Chapter 2

# 2D AND 3D INFORMATION VISUALIZATION RESOURCES

All the information contained here is time-sensitive and of importance to 2D and 3D information visualization. All information is current and accessible as of Nov. 10, 2004.

Each section below contains a snapshot only of that format/topic at the time of writing; the section on websites and software is significant, given that these tools/experiments are available or under development for experimentation and exploration of 2D and 3D information visualization techniques.

Complex technical- and computer-oriented articles, materials, and conferences are included in the journals/conferences/research groups sections to show librarians where this field is going and where to find information related to the technical side of the topic. Each entry is annotated.

The resources detailed below that are likely to be of the most helpful to information organizations are listed in Chapter 3.

## Journals

Each of the websites for the journals listed do not necessarily permit access to content.

### *ACM Transactions on Computer-Human Interaction*

www.acm.org/pubs/tochi

This archival journal publishes original research that spans the field of human-computer interaction. Beginning with its first issue in March 1994, it has sought to present work of high scientific quality that contributes to practice in the present and future. The primary emphasis has been on results of broad application, but the journal considers original work focused on specific domains, on special requirements, on ethical issues—the full range of design, development, and use of interactive systems.

### *Association for Computing Machinery (ACM) Interactions*

www.acm.org/interactions

This journal is ACM's bi-monthly magazine for designers of interactive products.

### *Human-Computer Interaction (HCI)*

http://hci-journal.com

This journal covers theoretical, empirical, and methodological issues of user science and of system design.

### *IEEE Transactions on Visualization and Computer Graphics (TVCG)*

www.computer.org/tvcg/index.htm

This journal was published quarterly but is now bi-monthly. *TVCG's* scope of publication includes subjects related to visualization and computer graphics techniques, systems, software, hardware, and user interface issues.

Specific topics include but are not limited to: visualization techniques and methodologies, visualization systems and software, volume visualization, flow visualization, information visualization, multivariate visualization, modeling and surfaces, rendering techniques and methodologies, graphics systems and software, animation and simulation, user interfaces, virtual reality, visual programming and program visualization, and applications.

### *Inf@Vis!*: the digital magazine of InfoVis.Net

www.infovis.net/MainPage.htm

This online journal is available in both English and Spanish. It is devoted to information visualization.

### *Information Visualization*

www.palgrave-journals.com/ivs

This new journal's (began publication in 2002) stated goal is to "act as a dedicated forum for the theories, methodologies, techniques and evaluations of information visualization and its applications." It is quickly becoming one of the major journals in the field.

### *International Journal of Human-Computer Studies/Knowledge Acquisition (IJHCS)*

http://repgrid.com/IJHCS

This journal is published monthly by Elsevier. It encompasses a wide range of topics relating to computers and people, including intelligent user interfaces, natural language interaction, human factors of multimedia systems, human and social factors of virtual reality, human and social factors of the Web, human and social factors of software engineering, computer-supported collaborative work, speech interaction, graphic interaction, knowledge acquisition, knowledge-based systems, hypertext and hypermedia, user modeling, empirical studies of user behavior, the psychology of programming, systems theory and foundations of human-computer interaction, user interface management systems, information and decision-support systems, requirements engineering, and innovative designs and applications of interactive systems.

## Conferences

### ACM Special Interest Group on Computer-Human Interaction (SIGCHI)

ACM SIGCHI sponsors conferences about design, implementation, study, and evaluation of interactive computing systems. The topic of 3D information visualization often appears in papers and even sessions in many of the conferences that they support and sponsor. These include the well-known annual CHI

Access to all previous CHI conferences and their papers and presentations is available at http://sigchi.org/conferences, along with access to other conferences that ACM SIGCHI sponsors or co-sponsors.

conferences, with each year being maintained on separate websites and servers, depending on the main institutional sponsor.

**ACM Symposium on Software Visualization, known as SoftVis[year]**

http://rw4.cs.uni-sb.de/~diehl/softvis/org/index.php (previous conferences)

**Conference on Visualization and Data Analysis (formerly known as Conference on Visual Data Exploration and Analysis), known as VDA[year]**

http://vw.indiana.edu/vda2005

http://vw.indiana.edu/vda2004

http://vw.indiana.edu/vda2003

www.futurevisions.net/SPIE/vda2002

This conference, sponsored by the Society for Imaging Science and Technology (IS&T) and the International Society for Optical Engineering (SPIE), is another major forum for visualization researchers. VDA conferences prior to 2002 can sometimes be found, but little information or papers are available.

**IEEE Visualization Conference (also known as Vis[year])**

This website lists the conferences, has links to some of the conference websites, but more importantly has links to the various papers and conference proceedings of each, www.informatik.uni-trier.de/~ley/db/conf/visualization.

http://vis.computer.org/vis2004

http://vis.computer.org/vis2003

http://vis.computer.org/vis2002

http://vis.computer.org/vis01

www.erc.msstate.edu/conferences/vis00

www.erc.msstate.edu/conferences/vis99

Vis[year], sponsored by a number of information visualization organizations, is the premier forum for visualization advances in science and engineering for academia, government, and industry. This event brings together researchers and practitioners with a shared interest in techniques, tools, and technology. Each conference can only be accessed individually, not directly through one website.

**InfoVis**

www.infovis.org/symposia.php

The IEEE Symposium on Information Visualization, which started in 1995 and is probably the main conference related to information visualization.

**International Conference on Information Visualization, known as IV[year]**

www.graphicslink.demon.co.uk/IV04 (2004 conference)

This conference is sponsored by the Information Visualization Society and is now in its eighth year. Finding access to previous conferences is hit and miss at best.

**Information Visualization Society,** www.ivsociety.org

**International Symposium of Collaborative Information Visualization Environments (CIVE)**

http://vw.indiana.edu/cive02 and http://vw.indiana.edu/cive03 (calls for papers)

**International Society for Photogrammetry and Remote Sensing (ISPRS) Commission V Working Group 6**

This group appears to hold workshops related to 3D modeling.

Most ISPRS workshops can be found by typing "workshop visualization animation" into Google, but here are some websites: www.photogrammetry.ethz.ch/tarasp_workshop and www.photogrammetry.ethz.ch/pitsanulok_workshop.

## Significant research groups/people

Many important people and research groups are involved in 3D information visualization in its various forms.

Below are listed only a few of them:

- AT&T Labs, www.research.att.com/areas/visualization
- Katy Borner, http://ella.slis.indiana.edu/~katy
- Chaomei Chen, www.pages.drexel.edu/~cc345
- Vladimir Geroimenko, www.tech.plym.ac.uk/soc/staff/vladg
- Human-computer Interaction Lab (HCIL), University of Maryland, www.cs.umd.edu/hcil/research/visualization.shtml
- Pacific Northwest National Laboratory (PNL), www.pnl.gov
- Ben Shneiderman, www.cs.umd.edu/users/ben
- User Interface Research @ PARC (formerly Xerox PARC), www2.parc.com/istl/projects/uir

Fuller lists of significent research groups and people are available at http://iv.homeunix.org/people.php and http://iv.homeunix.org/research.php.

## Websites, presentations, news stories, and articles

These significant and important websites are devoted to information visualization. In some instances, they use 2D and 3D in their presentation; others are clearinghouses or bibliographies; and some are portals to extensive information, research, or experiments using 3D information visualization software and tools.

### ActiveWorlds

www.activeworlds.com/#

This website features many 3D virtual collaborative experiences. Users can build their own 3D virtual reality world, participate as a citizen in already-created 3D collaborative environments with other people around the world, explore more than 1,000 virtual worlds, play interactive 2D and 3D games, and choose from various avatar identities and chat with other avatars.

By clicking on the satellite maps from the front page, users can see how quickly the ActiveWorlds site has grown since 1996. The ActiveWorlds plug-in is free, and if a user clicks on the free software link, the software automatically downloads onto the desktop.

A 3D Homepage Creator and a nice 3D tutorial can be purchased at www.activeworlds.com/3dhomepage/tutorial/popup.htm.

Although the software is free, participating in the virtual worlds is not. Users must sign up and pay $6.95 a month to become a "citizen" to actively participate in these 3D worlds. Users have many areas to explore and discover in this website. The site is a great (and cheap) way to begin to explore interactive 3D virtual collaboration and chat, as well as to create easy 3D home page and virtual worlds.

### Antarctica Systems, Inc.

www.antarctica.net

This company is one of the leaders in 3D information visualization software and projects. Two of its major products are MapNet and VisualNet. The founder of Antarctica is XML co-creator and Open Text founder Tim Bray. See more on these products under the Software Products section of this chapter. This company has a good white paper on data and information visualization at www.antarctica.net/pdfs/whitepaper.pdf.

### An Atlas of Cyberspaces

www.geog.ucl.ac.uk/casa/martin/atlas/atlas.html

This resource was discussed extensively in Chapter 1. The representation of the many different ways in which cyberspaces can be visually and graphically mapped and manipulated is uniquely presented at this website.

