

IBM Research Report

Design and Implementation of a Visual Interface for Online Product Catalogs

Juhnyoung Lee, Ho Soo Lee

IBM Research Division

Thomas J. Watson Research Center

P.O. Box 218

Yorktown Heights, NY 10598

Priscilla Wang

Department of Computer Science

University of California at Berkeley

Berkeley, CA 94720



Research Division

Almaden - Austin - Beijing - Haifa - T. J. Watson - Tokyo - Zurich

DESIGN AND IMPLEMENTATION OF A VISUAL INTERFACE FOR ONLINE PRODUCT CATALOGS

Juhnyoung Lee, Ho Soo Lee

IBM T. J. Watson Research Center, P. O. Box 218, Yorktown Heights, NY 10598, USA

Email: jyl@us.ibm.com, lehs@us.ibm.com

Priscilla Wang

Department of Computer Science, University of California at Berkeley, Berkeley, CA 94720, USA

Email: pwang@cory.eecs.berkeley.edu

Key words: Electronic commerce, product catalog, visualization, user interface

Abstract: One of the key elements of e-commerce systems is the online product catalog. It provides sellers with a content management system that assembles, aggregates, normalizes, and distributes product information. It also provides potential buyers with an interactive interface that offers a multimedia representation of the product information as well as retrieval, classification and ordering services. In this paper, we discuss the interface of online product catalogs, focusing on its ability to help shoppers navigate and analyze product information. Specifically, we present a new interactive interface for online product catalogs that is effective in navigating through the product information space and analytically selecting suitable products. It uses a multi-dimensional visualization mechanism based on parallel coordinates and augmented by a number of visual facilities for filtering, tagging, color-coding, and dynamic querying. To demonstrate the capabilities of the product catalog interface for online retail stores and marketplaces, we implemented a prototype displaying a set of automobile data. We explain how the prototype visualizes the entire product information space in a single page and supports intuitive exploratory analysis with the visual facilities.

1. INTRODUCTION

Over the past few years, *electronic commerce* (or *e-commerce*) on the Internet has emerged as a dramatic new mode of business. One of the key elements of e-commerce systems is the *online product catalog* (or *electronic product catalog*). Online product catalogs are much more than the electronic version of printed product catalogs (Schmid 1997). On one hand, they are a *content management system* that provides sellers with the ability to assemble, aggregate, and normalize product (or service) information from supplier databases and to quickly, inexpensively, and easily distribute the information. On the other hand, they provide potential buyers with an *interactive interface* by offering a multimedia representation of product information as well as retrieval, classification, and ordering services.

There have been extensive research and development activities for both aspects of the online

product catalog. For content management, a number of commercial products are available from companies such as CardoNet, Interwoven, OnDisplay, Poet Software, and Vignette, and are used by many e-commerce sites (Neumann 2000). For catalog interfaces, various methods supporting product search and navigation have been developed and are being utilized. They include hierarchical browsing, search based on keywords or parameters, interactive product design or configuration, dialog-based product filtering, product ranking, and the side-by-side product comparison table (Stolze 1998). These product information navigation methods are sometimes referred to as *shopping metaphors*. The usability of several product selection mechanisms was empirically studied in (Callahan 2000, Stolze 1999). Also, the impact of different shopping metaphors on the effectiveness of online stores in terms of click-through and conversion rates was analyzed and visualized in our previous work (Lee 2000).

In this paper, we revisit the interface aspect of the online product catalog focusing on its ability to help shoppers solve the *product selection problem*. When selecting a product (or service) to buy, a shopper often needs to consider a number of different factors. For example, there may be factors related to the *product specification* such as price, material quality and properties, color and size. In addition, there may be factors related to the *service specification* such as delivery time and cost, and warranty. Furthermore, there may be *supplier qualification* factors such as delivery experience and reputation. To make reasonable decisions about which products to buy, the shopper should be able to analyze and compare the multiple attribute values of alternative products (and their suppliers). In this sense, product selection is a *multi-criteria decision analysis* process (Anderson 1998, Webster 1995). One of the important functions of the online product catalog interface is to facilitate the analysis process by helping buyers effectively navigate and analyze product information.

