mental Health Project.
Project Nurse: Total Fundholding Project.
Care Programme Approach Co-ordinator.
Part-time Lecturer - Runshaw College, Leyland, Lancashire, UK

CURRENTLY:
Chorley & South Ribble NHS Trust.
Team Leader: Community Psychiatric Nurse (Elderly Mental Health Service)
and
Student C.O.P.E Initiative
Univ. of Manchester

Personal Home Page- *The Reach*

ACKNOWLEDGEMENTS

There are several people (and more) I would like to extend thanks to: First, of course, to Brian for his support of this project, and patience during the long wait. For our meetings in Manchester, materials, notes and contacts that have proved invaluable. To Judy Norris in Canada for support and the web link and to the many other contributors whose efforts on the Nursing Theory Site proved the stimulus I needed. If you haven't - arrived here from there - give Judy's site a try there are many models and theories of nursing represented, but many more that could be completed. Who knows you might end up learning nursing theory and new IT skills at the same time - an ideal project?

Finally, thanks also to Francis Biley for words of encouragement and comments via E-mail on nurse theory in the UK; and to Sandra Holden for help in transfer of Brian's typed notes to PC format.

The health career model has been my cognitive companion for over a decade the assessor's faithful helper but in conception and application HCM should not end there?

There is much more that could be done here:

CRITIQUE?
CASE STUDIES?
CAL - computer aided learning?
COMMENT FORM?
REVISION!
RESEARCH?
RESOURCES?

If you have any comments, observations, or would like to assist in some way please contact us.
Thank you for your visit.

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Visualisation in the Social Sciences Workshop

Show and Tell

Jackie Carter

Visualization Tools for the Exploration of Census Data : the Cartographic Data Visualizer (cdv) and DESCARTES

1. Introduction to exploration of area enumerated census data sets

MIDAS (Manchester Information Datasets and Associated Services) hosts a number of large and complex strategic datasets for use in the UK academic community. These include the Census of Population area based statistics and the associated digitised boundary data. The KINDS (Knowledge-based Interfaces to Spatial Datasets) Service, hosted at MIDAS, seeks to support users of spatial data, regardless of their level of expertise. Spatial data is hard to use. Census data is voluminous. A current JISC-funded project at Manchester Computing is developing and supporting software which will enhance the KINDS system by creating a Visualization Gateway to the Census Datasets held at MIDAS. This will allow users to visually explore census data sets for their area of interest supporting the approach of 'visual thinking', before data is downloaded for use locally.

2. Software tools supporting the visual exploration of Census data sets

2.1 The Cartographic Data Visualizer (cdv)

The Cartographic Data Visualizer (cdv), developed by Jason Dykes (University of Leicester) under the JISC funded Project Argus, is being supported at Manchester Computing for teaching and research for users of area based population census data. cdv, written in Tcl/Tk, provides interactive graphical techniques which can be used for the exploration of such data. The approach emphasises the use of graphics in the development of ideas rather than in their presentation, supporting the notion of "display and play". cdv allows a user to look at census data, allowing spatial patterns in the counts to be explored/detected before deciding on the appropriateness of the data for further analysis.

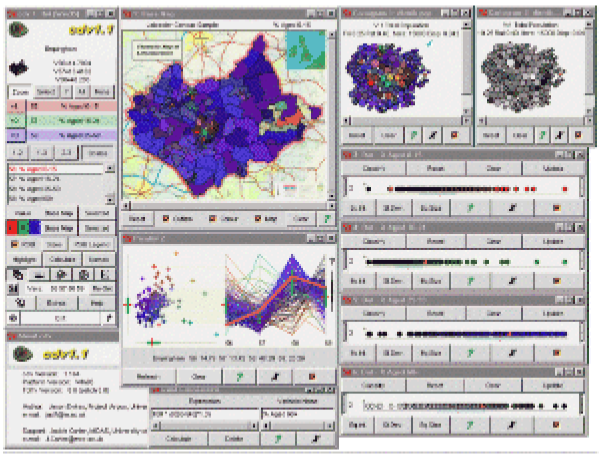
This cartographic visualization approach provides the following functionality which supports users in exploratory spatial data analysis:

- Ability to easily modify the data to be mapped
- Ability to display multiple alternative representations of the same data at the same time (i.e., choropleths, proportional symbol maps, cartograms)
- Interrogation of images on screen
- Ability to produce linked views