### Belmont Abbey College Library, North Carolina using VisualNet3 (Scholastica Project)

www.dlib.org/dlib/june03/beagle/06beagle.html

http://beta.belmont.antarcti.ca:8080/start

www.charlestonco.com/features.cfm?id=95&type=np

These Web links describe the experiment by Belmont Abbey College Library in North Carolina to become the first U.S. academic library to implement a real-time 2D visualization of its library catalog. Using the VisualNet software available from Antarctica.com, the links above describe the experiment through a *D-Lib Magazine* article, "Visualizing Keyword Distribution Across Multidisciplinary C-space," by Donald Beagle (June 2003, v. 9, no. 6), and "Visualizing the Digital Commons," by Donald Beagle, published in v. 4, no. 1 (July 2002) of the *Charleston Advisor*. The demonstration of the 2D virtual catalog itself is available at the middle link above. It is fun to play with this

virtual model of the Belmont Abbey College Library book stacks, representing a 2D visualization of the library catalog, using LC subject Headings/Classification as the visual model.

**"Better Search Results Than Google?" CNN.com News, Jan. 5, 2004**

www.cnn.com/2004/TECH/internet/01/05/seeing.search1.ap

**"Going Deeper Than Google." CNN.com News, Dec. 17, 2003**

www.cnn.com/2003/TECH/ptech/12/17/fortune.ff.deeper.google

These two interesting and timely articles on 3D information visualization focus on a few specific software products.

**The Big Picture(sm): Visual Browsing in Web and Non-Web Databases**

www.public.iastate.edu/~CYBERSTACKS/BigPic.htm

This website, one of many by Gerry McKiernan of Iowa State University and also the creator and maintainer of Cyberstacks(sm), focuses on projects, research, products, and services where visual browsing is accomplished through 3D information visualization products. Some of these software products are examined under the Software section. Many links are no longer active.

**Katy Borner's research in 3D information visualization**

http://ella.slis.indiana.edu/~katy/research

This website is chock full of current research and experiments in 3D information visualization, and especially in 3D virtual worlds. The website is divided into Visualizing Knowledge Domains, Visualizing Users of 3D Virtual Worlds, Visual Interfaces to Digital Libraries, and Previous Projects.

Dr. Borner is an information scientist at the University of Indiana in Bloomington, Ind., and is a major organizer of symposiums and conferences in information visualization. Some of her virtual worlds projects and current research are featured in the Software Products section of this chapter. An extensive bibliography of her writings is available in this report.

**"Building 3-D User Interface Components Using a Visualization Library" by Bill Hibbard, in *Computer Graphics* 36(1), 4-7, 2002**

www.ssec.wisc.edu/~billh/VisGUI.html

Interesting article discussing the VisAD software program, as well as metadata needed for visualization. It is technical but informative.

**CyberStacks(sm): Net Projects**

www.public.iastate.edu/~CYBERSTACKS/Projects.htm

A listing of projects that Gerry McKiernan of Iowa State University maintains of significant Web resources that focus on various technologies and futuristic applications, which he then categorizes using the Library of Congress classification scheme. All the resources are full-text, hypertext, or hypermedia, and of a research or scholarly nature.

### Digital Worlds Institute

www.digitalworlds.ufl.edu

This website, hosted at the University of Florida, contains many interesting digital media and 3D visualization projects using its Research, Education and Visualization Environment (REVE), which includes a polymodal immersive theater (PIT), a virtual production studio (VPS), and digital media suite (DMS), and the REVE image generator (RIG). In addition, the New Automated Virtual Environment (NAVE) laboratory has digital media research and production space with an immersive three-screen rear projection environment and network access to Internet2.

### The Geography of Cyberspaces Directory—Visualising Information Spaces

www.cybergeography.org/vis_infospaces.html

See the entire directory at www.cybergeography.org/geography_of_cyberspace.html.

This is an excellent resources page for 2D and 3D information visualization that is kept up-to-date. The directory is divided into commercial applications/companies, research work, commentary and research papers, and other good meta-lists on visualizing information space. The website has some excellent links resources, projects, software, and demonstrations; some links, however, do not work.

### "Geospace: An Interactive Visualization System for Exploring Complex Information Spaces" by Ishantha Lokuge and Suguru Ishizaki

www.acm.org/sigchi/chi95/Electronic/documnts/papers/il_bdy.htm

An interesting paper, with 3D examples, of a project to visualize complex information spaces in 3D. The paper is geared toward geospatial data and examples.

### Google directory links

Knowledge Discovery:

http://directory.google.com/Top/Reference/Knowledge_Management/Knowledge_Discovery

Information Visualization:

http://directory.google.com/Top/Reference/Knowledge_Management/Knowledge_Discovery/Information_Visualization

Software:

http://directory.google.com/Top/Reference/Knowledge_Management/Knowledge_Discovery/Information_Visualization/Software

Topic Maps:

http://directory.google.com/Top/Reference/Knowledge_Management/Knowledge_Representation/Topic_Maps

The Google Directory has an interesting list of reference websites in Knowledge Discovery, Information Visualization, Software, and Topic Maps, as well as many other related areas. The best way to accessing them is at the Google Directory. Follow the Reference link down to the Knowledge Management page, where all these resources are available.

**Martin Graham's Information Visualization Links**

www.dcs.napier.ac.uk/~marting/linksFrame.html#infvis

An extensive listing of information visualization resources, including links to many of the major conferences and their proceedings, journals, and demos of software products.

**"Graphical Interfaces To Support Information Search: An Annotated Bibliography"**

www.lis.uiuc.edu/~twidale/irinterfaces

Another bibliography compiled by a library graduate school class, last updated in 2000. It is divided into some overview articles, frequently cited classics, demo potential (software products), other systems, user-testing, and links to other existing bibliographies. Many links do not work.

**"Graphical searching of two ebook collections"**

www.wisc.edu/wendt/help/graphical.html

Even though the database and presentation listed in this article no longer work, it is an interesting experiment to graphically display another library collection. This project used the VisualNet software from Antarctica.

**"Grokking the infoviz," *The Economist,* June 19, 2003**

www.economist.com/science/tq/displayStory.cfm?story_id=1841120

This fascinating article discusses the field of 3D information visualization, focusing on a few of the major companies and software available.

**HighWire Press TopicMap**

http://highwire.stanford.edu

This fascinating presentation using a hypertree application to illustrate the content available at the HighWire Press website (more than 14,000,000 articles in 4,500 Medline journals) incorporates the Inxight Star Tree software product from the Xerox PARC research center.

When the user clicks the "Browse using TopicMap" link, a separate window appears that allows users to graphically access all the content at HighWire Press. Instructions are simple: A huge topic map of the contents appears to the user, who then can click to select a topic, and double-click to observe the documents list. Or the user can enter topics in a search box and receive information in a topic map structure as well.

**"Information Visualization: Failed Experiment or Future Revolution" PowerPoint presentation by Karl Fast at the 5th Annual ASIS&T Information Architecture Summit in Austin, Texas (Feb. 27-29, 2004).**

www.livingskies.com/writings/2004/ia-summit

**Information visualization Introduction**

www.cs.ubc.ca/~tmm/courses/cpsc533c-03-spr/0108.intro

This site is a somewhat technical yet visually stimulating introduction for a graduate course on information visualization. No lecture notes are available, but the presentation is graphically interesting and the scope of the lecture can be somewhat followed.

**Information visualization and knowledge management graduate class**

www.cs.uvic.ca/~mstorey/teaching/infovis/notes.html

This excellent series of PowerPoint demonstrations/lectures is from a graduate Information Visualization class from 2002. It includes more than 20 linked PowerPoints, from Introduction to Information Visualization, to Visual Perception, to Visualizing Knowledge, as well as sections on Trees and Networks, Software Visualization, Visualizing Queries, Digital Image Management, and many lectures on Visualization from many viewpoints (industry, GIS, and handheld devices).

**Information visualization lecture notes by Keith Andrews**

www2.iicm.edu/ivis/ivis.pdf

This site has an excellent, although somewhat technical, explanation of information visualization and its different manifestations.

**Information visualization links from Timothy Cribbin's home page**

www.brunel.ac.uk/~cssrtfc/iv_links.htm

This excellent information visualization resource is divided into research, directories (software), useful software, and commercial systems.

**Information visualization resources by John Goodall**

http://iv.homeunix.org

Another excellent compilation of information visualization resources, it is kept up-to-date. It is subdivided into journals, conferences, books, software, articles, people, research, and websites.

**"Interactive 3D Scatterplots—From High Dimensional Data to Insight," master's thesis by Gerald Nikolaus Sahling**

www.vrvis.at/vis/resources/DA-NSahling/masterthesis.html

Although this thesis is technical, it does have a good table of contents with lots of graphics and explains in somewhat layman's terms the concepts, manifestations, and innovations of 3D information visualization.

**Information visualization resources on the Web**

http://graphics.stanford.edu/courses/cs348c-96-fall/resources.html

http://graphics.stanford.edu/courses/cs348c-96-fall/selbib.html#Ahlberg95

Another graduate class project, this time by students at Stanford University in 1996, this bibliography was current for 1996 but is seriously dated. It does, however, provide access to PowerPoint presentations used by various professors around the world who taught information visualization around 1996. It also is a good historical bibliography/resource for the field (many links do not work).

**KartOO Technologies**

www.kartoo.net/e/en

This company's website features interactive demos of products and software, some of which are featured in the Software Products section of this chapter. Clicking the Demos link brings users to many demonstrations of its products.

The most interesting demo is of its Visualization product, www.kartoo.net/e/en/demos.php?p=visu.

**KDnuggets: Software: Visualization**

www.kdnuggets.com/software/visualization.html

This website features information visualization software packages, some of which are discussed under the Software Products section of this chapter.