In this paper, we present a new interactive interface for online product catalogs for e-commerce sites such as online retail stores and marketplaces. The interface is referred to as *Visual One-Page Catalog* (VOPC). It uses a visualization mechanism based on *parallel coordinates* and augmented by a number of visual operations. In several ways, VOPC facilitates navigation of the product space and analysis of individual products taking their multiple attribute values into account. It presents the entire information space of offered products in a single Web page. This compact display makes it easy to navigate through the product space and compare different products. Despite the amount of product information shown in a single page, the visual presentation of VOPC alleviates the possibility of information cluttering. Diverse visual operations together with the visualization solve the navigation and analysis aspects of the product selection problem. Easy-to-use facilities such as filtering and dynamic querying, tagging, color-coding, and auxiliary multimedia data are also effective for navigation and analysis of the product information space.

To demonstrate the usefulness and applicability of the VOPC interface to Web sites such as online retail stores and marketplaces, we implemented a prototype displaying a set of automobile data. We explain how the prototype supports intuitive exploratory analysis and helps interactive analysis with the visual facilities.

The rest of this paper is structured as follows: Section 2 explains the requirements of the online

product catalog. Section 3 describes the design and facilities of the VOPC interface. In Section 4, we describe the implementation of the VOPC prototype with a set of automobile data. Finally, in Section 5, conclusions are drawn and future work is outlined.

2. REQUIREMENTS

The ability to efficiently navigate and analyze product information in Web sites is particularly important to *rational buyers* (or *analytical buyers*) (Stolze 1998). Unlike emotional, habitual, or social buyers who shop for fun, to exchange ideas and opinions, or to share the shopping experience with others, rational buyers analyze and compare different product offers looking for the one that best fits their specification (e.g., best value for price). Many consumers who search the Web for good deals are rational buyers. Also, business buyers are typically rational buyers. For example, when a business buyer who works for procurement in her/his company visits an online MRO (Maintenance, Repair, and Operations) market such as Grainger.com and searches its product catalog, s/he is primarily concerned about finding products that best fit her/his company's needs. In this section, we summarize several basic requirements for the product catalog interface in effectively supporting such rational buyers in their needs for analytical product selection.

First, the online product catalog interface should provide a multi-attribute matching capability. As explained earlier, product selection is a multi-attribute decision analysis process that takes into account multiple attributes of products in various categories such as product and service specification, and supplier qualification. In addition, there are a couple of factors that make the analysis process even more complicated. First, some attributes are more important than others. For example, express delivery service or extended warranty may be more important than the product price for some buyers. Second, there may be relationships among product attributes. For example, the importance of one attribute may be conditioned by the value of another attribute. Regarding the multi-attribute matching requirement, the catalog interface should facilitate frequent operations such as finding one or more products having a certain set of multiple attribute-value pairs, finding a set of multiple attribute values of a given product, and comparing multiple attribute values of two or more products.

Second, the online product catalog interface is required to facilitate efficient navigation of the

product information space. Often in online stores, buyers are required to go through many Web pages (and therefore, mouse clicks) to locate information of interest. Also, search facilities often provide many results that seem unrelated to the request. It was reported that navigation problems are the second most cited reason for not shopping online (after security concerns) (Manning 1998). Online catalog interfaces should allow rational buyers a high level of analyzability by providing the ability to easily navigate through the product information space and locate information of interest.

Another requirement related to navigation is “soft” navigation capability. In online buying processes, it is important to distinguish “hard” and “soft” navigation (Stolze 1998). Product catalog interfaces that offer only hard filtering mechanisms exclude products that do not match the constraints specified in navigation. Hard filtering mechanisms interpret buyers’ requests as requirements and not as preferences, although in many cases, it is natural to interpret them as preferences. Soft navigation (or flexible navigation) reduces this problem by allowing buyers to distinguish between requirements and preferences. One of the proposed soft navigation methods is *product scoring* (Stolze 1998). While requirements are still used for product filtering, preferences are used for computing a product score that describes how well a product matches the specified preferences. Products that match fewer preferences receive a low score, but are not excluded from the catalog view.

Finally, the online product catalog interface should support buyers in terms of allowing them to feel confident that their purchase decision using the interface saved them both time and money. This requirement is particularly important for business buyers whose purchase decisions always need to be justified. To achieve this accountability, it is critical to provide an appropriate explanation of why the selected product best fits the buyer’s specifications. That is, the catalog interface should simplify thorough navigation of relevant products and comparison of their attribute values.

The objective of this work is to design an online product catalog interface that fulfills these inter-related requirements for analytical product selection. As we will explain, by utilizing the multi-dimensional visualization mechanism of parallel coordinates and adopting various visual facilities for analysis, the VOPC interface provides a novel solution to the product selection problem.