- Descriptive statistics (median, quartiles, max/min on dot plots, scatterplots)
- Ability to interact with and control a representation (class numbers, class sizes, symbolism)

A Graphic depicting a typical cdv session using Leicestershire 1991 Census data set

Using cdv a researcher can produce multiple, linked spatial and statistical views, of a data set. In the graphic below, the age-distribution of the population for the county of Leicestershire is being investigated. A choropleth (area-valued) map of the data is shown where the shading represents the three age distributions: percent aged 0-15 (red), percent aged 16-24 (green) and percent aged 25-59 (blue). Some less familiar views are also shown - 2 population cartograms (which emphasise the most populated regions) and a parallel co-ordinates plot in which the missing age range (percent over 60) is also included. Dot-plots corresponding to the age distributions are also shown. All views are linked which gives valuable spatial information to non-spatial views and particularly aids in the interpretation of cartograms. Data can be sub-selected from any of the views for additional analysis of the variation within a subset of values and new values can be computed using an equation parser. The result is a highly interactive environment in which a user can query the data and select a variety of views of the chosen values.

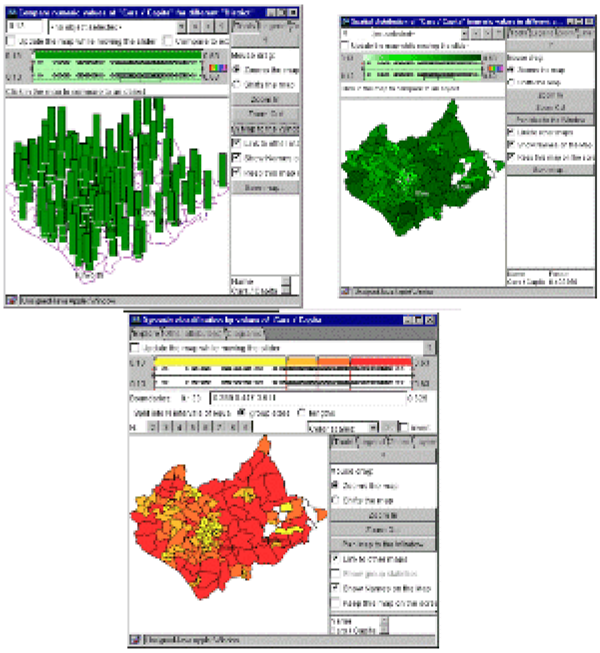


2.2 Descartes

Software is also being developed to allow this approach to be used within a WWW browser. Links have been established with the German Research Centre for Information Technology (GMD) in Bonn. GMD have written a client-server system, Descartes, in Java which supports some of the cartographic visualization techniques demonstrated in cdv and which can run within a WWW browser. It is hoped that Descartes can be further developed to incorporate additional functionality in order to provide an interactive visualization environment for users of the UK Census of Population.

Graphic showing Descartes with Leicestershire 1991 Census data

The following graphic shows three views that can be produced from a single census count (here, Cars per Capita). Descartes supports only choropleth and proportionate symbol views to date but has some useful interactive functionality, such as the ability to compare easily any data value to a reference value by use of a slider. Thresholding has also been recently introduced into the system enabling outlier values, which may distort or mask information in the resulting views, to be temporarily eliminated from the resulting view. Brushing and dynamic linking has been incorporated as a result of our contact with the group.



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Visualisation in the Social Sciences Workshop

Show and Tell

Kate Moore

Urban modelling with VRML/Java

This graphic is a composite of software currently under development. It shows an interface for interactively creating VRML from 2D building plans and user input of land use by floor for each building.
The VRML model is georeferenced for subsequent tracking on a map interface and external spatial database linking. The sm on lower left switches colours on/off and provides a key for colour values.

Animation surfaces are also planned to display pedestrian space-time movements through the street scene (not shown here b available for the workshop!)

The research/teaching problem it addresses

The software is being developed in conjunction with the Virtual Field Course (VFC) project to provide IT support for fieldw
Visualisation and virtual reality are being seen as key components for integration into this teaching format.

This example focuses on a specific fieldwork project where students survey land use and pedestrian movements within the u

Land use mapping has previously been undertaken on a 2D map basis which is highly inappropriate for the essentially 3 dim
of towns and cities.