**"New Age Navigation: Innovative Information Interfaces for Electronic Journals" by Gerry McKiernan. *The Serials Librarian*, v. 45 (2), 2003. Also PowerPoint presentation**

www.public.iastate.edu/~gerrymck/NewAge.pdf

www.public.iastate.edu/~gerrymck/NewAge.ppt

This fascinating presentation, also published, discusses some of the major 3D information visualization software products and research available.

**Nooface: In Search of the Post-PC Interface**

www.cs.uvic.ca/~mstorey/teaching/infovis/notes.html

This Web log covers post-PC interfaces and has many stories on information visualization and cyberspace mapping.

**Olive: On-line Library of Information Visualization Environments**

www.otal.umd.edu/Olive

Already discussed and used as a resource in Chapter 1, this excellent website started as a class project for Dr. Ben Shneiderman's fall 1997 graduate class on information visualization. It has not been maintained since 1997 but is an excellent resource on the eight data types used in information visualization, along with resources for each.

**Open Directory Information Visualization listings**

http://dmoz.org/Reference/Knowledge_Management/Knowledge_Discovery/Information_Visualization

The Open Directory Project's listing of resources is in the topic of information visualization.

**The Open Video Digital Library (OVDL)**

www.open-video.org

www.dlib.org/dlib/december02/marchionini/12marchionini.html

This exciting project, a digital library of digital video, is built on the Sharium concept for digital libraries. The DLib article explains much of the history of digital video libraries in 2002, as well as the history of the OVDL, its system architecture and user interface research, and some of its plans and future directions. A digital librarian toolkit, interactive shared educational environments, and a peer-to-peer tool for librarians to view and exchange video segments are some of the tools that OVDL is developing.

**Outerworlds**

www.outerworlds.com

This 3D virtual reality chat website has software freely available to download.

**"Portal: Gateway to New Visions, Worlds" *UCLA Today*, Jan. 25, 2000**

www.today.ucla.edu/2000/000125portal.html

www.ats.ucla.edu/portal/about_p.htm

www.ats.ucla.edu/portal/about_vis.htm

www.ats.ucla.edu/portal/InthePortal/index.htm

An article with links on the UCLA Portal, an immersive 3D visualization laboratory, contains a visualization portal and laboratory.

**Searchtools.com Visualization and Clustering Tools topic page**

www.searchtools.com/info/visualization.html

This excellent resource website is divided into research & articles, products, and resources.

**SIMS 247 "Information Visualization and Presentation" class**

www.sims.berkeley.edu/courses/is247/s02/Lectures.html

The 2003 graduate class at Berkeley used many PowerPoint presentations and links to software products.

**Software Visualization website**

www.info.uni-karlsruhe.de/~frick/SoftVis

This website is a good start for information on software visualization, though it has not been updated since 1997. It lists some of the leading projects and software available at that time.

**Special issue of the ACM SIGGRAPH *Computer Graphics* newsletter (v. 34, no. 1, February 2000) on New Visualization Techniques**

www.siggraph.org/publications/newsletter/v34n1/index.html

This dated issue has eight articles on new visualization techniques in 2000.

**3D Insects**

www.ento.vt.edu/~sharov/3d/3dinsect.html

This cool website has various insects created in 3D using the Virtual Reality Markup Language (VRML). Users can view 3D 360-degree rotating images of virtually created insects. This website is useful and enjoyable for use in K-12 science classes. It also has some good 3D Web links.

**3D Online World**

www.moove.com

This site has another 3D interactive world website, where the player is freely available for download, and it appears that membership to explore the virtual worlds is free.

**Touchgraph.LLC**

www.touchgraph.com

Many 2D and 3D application software, featured in the Software Products section of this chapter, include Dynamic Graph Layout, TGGoogleBrowserV1.01, Planet-Wissen Navigator, and TG WikiBrowser V.1.02.

**"Trend-Setting Products of 2004" by Hugh McKellar of *KMWorld Magazine* (v. 13, no. 8)**

www.kmworld.com/publications/magazine/index.cfm?action=readarticle&Article_ID=1872&Publication_ID=118

This sites lists various innovative and trendsetting software products. Included are various 3D information visualization software, including Anacubis, Antarctica Systems, and Spotfire (all included in the Software Products section in this chapter).

**"2D is better than 3D" Jakob Nielsen's Alertbox for Nov. 15, 1998**

www.useit.com/alertbox/981115.html

This caustic retort to the field of 3D information visualization on the Web in 1998 is interesting, both in that it is dated and that it supports 3D only in the area of scientific visualization. The Web has come a long way since 1998, especially in regards to computing space on current PCs, and interest from users in computer graphics that mimic the video game environment.

**"Virtual Browsing the Electronic Bookshelves: Overview and Demonstration of Graphical Browsing Applications From Around the World" by John Wanserski and Michael Sorensen**

www.wils.wisc.edu/events/wworld03/present/72403/vbrowsing.ppt

This presentation is the best one available showing current 3D information visualization applications, especially related to libraries and information organizations. The graphics are great and show the range of products and services in the marketplace.

**Virtual Worlds Linklist**

www.well.com/user/hlr/vircom

Also known as Rheingold's Brainstorms, this website provides access to resources related to 3D virtual worlds and communities. Categories include New Finds, Meta Sources, Articles, Places and Communities, Virtual Reality Info, and Critiques of Cyberculture and Technology.

**Virtual-Worlds.net**

www.virtual-worlds.net

This website features innovative 3D projects, news, conferences, books, and papers.

**Virtual Worlds Review**

www.virtualworldsreview.com

This site is a clearinghouse and portal to various 3D virtual worlds and persistent online social virtual worlds.

**Visualization and Interaction for Business and Entertainment (VIBE)**

http://research.microsoft.com/research/vibe

The Microsoft research team is working in 2D and 3D information visualization products.

**"Visualizing Bibliographic Metadata—A Virtual (Book) Spine Viewer" by Naomi Dushay. *D-Lib Magazine* 10(10), 2004**

http://dlib.anu.edu.au/dlib/october04/dushay/10dushay.html

This recent article uses 2D and 3D visualization to promote virtual spine labels for users browsing the National Science Digital Library (NDSL), using the Inxight StarTree™ software product.

**"Visual User Interfaces: Challenges and Opportunities" by Katy Borner and Chaomei Chen. *IEEE Technical Committee on Digital Libraries (TCDL) Bulletin*, Summer 2003**

www.ieee-tcdl.org/Bulletin/current/borner/borner.html

A good article by two well-known researchers in this field on 3D information visualization in digital libraries, along with challenges and crucial research issues that still need to be resolved.

**"VISVIP: 3D Visualization of Paths Through Web Sites" by John Cugini and Jean Scholtz**

www.itl.nist.gov/iaui/vvrg/cugini/webmet/visvip/webvis-paper.html

An interesting paper from 1999, discussing 3D visualization of paths through websites. The examples can be clicked to make them more viewable. The software used, Linklint, is no longer available via the link in the footnotes.

VISVIP documentation is available, however, at ftp://ftp.nist.gov/pub/itl/div894/vvrg/visvip/documentation.html and is available for download at ftp://ftp.nist.gov/pub/itl/div894/vvrg/visvip.

**Vivisimo**

http://vivisimo.com

http://clusty.com

A company that features information visualization products; namely, the Vivisimo Clustering Engine, Content Integrator, and Enterprise Publisher. In September 2004, Vivisimo launched Clusty.com, the first full-service website powered by its breakthrough clustering technology. Clusty.com groups search results into folder topics, giving the user the option of seeing their results as main themes and letting them focus on topics of interest. See more on these products in the Software Products section of this chapter.

**Worlds.com**

www.worlds.net

Another 3D virtual collaborative world website, the WorldsPlayer 3D Portal is freely available for download. It appears that users may freely participate and explore the hundreds of virtual worlds available. This company also has the WorldsShaper™ (the visual authoring component of WorldsPlayer) and the WorldsServer™.

**Yahoo Directory: Computer Graphics>3D**

http://d5.dir.scd.yahoo.com/computers_and_internet/graphics/3d

This nice site lists 3D resources as organized and described by Yahoo.

## Software products

This section is devoted to the core essence of this report—software products available for purchase or open-source that allow users and libraries to experiment with 2D information landscapes or posters set in a 3D world, true 3D information visualization, and 3D virtual worlds for collaboration or interaction.

Because this marketplace is rapidly changing, and software comes and goes, this section only highlights the most important or interesting 3D information visualization software products, especially those that offer free demo or trial versions.

This list is not meant to be either definitive or exhaustive, but to illustrate the vast array of experimentation and products available to indicate the direction and future research and development (R&D) activities of many companies, research laboratories, and graduate schools of information science and computer science.

### Advanced Visual Systems (AVS)

www.avs.com/index_wf.html

AVS produces many 2D and 3D visualization software products targeted at business as well as technical visual data analysis. These tools include OpenViz, AVS/PowerViz, AVS/Express, Gsharp, and Toolmaster.

- OpenViz graphically illustrates data in 3D charts.
- AVS/PowerViz is a network software for companies and businesses that wish to visualize their information.
- AVS/Express is an object-oriented visualization tool that can be deployed on many servers, including HP, Sun, IBM, Linux, SGI, and PC and Mac systems. AVS/Express is available in a Visualization Edition for end users, a Developer Edition for software engineers, and a Multipipe Edition for research teams.
- Gsharp is a multiplatform charting tool that can create 3D technical charts and graphics from almost any data source and publish them via the Web.
- Toolmaster is a portable graphics tool for Windows developers with more than 500 C++ and Fortran functions for scientific, technical, and commercial graphics.