3. DESIGN

A parallel coordinate system was proposed as a more practical way of displaying multi-dimensional data sets (Inselberg 1991). Visualization of higher (i.e., more than three) dimensional geometry with the traditional Cartesian coordinate system where all axes are mutually perpendicular is difficult. Because we live in a three-dimensional world, understanding the space involved with a Cartesian coordinate system of more than three dimensions is a near impossible task for most people.

In parallel coordinates, all axes are parallel to each other and equally spaced (the spacing between adjacent axes is typically of unit length). In an n -dimensional space, there are n parallel axes (X_1, X_2, \dots, X_n) each representing a separate variable. To plot an n -dimensional point (x_1, x_2, \dots, x_n) , adjacent values on their respective vertical axes are connected by a line for a total of $(n-1)$ connected line segments. In this way, parallel coordinates allow the visualization of higher order geometries in an easily understood two-dimensional representation. Parallel coordinates are able to display correlations and patterns in multi-dimensional data sets. Figure 1 shows the representation of a six dimensional point $(4, -2, -3, 2, 1, -2)$ in parallel coordinates. The Visual One-Page Catalog uses parallel coordinates to display products and their attributes in a single Web page. Each axis represents an attribute; the online shoppers dynamically determine the number and type of attributes. The plot of a (multi-dimensional) point represents a product.

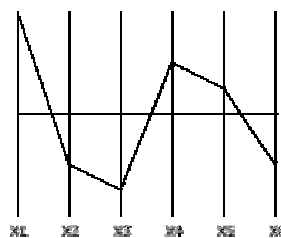


Figure 1. A point in parallel coordinates

3.1 Design Notes

In the VOPC interface, the layout of the typical parallel coordinate system is rotated clockwise by 90° so that the parallel axes are horizontal. The axes are rotated from the standard vertical position because users are generally more accustomed to using the vertical scrollbar, which would be necessary if the online shopper specified many

attributes so that all the axes do not fit on a single screen. We believe that the horizontal layout is also more intuitive and natural in general for this application.

The background color is black since it is generally more visually pleasing when the color-coded products are placed on a black background than when they are placed on a light gray or white background. The data plots along the attribute axes are short vertical lines (“matchsticks”). This minimizes the amount of overlapping that can occur between two or more data points. The product lines consist of straight-line segments connecting appropriate values across the attribute axes. For a more artistic look, slightly curved lines can be used to make the product lines flow more smoothly. Figures 3, 4, 5 and 6 show sample VOPC views.

3.2 Product Categories

The product categories represent the different types of products in a catalog, or how products are organized in the product catalog. For example, two categories in an automobile catalog are vehicle type and manufacturer. In the VOPC interface, each category is associated with a hierarchical view of the products. Shoppers can view the different tree structures by clicking on their preferred category of organization in the tabbed pane on the left side of the user interface (see Figure 7).

Each category is also associated with a different color-coding of the products. If all categories requested do not have any sub-categories, then the products are color-coded according to their category. However, if any category has sub-categories, then products are color-coded by one category only. For example, cars can be color-coded either according to their vehicle type or according to their manufacturer (see Figure 7).

3.3 Product Attributes

The product attributes are multiple factors that a shopper considers when purchasing a product. As mentioned earlier, they include factors related to product specification, service specification, and supplier qualification. In this design, we focus on the first two types of factors.

First-Tier Attributes

Attribute values in this tier are crucial in the decision analysis process and/or have known most

desirable values (i.e., most desirable values do not vary from shopper to shopper). For example, in an automobile catalog, first-tier attributes would include price and ratings. Attributes in the first tier are included in the parallel coordinates plot as axes.

Second-Tier Attributes

Second-tier attributes are important, but do not fit in the first tier (i.e., lower or higher boundary values are not necessarily more desirable). In an automobile catalog, second-tier attributes might include an image of a car and fuel tank capacity. Attributes in the second tier are either included in the parallel coordinates plot with the use of target values (see “Comparing Product Lines” below), or displayed if the user decides to view additional information about a product (see “Viewing More Product Information” below).

Third-Tier Attributes

Attribute values in this tier are relatively unimportant to the typical shopper. In an automobile catalog, third-tier attributes might include number of cylinders and braking distance. Third-tier attributes are displayed if the user decides to view additional information about a product (see “Viewing More Product Information” below).