Pedestrian counts are recorded at street level only. Again students normally only have the facilities for producing static repre
essentially dynamic event.

How it helps solve the problem

Virtual reality provides new dynamic, interactive methods for visualisation in 3 dimensional space.
The urban model is constructed as a 3D thematic representation that can more accurately help to visualise the functional cha
urban scene. Users can move freely through this new representation of reality and view it from any angle.

Students gain a greater engagement in the fieldwork project from construction of the model and subsequent interaction. The
constructed by combining component parts produced by individuals which establishes a degree of collaboration in the projec
interpretation of urban structure can be gained from the model through analysis of the 3rd dimensional component.

Space-time simulations can give a deeper understanding of social patterns and the dynamics involved. Using VRML animati
identify the spatial properties of the city business district and the relationships between the CBD and human movement thro

The ability to visualise and interrogate spatial movement within VR offers a new thread of research into the patterns of popu
within the urban environment. Potential applications include retail and advertising site analysis and urban planning.

Tools used in its creation.

Virtual reality models are built interactively using the Virtual Reality Modelling Language (VRML) in conjunction with the
language through the External Authoring Interface (EAI).

The VRML model runs in EAI compatible VRML plugins (CosmoPlayer, WorldView) for standard web browsers: Internet
Netscape.

2D plans are imported from Arc ungenerate format.

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Visualisation in the Social Sciences Workshop

Problems and Solutions in Visualisation in the Social Sciences

The workshop was split into four groups, who were asked to look at the problems and suggest solutions, in the following areas:

- Imagery
- Visualising networks
- Visualising statistical data
- Maps

Imagery

The first question raised was 'What do we mean by imagery?'. It became clear that this does not simply refer to graphics, but also the relationship between visual and other media, such as text and sounds. Images on the Web present particular problems:

- Consistency - will the viewer see the image in the same way as the author, or will colours, resolution etc., be changed due to the technological constraints
- Control - the author 'loses' control of the image, which affects copyright, IPR and ethical issues, since the image can be taken off the web and used in unforseen ways.
- Formats - are they suitable and are they used appropriately. Suitable formats must support transparency, as data is often overlayed on top of other data. There is a need to store metadata with images, for example author, how the visualisation was created and from what dataset. Work in this are is being carried out as part of the Electronic Libraries project, TASI and IMS.

There seems to be a divide between qualitative and quantitative data, perhaps reflecting an 'art/science dichotomey' in the use of visualisation. Qualitative researchers need to be encouraged in their use of computers and visualisation.

Finally concern was raised about how the user interprets the visualisation or images, reflecting the need to asses the useability of such visualisations.

It was noted in the discussion that in scientific visualisation the author and viewer are the same person, with the visualisation being used as a tool for analysising the data. In the social sciences there seems to be a larger role for visualisations as a method of presenting data and results to an audience.

Visualising Networks

There are a number of different types of networks -

- representations of space e.g., eculidian topology of the rail network
- non-euclidian such as global trade networks or representations of the Internet
- conceptual networks e.g., family trees or relationships

- artefacts - networks of symbolic meaning (see Show and Tell, Diego Jimenez)
- programming can also be visualised as a network - e.g., in Explorer, AVS and Khoros

There appears to be a gap between the supply and demand for visualisation tools and techniques to display these networks. In some cases the tools are available, but in a different discipline, and there are often problems with interdisciplinary communicaiton, particularly between computer scientists and social scientists. Tools are available for showing and developing links within networks, but these are mostly text based.

Problem Areas

Although mapping physical networks and cartogram transformations are relatively easy, visualising very large networks, e.g., journey to work data for Great Britain, is difficult. Visualisation of conceptual networks, e.g., academic collaborators, is also difficult. The addition of a temporal aspect requiring dynamic visualisation of netwoks adds further difficulties.

When a visualisation has been created, we must be confident it is conveying the right message. We can learn from cartographers and graphic designers about the aesthetics of design to ensure that the visualisations are readable.

Visualising Statistical Data

A number of restrictions on the success of visualising data were highlighted:

- lack of interdisciplinary communication
- lack of understanding of the tools and techniques available
- lack of imagination - a restriction we place on ourselves
- understanding the problem in the first place
- the amount of data to be analysed - too much data can be hard to manage

- have we collected the right data?