**Examples of OpenViz deployment,** www.avs.com/software/soft_b/openviz/implementation.html, along with PDF documents and files available for download on all these products.

### Advizor Solutions

www.advizorsolutions.com

This company has interactive data visualization software products, developed at Bell Laboratories over a 10-year period and comprising more than 27 patents, and is a collection of 12 Interactive visual components. These components include: Bar Chart, Counts, Data Sheet, Time Table, Multiscape, Data Constellations, Data Constellation Maps, Histogram, Line Chart, Parabox, Pie Chart, and Scatterplot. These components are more like various 3D applications for viewing data in different ways.

These components are packaged in three different ways: Desktop Analyst for business analysts; Enterprise Author for end users producing reports, analysis, and dashboards; and Enterprise Deployment for large groups of users. Visual Discovery™ is the software used in all these applications.

Desktop Analyst is comprised of an Advizor Analyst Workbench, an Advizor Analyst Workbench Lite, and an Advizor Client Viewer. Enterprise Author has an Advizor Authoring Toolkit that features many plug-and-play sets. Enterprise Deployment has the Advizor server and the Advizor VZ Web prebuilt visualization applications available.

**Demonstration of Visual Discovery™ at work in the Advizor server,** www.advizorsolutions.com/products/demo.asp (after consumer information is provided).

### Alice

www.alice.org

Alice (Version 2.0b) is an interactive 3D graphics program developed at Carnegie Mellon University. It is geared toward middle-school girls to assist them in learning about programming a computer by providing animated, 3D onscreen virtual objects for programming instead of typed commands and obscure rules of syntax. It is freely available for download and use.

### Anacubis

www.anacubis.com

Established in 2001, Anacubis is a division of the i2 Group, a company that delivers data visualization and link analysis software to investigators and intelligence professionals. Anacubis means analytical cubism: a means of depicting different viewpoints simultaneously, that is, producing a conceptual image of an object as opposed to a perceptual one.

Under Products, users can see the major products of Anacubis: the Anacubis Desktop, the Anacubis Desktop add-ins, Anacubis Connect, and Anacubis View Manager. The Anacubis Desktop is the feature product of this company and is available through a 10-day free trial download.

An interesting and fun interactive product guide is available that moves the user through the basic features and benefits of this product. Anacubis includes add-ins to its desktop product that are available for additional power and functionality. Anacubis Connect is available for companies and departments that wish to employ Anacubis products throughout their organization.

The Anacubis View Manager is a free downloadable desktop application that enables users to view charts created in Anacubis Desktop. This product is featured in the McKellar "Trend-Setting Products of 2004."

### AquaBrowser by Medialab Solutions

www.medialab.nl

This product is a 2D visualization software for library catalogs, that shows related concepts on the left side of the screen. It appears to be a search engine interface to a user's information, specifically library catalogs for K-12 students, allowing different visual approaches for the user to find information.

The AquaBrowser Pro is the software product, and the AquaBrowser Library integrates the software into public library and other catalogs to provide a more visually pleasing interface to the user's information.

A quick overview to the AquaBrowser Library, www.medialab.nl/index.asp?page=aquabrowser library/overview

### Astrophysical Journal (1994-2000)

http://simbad.u-strasbg.fr/ApJ/map.pl

This 2D presentation of information contained in the Astrophysical Journal from 1994-2000 is presented in the form of a self-organizing map, where articles are classified on the basis of their keywords.

The designers have used the star map concept to visually present information to astrophysicists. Document density is smallest in blue areas and largest in red areas. The visualization is only at the front end; once the user clicks the star

map, information on the star map can be constructed into a local map of documents by clicking the "construct a local map" option.

As the user proceeds through the star maps, eventually the information is presented in basic text format (that is, the contents of the database). Tutorials for the databases contained at this website are available through the toolbar at the top. Since the website was constructed using frames technology, the URL remains the same as users navigate through the information.

### Autonomy

www.autonomy.com/content/home

This company has many visualization products that produce concept maps and topic clusters without human intervention. The IDOL server is the basis for all the Autonomy products. It offters access to many white papers and product descriptions on the website, but users must provide contact information to view this information.

Some video case studies from the Ford Learning Network, Ove Arup, the U.K. Department of Trade and Industry iBio team, and Belga are available at www.autonomy.com/content/showreel.

Some links to articles discussing Autonomy products include:

- Knowledge managers get help: Autonomy, Vignette link tools *Infoworld,* Jan. 11, 1999, by Emily Fitzloff. Autonomy's technology can automatically categorize data stored in Vignette's StoryServer
- See It! Knowledge Management *CIO Magazine,* June 15, 1998, by Tom Field. Describes Autonomy's Probabilistic Concept Modeling tools in the context of data visualization.

### The Cooperative Association for Internet Data Analysis (CAIDA)

www.caida.org/home

CAIDA provides many visualization tools for Internet data analysis. Some of these software include GeoPlot, GTrace, LibSea, Mapnet, Otter, Plankton, plot-latlong, PlotPaths, and Walrus:

**Access to the software,** www.caida.org/tools/visualization

- GeoPlot is a java applet to create 3D geographical images of datasets.
- GTrace is a graphical front-end to Traceroute, a popular software that assists in data debugging and IP location tracing.
- LibSea is both a graph file format and a Java graph library for representing large directed graphs on disk and in memory.
- Mapnet is a macroscopic internet infrastructure visualization and measurement tool that can show multiple international backbone providers simultaneously.
- Otter is a historical tool for topology display that is used for visualizing arbitrary network data as a set of paths, links, or nodes.
- Plankton is a software application/project used to visualize NLANR's Web cache hierarchy.
- Plot-latlong is a Perl program that takes latitude/longitude pairs and plots them as points on geographic maps.
- PlotPaths displays reverse and forward network path data from one or more sources or destinations.
- Walrus is a 3D interface for displaying large graphical information using fisheye distortion.

### Croquet Project

http://croquetproject.org

Croquet is a combination of network architecture and freely available computer software that supports 2D and 3D wide-area environments and collaboration among users across the Web. It is a complete development and delivery system for doing real collaborative work in a distributed 3D space.

**Interactive screenshot demonstration,** http://croquetproject.org/About_Croquet/screenshots.html

### CubicEye

www.2ce.com

CubicEye organizes information into a navigable cube. Cubes can be arranged by functional or thematic subject matter and can be explored individually or collectively as part of a structure of multiple cubes.

CubicEye has excellent interactive demonstrations and tutorials showcasing its abilities, www.2ce.com/demos.html, including building, powersearching, navigating, and creating cubes and worlds. A new tool for browsing in 3D called the NavWheel also is showcased.

### CViz

www.alphaworks.ibm.com/tech/cviz

CViz appears to be part of IBM's alphaWorks website. It is a visualization tool for analyzing high-dimensional data in large, complex datasets (mainly for statistical mathematics). Downloading is available but only after registering.

### Cyberspace geography visualization

www.girardin.org/luc//cgv

This project looks at self-organizing maps of cyberspace to help users map their way through the Web. Some links do not work.

### Daisy

www.daisy.co.uk

This graphical analysis and interactive investigation program (available as OCX) focuses on data mining and analysis.

### DataDescription, Inc.

www.datadesk.com

This company features many visualization products, including Data Desk, Data Desk XL, and Viz!on. Data Desk provides interactive tools for exploring data display and analysis. The site provides a nice multimedia tour of the Data Desk product. Data Desk XL and Viz!on work with data in Excel.

### DataMontage™

www.stottlerhenke.com/datamontage

DataMontage™ is a Java class library of applications for the interactive graphical display of multivariate time-oriented data. The website provides many interactive demonstrations of this software.

### Davisor Chart

http://products.davisor.com/chart/index.html

This product (Version 4.2) enhances Web applications by adding dynamic and interactive graphs and charts. It uses Davisor Chart Markup Language (DCML), a proprietary markup language, to render information in 2D and 3D. Software extensions to this product allow users to display information in vector graphics (SVG), visual clustering (SOM), and real 3D. Examples of the product in action are available.

### DbVisualizer

www.minq.se/products/dbvis

A 2D cross-platform database tool for relational databases. Currently in Version 4.1.1, this software assists developers and database administrators in maintaining their databases. It is freely available for download, and screenshots are available for viewing.

### EntertainmentSpace (ET-Space)

http://ai.bpa.arizona.edu/Libraries/frame1_demos_1.html

The Artificial Intelligence Group in the Management Information Systems Department at the University of Arizona developed this concept-based search tool. ET-Space uses a clickable self-organizing map (SOM) and a searchable entertainment concept space (thesaurus) that are generated automatically using a DEC Alpha workstation.

An NSF/CISE and an NSF/ARPA/NASA Illinois Digital Library Initiative project grant in the late 1990s funded this search tool. See many demonstrations of other software on this website (it is built with frames technology, so the URL remains constant). These software include Geo Space, Wormspace, CSQuest, Vocabulary Switching, Hopfield Net, and Fisheye Viewing.

### Entrieva (formerly Semio)

www.entrieva.com/entrieva/index.htm

Entrieva has many software products focusing on data mining and displaying the concepts and relationships in a 3D map. Some of these software products include SemioTagger™, SemioSkyline™, SemioTaxonomy™, SemioMap™, and SemioDiscovery™.

SemioMap is a graphical interface able to take information from SemioTagger, which allows for analysis and data discovery in 3D.