3.4 Catalog Operations

Viewing Product Attributes and Values

Figure 2 shows an example user interface that a shopper can use to request the initial product catalog view. Using this interface, the shopper can set bounds on attribute values to narrow the scope of products s/he is interested in possibly buying. For example, the shopper may wish to look at only those cars that have MSRP values between \$24,000 and \$40,000. In this case, the shopper must simply enter those two values as the lower and upper, respectively, MSRP bounds. Then when the associated product view is displayed, the MSRP axis is bounded by those two values. If the shopper does not specify bounds for an attribute in the initial catalog view request, the minimum and maximum values for that attribute for all products in the catalog are used for the bounds. Figure 3 displays an initial product catalog view in the VOPC model showing five first-tier attribute values of ten products from three different product categories (distinguished by the

color used for the “matchsticks”). The names of the attributes and the unit of their values are specified below each axis. The attribute values displayed as “matchsticks” in the view are color-coded by product category. Also, the visualization of attribute values helps the shopper intuitively understand how the product attribute values are distributed over individual attribute coordinates.



Figure 2. Initial product catalog request form

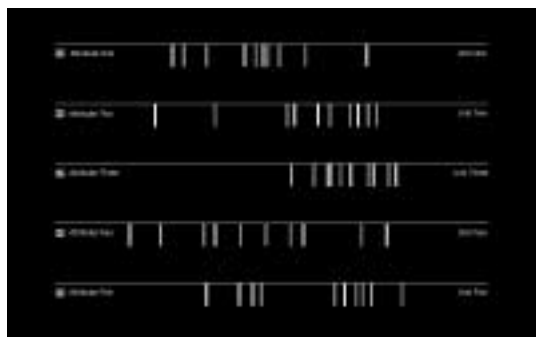


Figure 3. An initial product catalog view

Customizing Product Attributes

VOPC allows the shopper to dynamically choose all the attributes to show in the initial product catalog view. Initially, all checkboxes (each

associated with an attribute) are selected. However, if the shopper later decides that a particular attribute is not that important in the analytical product selection process (e.g., if all products share the same value for an attribute), s/he can de-select the checkbox for that attribute. De-selected attributes are moved to the end of the list of attributes, and are not part of product lines. The corresponding axis and points are moved accordingly (see Figure 7).

Selecting a de-selected checkbox moves the checkbox and its corresponding axis and points to the end of the list of attributes that are already selected. The shopper can do a series of de/select operations on the attribute checkboxes to order the attributes by decreasing importance. Doing so would aid the shopper’s analysis process (see “Comparing Product Lines” below). The operation of changing the order of the attributes can be simplified by adding drag and drop capabilities to the checkboxes.

Viewing Product Lines

A product line is the line formed as a result of plotting a point on the parallel coordinates axes. Each product has an associated product line. Only a subset of product lines is visible at a time. The subset is determined by where the mouse pointer is positioned on the VOPC screen. If the mouse pointer were positioned over a data point, all product lines that share that data point would be made visible. Figure 4 shows the display of a product line in the VOPC view triggered by a mouse fly-over. It also displays a tool-tip showing the short description of the associated product.

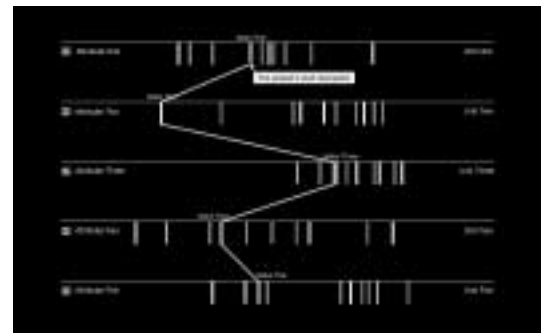


Figure 4. Viewing a product line

Tagging Product Lines

Since a product line is only displayed when the mouse pointer is positioned over one of the product

line's data points, the tagging operation relieves the shopper of having to rely on visual memory when comparing two or more product lines. To tag a product line, right-click on any data point that is part of the product line and select "Tag." Figure 5 shows a pop-up menu window for tagging and other operations ("More Info" and "Add to Cart") associated with individual product lines. If multiple product lines share a data point and that data point is used as the starting point of the tag operation, the shopper is prompted to choose which product line(s) to tag. Tagged product lines remain visible in the catalog view even when the mouse pointer is no longer positioned over one of the product line's data points. Product lines may also be untagged. To untag a product line, right-click on any data point that is part of the product line and de-select "Tag."