The need to choose the right visualisation tools for the problem was shown with a simple example, height and weight data from every county in the US. The scatterplot below represents a data set with several thousand points, one point for each county. With such as large dataset, a simple scatterplot is effectively meaningless, the main problems being:

- most dots overlap, so what you see in the plot is mainly the outliers rather than the bulk of the data
- some dots may be more important than others - in this case some counties have much larger populations than others
- a minor, but important, part of the pattern can easily be lost

As computer power has increased, and readily available tools such as Microsoft Excel have become able to handle large datasets, the danger of inappropriate tools being used has increased.

Solutions

- Density kernel estimation - to produce contours which will show up clustering. The gets round the problem of plot density, and points can be weight to reflect their importance

- Divide the scatterplot into squares and count the number of points in each. Draw a square or circle within the grid whosize relates to this count. This conveys density information and again allows for points to be weighted
- Divide the graph into categories of weight and use a box and whisker plot of height (or visa versa) in each category.

All of the above solutions can be easily printed. Other solutions include:

- An interactive 'magnifying glass' which when moved over the plot shows more details
- Jittering - adding a small random displacement to each point, which allows many points in the same place to be visible

For visualisation to be most successful, it is important that visualisation experts are be involved right at the start of the research, in a similar way to statisticians. It is important that the visualisation tool chosen does not confuse the issue.

Maps

The group identified a number of problems, but concentrated on three in particular:

- Time and spatial units changing simultaneously
- Hypervariate data
- Representation of flows

Time and spatial units changing simultaneously

For example, in census data the census wards may change. A number of solutions were proposed:

animation of the data
: though this can be difficult to interpret when the spatial units are changing

cartogram
: the problem here is linking the cartogram back to the real world, as cartograms on their own can be difficult to interpret. One method of doing this is to link the cartogram to a more traditional euclidian representation of the space, or to animate the two in parallel.

grid data
: reducing the spatial data to a standard form over time. To do this values within the grid must be estimated, and therefore the technique is only useful if the estimation is good / accurate.

It was suggested that it would be useful to look at both cartograms and grids, so that any anomalies in one method would be shown up.

Hypervariate Data

This refers to data with more than three dimensions, i.e., not easily represented in normal space. One standard solution to representing many variables is a pie chart map, but this is often hard to read. Other solutions include:

- multiple maps
- sequential view of variables on a single map. The order of the variables may be changed, and the sequence run through to see if any patterns emerge

- reduce the dimensionality and link it to the map, for example a RadViz plot

Representation of Flows

There are a number of different types of flow, for example individuals, aggregate flows of people/materials, flows between points or areas and flows along routes, but flows are difficult to represent in traditional cartography. Solutions suggested include:

- using arrows to represent the flow on the map
- animate traditional maps
- animate the flow, giving a visual representation of the magnitutude of flow
- animate the changing state of the end point

Visualisation in the Social Sciences Workshop

Towards a Research Agenda for Social Science Visualisation

In an attempt to derive a research agenda for future visualisation work in the social sciences, workshop participants conducted a pyramid exercise. In this each first wrote down four items they saw to be the most important for future work. These were then merged with the ideas of others in successively larger groups of two, four, and then eight. Eventually, after much discussion, twelve issues emerged from the group (see Table 1). Tables 2, 3 and 4 summarize the identified issues at each stage in the process with each labeled A, B or C according to the 'family tree' from which it emerged. Note that not all participants completed arrived at four issues and that with twenty-two participants not all groups were exactly of the labeled size. Inevitably, numerous issues emerged from the exercise, but it is possible to recognize three general areas of research need:

1. Aspects of the use of existing visualisation methods

If visualisation is to be as successful in the social as it has been in the natural and physical sciences, there is a need for work on the experiences to date using visualisation in the social sciences. A major task is to widen the audience to include a much wider range of disciplines than was present at the symposium. Such work needs to examine the effectiveness of specific visual techniques as well as that of the general strategy. Research into the effectiveness and usability of visualisation systems is an area in which the social sciences can contribute to the physical and natural, a good example being work on the perception of colour and its use in displays.