SemioDiscovery is Entrieva's latest search engine and viewer for mining unstructured data and is linked to SemioTagger by incorporating personalization, audit tracking, and graphical visualization to the contents contained in SemioTagger.

The company website contains numerous explanations and examples of what its products can do, but it has no free trials or downloads. Entrieva markets to the pharmaceutical, government, publishing, health care, and litigation industries, although it mentions that SemioTaxonomy has been built with the assistance of knowledge managers and librarians.

**SemioMap online demonstration,** www.entrieva.com/entrieva/products/semiomap.asp?Hdr=semiomap. The demo is slow-moving and noninteractive.

### File System Visualizer (FSV)

http://fsv.sourceforge.net

FSV is similar to FSN but runs on Linux.

### FSN

www.sgi.com/fun/freeware/3d_navigator.html

This freeware (featured in the movie "Jurassic Park" and pronounced *fusion*) produces a cyberspace rendering of a file system.

### GGobi Data Visualization System

www.ggobi.org

This data visualization system lets users view high-dimensional data. It is open source and is the next version of the xgobi software. GGobi incorporates GTK+, a multiplatform tool for creating graphical user interfaces.

See screenshots of how information looks in GGobi at www.ggobi.org/Screenshots.html.

### Graf-FX

www.gr-fx.com

www.gr-fx.com/graf-fx.htm

This open-source software can analyze up to eight numeric values and go down to five levels of detail. Information can be viewed as 2D or 3D graphs and queries, and the software interfaces with Access. An interactive demonstration is available.

### Graphical Interface for Digital Libraries (GRIDL)

www.cs.umd.edu/hcil/west-legal/gridl

This simplified 2D display uses categorical and hierarchical axes to present information. This software allows a user to view several thousand search results at one time. It was developed at the Human-computer Interaction Laboratory (HCIL) at the University of Maryland. It is available for download from this website.

### Grokker

www.groxis.com/service/grok

Grokker is a visualization software product that has received extensive media coverage because it is geared toward both companies and the individual computer user. Grokker is in Version 2.1, and a free 30-day trial is available at the website.

Grokker lists for a reasonable $49. It also has plug-ins that can be downloaded or customized.

According to the website, its four plug-ins are: The Web (searches six search engines at once: AltaVista, MSN, WiseNut, Fast, Yahoo, and Teoma), Google (Beta version), Amazon.com, and My Files (search your hard drive or network drive).

**Groker QuickTime demos doing map browsing, filtering, and searching Amazon.com,** www.groxis.com/service/grok/g_prod_demo.html

**Screen snapshots of how Grokker displays information,** www.groxis.com/service/grok/g_prod_grok_screens.html.

The user can edit, save, and build maps for up to 2,000 items. Since a free 30-day trial is available, information organizations should take the time to experiment with this product before purchasing.

**Demonstrations of its Honeycomb software,** www.hivegroup.com/demos.html.

### The Hive Group

www.hivegroup.com

This visual data analysis software uses various types of treemap views.

### ILOG Discovery

www2.ilog.com/preview/Discovery

This 2D visualization software is for data and browsing databases. The company provides a nice walkthrough demonstration of its visualization software.

### InFlow

www.orgnet.com/index.html

www.orgnet.com/inflow3.html

InFlow is a network mapping and measuring software that displays information in 2D. It is a product of Orgnet.com and is in Version 3.0.

### Information Visualization products at the Pacific Northwest National Laboratory (PNNL) of the Department of Energy

www.pnl.gov/infoviz

PNNL (operated by Battelle Memorial Institute) has a suite of information visualization software tools available to the federal government, as well as commercial customers. Each of these tools is explained in detail at www.pnl.gov/infoviz/technologies.html, where both software products and current research have annotated entries.

Four software products are included:

- Galaxies (using the image of stars in the night sky to represent a group of documents)
- ThemeView™ (using a relief map of natural terrain to represent a set of documents)
- Starlight (an advanced, multiformat, object-oriented approach to display interrelationships between and among database elements and their properties)
- OmniViz Pro™ (a visualization and data-mining product that handles large volumes of information in high dimensions)

In-Spire™, http://in-spire.pnl.gov. At the site, the product is explained, FAQs are available, training and support as well as a discussion group can be accessed, and information on obtaining a copy is available.

Galaxies and ThemeView™ both use the In-Spire™ information visualization tool suite, which is PNNL's main information visualization software product.

PNNL also has many research projects it is working on. These projects include:

- ThemeRiver™ (using time-related information to visualize a large collection of information)

- Topic Islands™ (uses wavelet transforms and a technology called Topic-O-Graphy™ to generate fuzzy document outlines and other features of a document set)
- Surmise™ (explores multiple queries or hypotheses within a collection of documents)

In addition, many concepts are described, including Dynamic Analysis, DNA Memory, Hypercube, and CATCH (Computer Aided Tracking and Characterization of Homicides).

PNNL appears to be taking the lead in designing and experimenting with 2D and 3D information visualization technologies for the federal government. In fact, the National Visualization and Analytics Center (NVAC) of the Department of Homeland Security is using all of PNNL's technologies to assist in its work to provide proactive, predictive analysis for early warning of potential terrorist activities.

See http://nvac.pnl.gov/ and http://homeland-security.pnl.gov for more information.

### Insightful

www.insightful.com

www.insightful.com/products/splus/default.asp

www.insightful.com/products/iminer/default.asp

This company features two products. S-PLUS is a statistics and graphics tool, and Miner 3 is a highly scalable data analysis workbench. Both of these products are geared for desktop use and also can be purchased as enterprise solutions by companies. Many specialized add-ons are available for data analysis in various fields.

Many interactive demonstrations are available at www.insightful.com/support/downloads.asp once the user provides a name and e-mail address.

### Institute for Human and Machine Cognition (IHMC)

http://cmap.ihmc.us

This freely available concept mapping software was developed by IHMC. Featured in the article "Concept Maps Discover Digital Repositories: A Look at Tuft's VUE" (*Syllabus Magazine*, June 2004, v. 17, no. 11), this innovative software allows the user to see concepts presented in a visual rather than a text environment. The user just clicks the images that show either a document or tree icon, which then moves to mouseovers indicating choices regarding concept maps or documentation.

### Internet Foyer

www.crg.cs.nott.ac.uk/research/projects/Foyer/#functionality

This software uses a mixed reality environment: an electronic meeting space that spans both the physical and virtual worlds. It involves the use of collaborative virtual environment technology to create a navigable 3D visualization of an organization's website.

This project, done by the Computer Science Department at the University of Nottingham in England, has a detailed summary and explanation of the experiment at its website. This software not appear to be available for download or experimentation.

### Inxight software products

www.inxight.com/about

### HighWire Press TopicMap

http://highwire.stanford.edu/help/hbt

Inxight was spun out of Xerox PARC (an early leader in information visualization software) in 1997. Its enterprise software products are Inxight SmartDiscovery™, Inxight VizServer™, and Inxight Categorizer™. Its core technology products are Inxight LinguistX® Platform, Inxight Star Tree™, Inxight Summarizer™, Inxight Table Lens®, and Inxight Thing Finder™. Its website has many streaming video presentations from various news organizations that feature its products, as well as PDF reviews.

One of the most visible and widely available implementations of the Inxight software products is HighWire Press's TopicMap. Using the Inxight Star Tree™ product, the contents of HighWire Press can be viewed in a graphical form. A Java applet launches a separate box on the Web screen, which displays a graphical topic map of the contents of the website.

Simple instructions for browsing and finding information via the available topics are at the bottom of the screen. The user clicks and drags topics of interest around the map, which then reveals further divisions and relationships among the topics. Once the user has chosen the topic of interest, double-clicking reveals the set of documents in the Web browser associated with that topic.

According to the Inxight website, the Inxight VizServer™ assists in the exploration and visualization of large information collections with the Star Tree™, Table Lens™, and Time Wall™ products, allowing users to view and locate information and patterns in time-based, relational, tabular, or hierarchical datasets.

According to research at Xerox PARC and Inxight, its information visualization products have proven to be 60% faster than conventional methods of finding information in large datasets and 62% better for navigation than the standard Windows tree control.

### IRIS Explorer

www.nag.com/visualisation_graphics.asp

www.nag.com/Welcome_IEC.html

IRIS Explorer by the Numerical Algorithms Group (NAG), Version 5.0, is an advanced visual programming environment for 3D visualization, manipulation, and graphics.

### K.wiz

www.thinkanalytics.com/productServices/kwiz/index.htm

K.wiz, an open knowledge and data mining platform using a range of Java visualization components, is a product of thinkAnalytics. The company calls it a Business Analysis Automation platform, capable of displaying information as heatmaps, decision trees, and 3D scatter plots.

### Macrofocus

www.macrofocus.com

This company has many information visualization software products:

- SurveyVisualizer uses large and complex survey information as its primary data visualization.
- Fund'O'Scope visualizes large amounts of investment data for banks and investors.
- City'O'Scope was designed to assist economic researchers in analyzing the purchasing power of 60 cities around the world.
- TrendDisplay was designed for large amounts of data in the field of bioinformatics.
- Atom'O'Scope allows collaborative groups to share information in nanotechnology experiments related to atomic structures.

### Mankua

www.mankua.com/products.cfm

www.mankua.com/services.cfm

This company has a many fascinating 3D products, including Texture Layers, Kaldera, Flatten, and PowerStamper. Under its Services section, it has many interesting tools, including Di-O-Matic's Facial Studio, Cluster-O-Matic, and Morph Toolkit, and many free 3D visualization tools such as Mapale, TLUnwrap, ViewTools, Stress, and Modspace.