2. Methodological and technical developments associated with the specific needs of the social sciences

Outside of GIS and mapping, existing visualisation systems supported by the higher education computing community (such as AVS, and IBM Explorer), as well as the graphics available in popular packages such as Excel, MINITAB and SPSS, do not readily enable visualisations of several types of social science information. Examples include non-hierarchical text such as CD-ROM and interactive maps, highly multivariate data (hypervariate is the term that was used), the outputs from statistical and mathematical models, and temporal and spatial dynamics in populations of individuals or aggregates of individuals. Since many problems in the social sciences, including many of the so-called 'qualitative' type, can be addressed by data organized as a network or interaction matrix, there is a clear need for technology to be developed to enable the visualisation of large and complex networks. In a computing context, such visualisations may well be the only way that we can use to address the complexity of the Internet and its use. A practical but important issue is the evident need to provide existing visualisation systems with appropriate interfaces to enable them to access data coded into standard relational or GIS databases.

3. Issues related to the environment of visualisation

Finally, a cluster of 'human' issues were identified, particularly a need for work on how a visualisation strategy is incorporated into research, to assemble a library of suitable visualisation algorithms and case studies of their use, and to enable visualisation to be a collaborative activity.

Ways by which these agendas might be addressed formed part of a subsequent Workshop discussion.

David Unwin

TABLE 1: Twelve issues identified at Stage 4 (Groups of eight)

TABLE 2: Twenty-four issues identified at Stage 3 (Groups of four)

TABLE 3: Thirty-five issues agreed at Stage 2 (Groups of Two)

TABLE 3: Sixty-seven issues identified by the twenty-four participants

Visualisation in the Social Sciences Workshop

Towards a Research Agenda for Social Science Visualisation

TABLE 1: Twelve issues identified at Stage 4 (Groups of eight)

A:	Naming and shaming: research into user experiences and appropriations of visualisations and visualisation tools
A:	Different shape graphs: visualisation of multivariate, multimodal data
A:	Take it from the top: involvement of visualisation techniques from problem formulation
A:	Talk to each other: communication between disciplines and approaches
B:	Assessing the effectiveness of visualisations
B:	Development of methods for collaborative visualisation
B:	Development of methods for visualising temporal change of spatial data
B:	Developing of method for visualising large complex networks including virtual networks
C:	Develop ways to assess appropriate necessary and effective visualisation
C:	Visualizing networks of qualitative data
C:	Evaluation of the role of VR in visualising spatial data in the social sciences
C:	Visualisation of population socio-economic dynamics

Visualisation in the Social Sciences Workshop

Towards a Research Agenda for Social Science Visualisation

TABLE 2: Twenty-four issues identified at Stage 3 (Groups of four)

A	Research into peoples understandings of visualisations and the implications for dissemination
A	Development and incorporation of visualisation techniques at the start of research projects
A	Potential of visualisation in the construction of non-hierarchical texts such as CD and interactive maps.
A	Innovative use of technology
A	Statistical model validation via EDA
A	Public domain visualisation
A	Schematic paradigm for visualisations
A	Visualization of highly multivariate and multi modal data.
B	Visualisation over shared environments
B	Visualisation of large and complex networks
B	Evaluation of Visualisation techniques
B	Visualisation of spatial modelling
B	Temporal aspects of spatial data
B	Improve access to visualisation tools, including a repository of algorithms
B	Network visualisation (especially Internet)
B	Perceptual aspects of visualisation
C	Evaluation of the role of VR in visualising spatial data in the social sciences
C	Visualisation of population socio-economic dynamics
C	'Collapsing the McEachren cube'
C	Dissemination to all social science disciplines from the visualisation 'champions'

- C Develop ways to assess appropriate necessary and effective visualisation
- C Visualising networks of qualitative data
- C Development of methods to visualize hypervariate data
- C Investigate how people structure, link and navigate images and texts

Towards a Research Agenda for Social Science Visualisation

TABLE 3: Thirty-five issues agreed at Stage 2 (Groups of Two)

A	The potential of visualisation for the construction of non hierarchical texts such as CD and interactive maps
A	Research into user experiences, appropriations etc of visualisation, its tools and the implications of this for dissemination
A	Research to create a way of identifying and forging links between different work on visualisation
A	Research into how visualisation can inform problem formulation as well a problem solving,
A	Communication between disciplines
A	Development and incorporation of techniques and assessment of their utility
A	Innovative use of the technology
A	Repository of example case studies and tools.
A	Naming and shaming of the worst examples of visualisation by academics
A	Visualisation of highly multivariate data
A	Schematic visualisation
A	Chernoff face research centre (?)
B	Collaborative visualisation
B	Evaluation off visualisation techniques (cognitive, empirical. theoretical, How do we reason?)
B	Visualisation on the web (accessibility)
B	Visualisation of qualitative information in the social sciences
B	Use of visualisation in spatial modelling
B	Visualising large networks
B	Local indicators of spatial association
B	Work on linked graphics rather than the data flow paradigm