### MAYA Viz

www.mayaviz.com/web

This company produces Katalyst software, which supports and enables users to share visualizations of data.

Its CoMotion® product is featured at www.mayaviz.com/web/solutions/comotion.mtml, with an interactive demonstration and various documents related to its visualization portfolio. See some fields it is working in, www.mayaviz.com/web/visualization/visualization.mtml.

### Mercury Computer Systems, Inc.

www.tgs.com

This website features many interactive 2D and 3D graphics products, including Open Inventor (Version 5.0), an object-oriented 3D graphics developer toolkit with many extensions; amira (Version 3.1), an advanced 3D imaging software for many different fields including biology, biomedicine, engineering, and geosciences; GPHIGS+ (Version 6.1), which is ISO/ANSI Standard 9592 for advanced CAD/CAM applications and data visualization; and Opale (Version 2.1), a 3D graphic animation server for the aerospace community.

### Miner3D

http://miner3d.com

Miner3D provides interactive 2D and 3D applications for advanced Microsoft Excel users in the areas of chart and report creation, data mining, navigation, and visual data analysis. It is a Web-authoring system for Internet 3D applications. Users can install the Miner3Dviewer for free from the website.

**Demonstrations of the software in action,** http://miner3d.com/m3Dsite/demos/index.html

### Moresophy

www.moresophy.de/english/index.php

This company creates browser-based tools for navigation and visualization of topic maps and semantic networks. A 3D demonstration directly from the front page is nicely done. Its L4 tool suite consists of Indexer, Modeller, and Networker modules.

### MusicMaps

http://fusion.sims.berkeley.edu/MusicMaps

This interactive 2D website graphically presents the many genres of rock and roll, its roots, and its various subgenres. Moving the cursor over a circle calls up information on that topic on the right-hand side of the Web page. Clicking a circle enlarges the topic circle to illustrate relationships between and among various subtopics around and within that topic.

Only some of the circles are clickable, and this fact is not readily apparent to the user. The movement of the circles as relationships, as they move into position, look like bubbles being blown through the air. Clicking the "Back to General Map" returns the user to the original presentation of the topics.

The content for this website is taken from Allmusic.com, but the technology/software itself is not explained. (This project may be partial or incomplete from the School of Information Management and Systems (SIMS) at the University of California, Berkeley.)

### Navigational View Builder

www.cc.gatech.edu/gvu/people/Phd/sougata/Nvb.html

This tool allows users to create interactive visualizations of information spaces. It uses hierarchization, filtering, clustering, and binding strategies as the underlying foundations for forming the visualizations.

### Oculus

www.oculusinfo.com

This company focuses on business visualization software. Its website contains some information on what it does, but none specifically related to the software products that it uses. Users need to provide contact information to access its demo area.

### OpenDX

http://opendx.org

OpenDX is the open-source version of IBM's Visualization Data Explorer product. IBM is allowing free downloads to attract the creativity of the world's developer community to its Deep Computing efforts. Downloads of various versions are available from the website.

### Orca

www.analytics.washington.edu/orca

This open-source software product is for data visualization. The Gallery on the left hand side of the webpage takes the user to some screenshots of this software in action. Downloading of the software is available.

### Panopticon

www.panopticon.com/panopticon/Sector?id=20

This company and its software focuses on visualization of financial information, specifically tree map technology.

It has a freely available desktop application, called Panopticon Explorer, which creates interactive tree map visualizations of files on a user's computer. Users must provide contact information to download this application.

Specific product information, www.panopticon.com/panopticon/Group;jsessionid=24E1E32908B53B65928C59556051BC60.tomcat1?id=2.

### Parvis

http://home.subnet.at/flo/mv/parvis

This tool is for parallel coordinates visualization of multidimensional datasets.

### Peakflow SP and Peakflow X

www.arbornetworks.com

Part of Arbor Networks, these two products build dynamic, granular graphs that can display traffic and routing information, both real-time and historic, for database administrators and developers. Based on XML, statistical analysis and management reports can be tailored to be visualized for individual or group display and manipulation.

### Piccolo

www.cs.umd.edu/hcil/piccolo

Another 2D graphics program developed at HCIL at the University of Maryland, Piccolo is a toolkit in C+ and Java that incorporates zoomable user interfaces (ZUIs), using a "scene-graph" model that is common to most 3D environments.

A PowerPoint presentation on this software is available, along with various downloadable applications. Much of the website is empty of content right now.

See some of HCIL's other software programs, such as DateLens, www.cs.umd.edu/hcil/datelens, SpaceTree, www.cs.umd.edu/hcil/spacetree, TimeSearcher, www.cs.umd.edu/timesearcher, and TreeMap, www.cs.umd.edu/hcil/treemap.

### Purple|insight

www.purpleinsight.com/home.html

The MineSet 3.1.1 software is a 3D visual data mining product comprised of a Splat Visualizer, Scatter Visualizer, Map Visualizer, Tree Visualizer, Statistics Visualizer, and a Record Visualizer. Interactive demonstrations of the product are available with a user name and password.

**Product explanations and examples,** www.purpleinsight.com/products/mineset/overview.html.

### PV-WAVE

www.vni.com/products/wave/index.html

This software, developed by Visual Numerics Inc., is a family of products that includes PV-WAVE, JWAVE™, and TS-WAVE™. These products were developed to assist users and companies to rapidly import, analyze, manipulate, and visualize data of any size and complexity. Various applications and toolkits are available to assist users with these products.

### Research Systems, Inc. (RSI)

www.rsinc.com

This company has two major products: the Interactive Data Language (IDL), which is a software platform for data visualization (Version 6.1); and ENVI, a software package for presentation, analysis, and visualization of all types of digital imagery and hyperspectral analysis (Version 4.1).

IDL is available with many applications, including an IDL DICOM toolkit (for medical imagery), the IDL Virtual Machine (a free runtime utility), the IDL Dataminer (a database-independent connectivity tool), and the IDL Wavelet toolkit (a GUI interface).

ENVI also has some add-ons, including the ENVI NITF module (based on the National Imagery Transmission Format for the U.S. intelligence community), ENVI RemoteView (an application for the defense and intelligence fields), and ENVI FLAASH (to address atmospheric visualization and analysis).

### ROOMS

http://rooms3d.com

This software turns a Windows desktop into a 3D world. The freeware version is limited, but users can download the fully functional World Viewer for $9 from the website. The ROOMS Creator license is available for $39, which allows for creating and publishing your own desktop worlds.

### SemTalk™

www.semtalk.com

SemTalk™ is an add-on to the Visio software product. The company indicates that it provides knowledge management solutions for the Semantic Web. A PowerPoint slide show also is available, which has a more technical explanation of the product (see Slides in the left hand index of the slide show). Much of this website is based on frames technology, so the Web address remains the same throughout the website.

**An interesting, interactive demonstration,** www.semtalk.com/semnet_files/semtalk.htm, with much of the navigation elements in both German and English.

### Spatial

www.spatial.com

Spatial provides high-performance 3D visualization systems, such as its Component Application Architecture (CAA) V5, 3D InterOp, 3D Modeling, and 3D Visualization software packages, for true 3D manipulation and viewing. Some components, such as its HOOPS 3D Viewer for ACIS and its OpenHSF 3D Stream Plug-In, are freely available for download once the user provides customer information.

**Free components,** www.spatial.com/downloads?LV2=Y

### Spotfire

www.spotfire.com

Spotfire's DecisionSite software focuses on visualization and analysis of large amounts of data. It also has a MapConnect product based on ESRI ArcMap and ArcGIS that works in collaboration with DecisionSite.

### Tableau

www.tableausoftware.com

http://graphics.stanford.edu/projects/polaris

Tableau is a visual spreadsheet for databases, based on the Polaris project from Stanford University. It has many screen views of the product in action, and it has a Standard and a Professional Edition.

### 3D Information Visualization projects/experiments by students of Katy Borner at the School of Library and Information Science (SLIS) at Indiana University

http://ella.slis.indiana.edu/~katy/research

Dr. Borner's website is a treasure trove of information, projects, and experimentation in various aspects of 3D information visualization. Most of this information is both informative and technical; This website should be examined and experimented with by both information organization professionals and information systems staff.

The projects/software are discussed below. They are current and active (the website provides links to appropriate publications and related project websites and software):

- **Visualizing Diffusion Patterns:** This projects looks to develop visualization techniques and analysis methods on the diffusion of materialistic (objects, people, and so on) and nonmaterialistic (ideas, concepts, and so on) over time and space.
- **Process Models of Scientific Structure and Evolution:** This National Science Foundation (NSF) grant looks at using visualization to examine large datasets related to citation analysis and knowledge domains.
- **TerraVis:** This research looks to create a mini-grid infrastructure for information visualization and information retrieval research and education. Numerous other grid projects and large datasets are linked from this project description.
- **Building Blocks for Virtual Worlds:** Design Principles for a Starter Kit for Educational Virtual Worlds: Another NSF grant project that is fairly self-explanatory in its title.
- **Visualizing Knowledge Domains:** Looks at the utility of information visualization techniques and data mining to support science and technology management. Quite a few citations to presentations and publications are associated with this project, including access to Dr. Borner's essay of the same name in Blaise Cronin, ed. *Annual Review of Information Science & Technology*, v. 37 (2003), Medford, N.J. Information Today, Inc./American Society for Information Science and Technology, chapter 5, p. 179-255.

**Building Blocks for Virtual Worlds,** http://vw.indiana.edu/building-blocks.

- **Project ENABLE**: Learning through Associations in a Grid based Bioinformatics Digital Library: Another NSF grant that looks at grid computing technologies and digital libraries in relation to bioinformatics information and datasets. ENABLE stands for Extensible Networked Association-based Bioinformatics Learning Environment.
- **Mapping Aging Research:** This National Endowment for the Humanities (NEH) grant visualizes information on the impact of governmental funding on the amount and quality of research publications on a 3D information landscape.

In addition to these projects, Dr. Borner's website contains some large 3D information visualization projects that require extensive discussion and use separate websites because of the quantity of information and the extensive resources generated by each of them:

**Information Visualization Software Repository,** http://iv.slis.indiana.edu

- Information Visualization Software Repository (also known as the InfoVis Cyberstructure: a data-code-compute resource for research and education in information visualization): This project was done as part of a graduate SLIS class to create a general information visualization software repository. The website contains many learning modules, software packages, databases, computing resources, and references.
    - o Learning Modules: Currently 10 learning modules are available, examining various 3D information visualization projects and providing evaluative exploration and analysis of each, with links.
        - — Time Series Analysis (Timesearcher vs Burst projects)
        - — Visualizing Tabular Data (GRIDL and Fisheye Tables)
        - — Visualizing Tree Data (Hyperbolic Tree, Radial Tree, Treemap)
        - — Semantic Data Analysis (LSA vs. Topics)
        - — Network Analysis & Visualization (Network Analysis Tool & Pajek)
        - — Error and Attack Tolerance of Networks (Random, Small World, and Free-Scale Networks)
        - — Search Performance of P2P Networks (CAN & PRU, CAN Search, & p-rand Breadth-First Search)
        - — Clustering Algorithms (Ward's Algorithm vs. Betweenness Centrality)
        - — Interaction and Distortion Techniques (Hyperbolic Tree, Fisheye Table)
        - — Social Visualizations (iUni and the AW toolkit)
    - o Software: Many interesting software are under this heading.
        - — Information Visualization Cyberinfrastructure (IVC): Open-source, freely available software to assist in creating a central code repository for information visualization work.
        - — Data Modeling and Data Analysis tools, including:
            - Structured Peer-to-Peer Models software
            - Unstructured Peer-to-Peer Models software
            - Various codes, most of which are available in the XML toolkit, including Network Search software, Vector Space

Model, Latent Semantic Analysis, Topics Model, Burst Detection, Pathfinder Network Scaling, Multidimensional Scaling, Self Organizing Maps, Clustering: Ward's Algorithm, and Clustering: Betweenness Centrality.

— Layout Algorithms software, including:
  - Parallel coordinates
  - SimVis
  - Spring embedding algorithm
  - Radial tree
  - Hyperbolic tree
  - Treemap
  - GRIDL

— Interaction algorithms software, including:
  - Fisheye table
  - Distortion
  - Zooming pan

— Software packages, including:
  - GeoZui3D (zooming user interface)
  - Worldmapper & User Trail & Chat Log Visualizations
  - Hierarchical Clustering Explorer
  - Time Searcher

— Open-source toolkits, including:
  - INRIA's InfoVis Toolkit
  - University of Maryland's Piccolo Toolkit
  - AT&T GraphViz
  - UC Irvine's Java Universal Network/Graph Framework (JUNG)
  - UC Berkeley's User Interface Research Group's prefuse
  - Social Network Visualizer

o Databases: access to an Oracle database that links up to various other databases that contain information and citations related to information visualization.

o Computer resources and references

- Collaborative Information Visualizations: Twin-Worlds—Memory Palaces & Mirror Gardens

  Virtual Worlds, http://vw.indiana.edu

  i-Palace, http://vw.indiana.edu/i-Palace

  i-Garden, http://vw.indiana.edu/i-Garden

  iUni—Information Universe, http://ella.slis.indiana.edu/~katy/iUni

  iScape—Information Landscape, http://ella.slis.indiana.edu/~katy/iscape

The Virtual Worlds websites are a shared online resource of documents for the faculty and students at the School of Library and Information Sciences (SLIS) at Indiana University.

Eventually, about 8,000 links will exist to various texts, images, videos, and software demonstrations. i-Palace organizes these links into a 3D space, and i-Garden visualizes user interaction data in 3D space such as navigation, chatting, Web access activity, and manipulation.

iUni is the result of a graduate SLIS class in 2D and 3D user interface design that produced a Natural Disaster Area, a Science House, a Quest Atlantis portal to different theme parks for kids, an Art Café, and a Virtual Collaboration area for faculty (links are provided off the iUni Web page).

iScape is a 3D information world that was the prototype for iUni. These 3D universes and landscapes can be accessed by downloading the free iUni 3D browser from the Virtual Worlds Web page.

- LVis: Visual Interfaces to Digital Libraries

  http://ella.slis.indiana.edu/~katy/InfoVis

  Called a "smart virtual reality interface to digital libraries," the Digital Library Visualizer (LVis) is a software product that supports the navigation through complex information spaces. It is a multimodal, virtual reality interface that maps data in digital libraries onto a 3D information landscapes.

- InfoVis Laboratory

  http://ella.slis.indiana.edu/~katy/gallery/index.html

  At this site, users see a visual presentation of much of the work previously mentioned above but with an interesting presentation called "Visualizing 3D Virtual Worlds and Their Users." VLearn3D, Avatars 2002, and other conferences and projects are shown in a 3D information world.

**A prototype demonstration of LVis with the Dido Image Bank in the Department of the History of Art at Indiana University,** www.dlib.indiana.edu/collections/dido.

### 3DNA

http://3dna.net

This software architecture seamlessly integrates the Windows desktop, Web browsing, and portal visualization into a compelling 3D environment. It also has many add-on worlds to download.

### 3DTop

www.3dtop.com/what.htm

Another software extension for Windows that represents desktop icons in 3D, letting the user fly around the desktop. Users can create background and floor textures, colored spotlights, paintings, clocks, flags that represent shortcuts, and more.

### TouchGraph LLC software products

www.touchgraph.com

Four major software products are available through this company. These software products are freely available for download and use. All these products use a 2D tree structure to display information and appear to be network information visualization applications.

The Dynamic Graph Layout unfolds and graphically displays information similar to a flower/tree layout, but the site provides little information on how to access or use this product, except for an applet that users can launch and play with.

The Planet-Wissen Navigator is used at the Wissen Planetarium website and allows the user to navigate through a topic map similar to stars in the sky. By clicking a topic in the topic map on the left side of the Web page, an explanation and visual examples of the topic are displayed on the right side of the screen. This particular software demonstration/website is in German, but it's worthwhile to play with.

**Wissen Planetarium,** www.touchgraph.com/PlanetWissen.html

The GoogleBrowser V.1.01 is a Java applet/browser that graphically retrieves the top 10 URLs that are similar to the initial URL written in the search box by searching Google. The user enters the URL in the search box, clicks "Graph it!," and a graphical representation of these top 10 links appears in a separate window. Clicking and double clicking nodes represented expands the number of retrievals from Google (an interesting product worth experimenting with).

An information page containing instructions for basic browsing, visual controls, and advanced graphics control is available at www.touchgraph.com/TGGB_FullInstructions.html. The Wiki Browser V.1.02 is similar to the Google Browser, except that it graphically maps wikis and their contents.

Nonfunctional screen shots of this product are available, but users need to download the software from Softforge (http://prdownloads.sourceforge.net/touchgraph/TGWB_102.zip) to examine the product in action.

### Visipoint

www.visipoint.fi

This software is a data visualization package.

### Visualization for Algorithm Development (VisAD)

www.ssec.wisc.edu/~billh/visad.html

VisAD is a Java component 3D software library application for interactive and collaborative visualization and analysis of numerical data. This website includes extensive documentation on the software, a user's tutorial, access to a mailing list, and various applications and experiments with the software, all of which appear to be open source and available for download.

VisAD was written by many programmers from around the world, including the Space Science and Engineering (SSEC) Visualization Project at the University of Wisconsin—Madison, the National Center for Supercomputer Applications, the Australian Bureau of Meteorology, the National Center for Atmospheric Research, and the Canadian National Research Council.

VisAdis a pure 3D information visualization program, using Java3D and Java2D in an ImmersaDesk virtual reality display. It has been adapted to many file formats, including GIF, JPEG, TIFF, QuickTime, and ASCII.

### Visualization Toolkit (VTK)

www.vtk.org

The Visualization Toolkit (VTK) is an open-source, freely available software system for 3D image processing, computer graphics, and visualization. It includes a textbook (*The Visualization Toolkit, An Object-Oriented Approach to 3D Graphics* by Kitware, 3rd ed., ISBN 1-930934-07-6), a C++ class library, and other interface layers in Tcl/Tk, Java, and Python. It is available in Unix, PC-based, and Mac versions.

**More VTK information and links to case studies,** www.kitware.com/case/vtkinuse.html

VTK has been used in many diverse application areas, including the Visible Human project and the Virtual Creatures for education project. Companies and universities that use VTK include CNMAT, DuPont, General Electric, GeoCap, Los Alamos National Laboratory, MapInfo, NCSA, SINTEF, Stanford University, University of Oslo, Vixbox, and Visual Numerics.