B	Repository of visualisation tools
B	Enhancement of GI tools for spatial analysis and visualisation
B	Network analysis
C	Identify and develop key visualisation tools in qualitative research
C	Co-ordinate and develop WWW site for social science visualisation
C	Develop tools for visualisation of flows and networks
C	Develop and evaluate tools for the effective visualisation of multivariate data in EDA
C	Develop Central WWW resource from existing site such as SOSIG/AGOCG
C	Effective visualisation of flows and networks for individuals and groups across space
C	Three dimensional visualisation of spatial and non-spatial multivariate data
C	Experimental methods to evaluate the effectiveness of scientific visualisation
C	Evaluation of the effectiveness of visualisation
C	Visualising networks in qualitative data
C	Effective strategies for visualisation of multinode flows
C	Investigate how people structure, link and navigate images and texts

Visualisation in the Social Sciences Workshop

Towards a Research Agenda for Social Science Visualisation

TABLE 3: Sixty-seven issues identified by the twenty-four participants

A	Research into user experiences, appropriations…
A	Support to encourage the development of visualisation in qualitative social science.
A	Research into the visualisation of text,
A	Research into the potential of visualisation in linking qualitative and quantitative research
A	Communication: clear identification of visualisation approach and communication of techniques
A	Development and incorporation of techniques at the start of research projects
A	Innovative use of technology
A	Repository for visualisation examples and tools.
A	Promoting inter disciplinary communication
A	Evaluation of the effectiveness of visualisation
A	Storyboarding websites
A	Organizing web data without anarchy
A	Non hierarchical data coding
A	Problem visualisation tools
A	Examples of good and bad practice
A	Visualisation of highly multivariate data
A	Schematic visualisation: one ink colour and so on
A	Chernoff face research centre(?)
A	Fund example projects in history and sociology to demonstrate actual usefulness
A	Name and shame examples of visualisation

B	'Lightweight' mapping
B	Visualisation of spatial statistics
B	Visualisation of networks, both physical and conceptual especially flow data, text, etc
B	Visualisation of spatially varying parameters
B	Visualisation of large interaction matrices
B	Visualisation of hypervariate spatial data
B	Persuade the rest of social science to use visualisation and not Excel
B	Collaborative visualisation
B	Visualisation on the web
B	Support for navigation through large multi-dimensional data sets
B	Evaluation of visualisation tools and techniques
B	The development and assessment of collaborative visualisation techniques
B	Making visualisation technologies more accessible to the social sciences
B	Assessment and evaluation of the effectiveness of the visualisation process
B	Visualisation of qualitative information
B	Techniques for the visualisation of temporal aspects of spatial data
B	Perceptual aspects of visualisation
B	Network visualisation
B	Dynamic visualisation of social phenomena
B	Development of customized visualisation tools for specific groups of end users
B	Tools for public or collaborative visualisation
B	Assessing the effectiveness of visualisation methods
B	Visualisation of complex multivariate data sets
C	Experimental methods to assess the effectiveness of visualisation
C	Development of effective strategies for visualisation of multi-node flows

C	Generic and general methods for structuring, linking and navigating images and texts
C	Experimental evaluation of how people use visualisation
C	Case studies development of use of tools in different social sciences
C	Postgraduate training courses in visualisation
C	Use of images as qualitative data in research
C	Visualising networks in qualitative data (e.g. NUDIST)
C	Evaluative work in the use of visualisation
C	Trying to spread visualisation wider within the social sciences
C	Visualisation officer for social sciences?
C	Person flow visualisation
C	The role of VR is visualising spatial data
C	Visualisation of individual level population dynamics
C	Visualisation of qualitative data
C	'Collapsing the MacEachren cube'
C	Development of methods to visualize hypervariate data
C	Development of ways to assess visualisation methods
C	Development of local statistics approach
C	Development of accessible tools for social science visualisation
C	Classification of psychological concepts in health care research
C	Information science tools in visualisation to support health care assessment programmes.
C	Research into existing manual/electronic forms of data capture

Visualisation in the Social Sciences Workshop

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