VTK is in Version 4.2 and is freely available for download from its website. It has a mailing list/listserv for users, a wiki, and FAQ.

### Visualize, Inc.

www.visualizetech.com

This company has many interesting products available. Most are built in Java. They include:

- VantagePoint™ creates 2D and 3D dimensional graphs.
- DataVista Explorer™ is a Java applet that graphically displays numerical data.
- StockPlot™ is for financial information
- DataVista Screener™ filters and ranks dynamic data in a browser environment.
- DataVista Spectrum™ converts large amounts of data into interactive color maps.
- DataVista Pedigree™ visually displays genealogical and human genetic studies information.
- Visual Genetics works with large datasets related to family and population-based studies
- MicroPoint™ creates graphic visualizations of data on handheld devices.

The website itself is dynamic, with constantly changing images and screen shots of the products in action. Under the "Technology" button, librarians can view explanations of the technology involved in an interactive environment.

### VisualLinks™

www.visualanalytics.com/Products/Visualinks.cfm

**Another VisualLinks demo,** www.visualanalytics.com/Products/Demo/VisuaLinks/VLDemo.html

A good demonstration of this product is available off the product information Web page cited under Overview (Flash), the last item on the menu on the right-hand side). The demonstration does a great job of explaining the product and its applications.

### VisualMine

www.visualmine.com/datasheet/datasheet.htm

www.visualmine.com

This product is a true 3D graphics visualizer, incorporating scatter, bar, tree, pies, clusters, planes, surfaces, and geographical maps, among others. It also comes with a Wizard, to help users perform activities in a semiautomatic way. This product also is designed to work in combination with other data mining tools.

### VisualNet

www.antarctica.net/products/visualnet.shtml

VisualNet is the major software product of Antarctica Systems. This visualization software product also has had extensive media coverage since the founder of this company, Tim Bray, is the co-creator of XML and one of the leaders of the Web.

VisualNet is in Version 4.2, and many projects have experimented with this software. The University of Wisconsin—Madison Kurt F. Wendt Library experimented with e-book collections graphically represented with VisualNet 3, and the Belmont Abbey College Library in North Carolina also used VisualNet 3 to graphically display its holdings on the Web (see URLs above the Websites section of this chapter).

The website does not provide any details regarding cost since each interested party probably has to negotiate price depending on size of collection/data and number of users, among other variables.

The site provides no opportunity to download or demo this software, although users can contact the company for information. Visiting the experiments indicated is the best way to see how this product works, although Version 4.2 would hopefully have more functionality than Version 3.

Map.Net appears to illustrate some real-world implementations of VisualNet, but it does not provide any clickable links to these implementations. The site includes a place to leave a phone number and e-mail address for access to these "customer deployments," but this action will probably place the user on a list of potential clients for the company to contact and nudge.

**Map.Net**, www.map.net

### Visual Thesaurus

www.visualthesaurus.com

### ThinkMap

www.thinkmap.com

Visual Thesaurus (constructed suing the ThinkMap software product) is a fascinating 2D/3D application applied to a thesaurus. Both a desktop and an online subscription are available for Visual Thesaurus at reasonable prices.

Visual Thesaurus creates an animated display of words and meanings—a visual representation of the English language. The visualization places the word in the center of the display, connected to related words and meanings. Users can then click these words or meanings to explore further.

The user can demo the product, by putting a term in the search box. Five clicks are allowed, before the demo indicates that the user has to buy the product to continue.

Incorporating the tree/star structure, terms are graphically displayed, with meanings of the requested word (as noun, adjective, verb, or adverbs displayed on the right-hand side). A history of the word is displayed in the bottom right-hand corner.

Moving the cursor over the nodes and clicking causes the image map to expand or contract into narrower/broader terms and move into other related areas from the original term requested. For example, if a user searches on the word *music,* the tree map displays a node close to the term *euphony.* When that word is clicked, the user moves into the narrower term *music of the spheres.*

This product is created using ThinkMap 2.5. More information on the architectural structure and the ThinkMap software development kit (SDK) are available on its website.

### Visual Understanding Environments (VUEs)

http://vue.tccs.tufts.edu

VUEs are tools that assist faculty and students with the integration of digital resources into their learning and teaching. VUEs are based on the idea of concept mapping as a learning tool, and much of the research and development of VUEs has been supported by the Andrew W. Mellon Foundation.

This website features the ability to download the VUE software, a user's guide, resources, a user's forum, and a place to upload and manage VUE maps. Some options require a login.

Other VUE websites of interest, also mentioned in the Syllabus article mentioned above, are the Open Knowledge Initiative (OKI) at MIT, which also features downloads of the OKI Open Source Interface Definition (OSID) software product; SourceForge, another source for download of the OKI OSID product; and the Fedora Project, which is used as a general-purpose digital repository system to support concept mapping.

*Note:* When concept maps not only represent ideas and directions, but provide access to the digital resources themselves, as in the above examples, then they become known as content maps.

**Open Knowledge Initiative,** www.okiproject.org

**SourceForge,** http://sourceforge.net

**Fedora Project,** www.fedora.info

### VisuMap

www.visumap.net

VisuMap (Version 1.6) is available in a Standard, Enterprise, and SDK edition.

### Vivisimo

http://vivisimo.com

http://clusty.com

This company features information visualization products; namely, the Vivisimo Clustering Engine, Content Integrator, and Enterprise Publisher. In September 2004, Vivisimo launched Clusty.com, the first full-service website search engine/browser powered by their breakthrough clustering technology.

Clusty.com groups search results into folder topics, giving the user the option of seeing the results as main themes and letting the user focus on topics of interest. These products are mainly geared toward the one-stop search engine that queries numerous databases, allowing the user to retrieve information from numerous locations and websites via one search query, rather than through multiple queries with multiple interfaces.

Although the search results do not appear in 3D or even 2D, this company offers an alternative product separate from many of the major online public access library vendors and their multiple search/one search interface products. Demonstrations of each of these products are available.

### VxInsight™

www.cs.sandia.gov/projects/VxInsight.html

This software, created by Sandia National Laboratories, is a 3D graphical tool for discovering relationships in large database. This software goes beyond other data retrieval tools and data mining software by revealing the implicit structure of the data.

Its primary focus is to help analysts uncover strategically important connections and patterns within datasets, which makes it an important knowledge management tool. The site has an FAQ, a demonstration video in API format, user case studies, and other information.

**Full description of Vxinsight,** www.cs.sandia.gov/projects/VxInsight/Vxfull.html

**Sandia's Data Visualization and Exploration department,** www.cs.sandia.gov/VIS, and its current list of projects, www.cs.sandia.gov/VIS/projects.html

### Webbook and Web Forager

www.parc.com/research/default.html

These two 3D visualization products, developed by Xerox PARC, do not seem to be available for download or purchase anymore. This website allows users to find out about this technology by typing either "webbook" or "web forager" in the search box in the upper right hand corner and retrieving various documents and research papers on these products.

The site has some nice screenshots and explanations regarding how these products would interact and work, but it at this time they are not available.

**An article on WEbbook and Web Forager,** www.infovis.net/E-zine/2004/num_154.htm

### Webbrain 2.0

www.webbrain.com/html/default_win.html

This website is an interesting 2D way to search the Internet. Users can click categories at the top of the website to see how topics and categories relate to one another. Appropriate links to those topics selected appear further down on the Web page. User also can do traditional searching via a search box.

### WEBSOM—Self-Organizing Maps for Internet Exploration

http://websom.hut.fi/websom

This software organizes miscellaneous text documents into meaningful maps.

**WEBSOM example,** http://websom.hut.fi/websom/comp.ai.neural-nets-new/html/root.html.

### Web Squirrels Information Farms

www.eastgate.com/squirrel/Farms.html#MarksFarm

This software tool tracks and visualizes Internet and other electronic information resources, notably e-mail and Web URLs. Some screenshots of the product in action are available at the website. Supposedly, this software uses the concept of information farms, a phrase coined by Frank Shipman of Texas A&M University and Cathy Marshall of Xerox PARC, whose VIKI software is an important influence on the design of this software.

### Xcruiser

http://xcruiser.sourceforge.net

**An engrossing Xcruiser, demo,** http://xcruiser.sourceforge.net/demo.html.

Xcruiser lets the user fly through a file system in 3D as if it were interplanetary space. Directories are represented as galaxies, files are represented as planets (whose mass is determined by the file size), and symbolic links are represented as wormholes.

### XGobi and XGVis

www.research.att.com/areas/stat/xgobi

XGobi is a freely available data visualization system for viewing high-dimensional data. It is based on scatterplots and line drawings moved into an interactive 3D environment. XGVis is an interactive visualization system for proximity data, networks, and graphs. More information on both, as well as download directions, is available from the website.

### XmdvTool

http://davis.wpi.edu/~xmdv

This free open-source software product is for the interactive visual exploration of multivariate datasets.

### xrefer Research Mapper

www.xrefer.com/research

This fascinating software product by xrefer presents search results in 2D clustering, allowing the user to see various relationships and tangents from their original search. Moving the cursor over the cluster map/points brings up related information in the specific cluster. Clicking these points then takes the user further into the hierarchy (for instance, have fun typing in search terms such as "music history," "music," "musicology," and "music of the spheres").

A free 30-day trial version is available for experimentation by information organizations at the website. Users also can play with this software by entering just one search term at a time (without the ability to click further into the information) at the URL given above.