Figure 5. Tagging a product line

Comparing Product Lines

One of the primary goals of the VOPC interface is to help the shopper analyze product information by comparing alternative products. Therefore, the layout of the product lines is key to the design of the VOPC interface. For the shopper to fully take advantage of VOPC, s/he must be aware of this layout. On each attribute axis, the values either increase or decrease according to whether higher or lower values, respectively, are more desirable in general. In this fashion, the product lines visually show their product's desirability. That is, product lines that are closer to the right side of the screen are more desirable than product lines that are on the left side of the screen. The right side of the screen was chosen to be the "target area" because the left side is already somewhat cluttered with attribute checkboxes.

It is likely that no product line will appear completely in the target area on the right side of the

screen. In this case, ordering attributes by importance helps the shopper to assess which products are most desirable. By placing the most important attributes towards the top of the screen, the shopper knows that a product line that fits in the target area in the top part of the screen and wanders out of the target area in the bottom part of the screen is more desirable than a product line that fits in the target area in the bottom but not top part of the screen. The shopper can use this kind of placement/desirability information to make a good decision about which product(s) to buy. Figure 6 shows the comparison of two products from different categories in the VOPC model.



Figure 6. Comparing product lines

Viewing Additional Product Information

Product values for additional attributes can be viewed by right-clicking on any data point of a product line that the shopper is interested in and selecting "More info" (see Figure 5). This operation causes a small window (or a Web browser) to pop up with the additional information. Attributes that are viewed in this fashion often include attributes that have non-numerical values such as text, image, audio, or related Web pages. Generally, these types of data cannot be ordered by desirability except by the shopper himself/herself, so they are typically not included in the catalog view.

Adding a Product to the Shopping Cart

This operation can be accomplished by first right-clicking on any data point that is part of the product line for the product to be added to the shopping cart, then selecting "Add to Cart" (see Figure 5). A product can be removed from the shopping cart by right-clicking on any data point that is part of the

given product and de-selecting “Add to Cart.” Clicking on the “Checkout” button launches a Web browser on a simple html page that shows the current state of the shopper’s shopping cart (see Figure 7).



Figure 7. The Visual One-Page Catalog prototype

4. IMPLEMENTATION

The VOPC prototype has been developed in the Java programming language using IBM VisualAge for Java IDE (Interactive Development Environment) and IBM DB2 Universal Database System. The prototype runs as a Java applet because VOPC is to be used in an Internet context. For implementing graphical elements of the VOPC interface, we used the JFC Swing classes. In addition to using the JFC Swing classes, we have created several custom classes including two applets, CarData and CatalogView. CarData is an applet that represents the initial product catalog view request form (shown in Figure 2). It provides an interface that allows the user to specify which sub-categories of products s/he would like to view. The user also needs to choose the attributes that should be plotted, and can set upper and/or lower bounds on the attribute values. Only products that meet all user requirements are included in the catalog view. CatalogView is an applet that represents the view of the one-page product catalog (shown in Figure 7). Using Swing’s GridBagLayout, the catalog view is split into three main sections. A left panel displays a color-coded hierarchical view of the products requested. A middle panel contains checkboxes associated with the attributes requested. The main panel is on the right and displays the parallel coordinates plot (consisting of axes and points).

The implementation uses a sample database of 39 automobiles stored using IBM DB2 Universal Database. We selected automobiles as the shopping domain for our prototype because cars make a good set of example products with many attributes of different types. The two main categories used to categorize the cars are vehicle type and manufacturer. There are six vehicle types: convertible, coupe, hatchback, sedan, SUV, and wagon, and three manufacturers: Audi, Lexus, and Saab. The six first-tier attributes are: MSRP, seating capacity, cargo capacity, horsepower, city mileage, and highway mileage, and are all integer-valued. Other attributes with integer values include dealer invoice, length, width, height, wheelbase, ground clearance, zero to sixty speed, top speed, braking distance, towing capacity, number of cylinders, valves per cylinder, driver crash test, passenger crash test, basic warranty, power warranty, and corrosion warranty. There is one double-valued attribute: fuel tank capacity. Also, there are several text-valued attributes: model, location of engine, engine type, drive train, transmission, reliability, injury frequency, vehicle theft, collision, country of manufacturer, and origin of assembly.

5. CONCLUSION

In this paper, we have presented a new interactive interface for online product catalogs that provides an alternative structure to the typical online product catalog. It uses a multi-dimensional visualization mechanism based on parallel coordinates and augmented by a number of visual facilities for filtering, tagging, color-coding, and dynamic querying that are useful for navigating and analyzing product information. The structure of VOPC involves compacting product pages into a single Web page. The use of parallel coordinates not only saves shoppers from needing to navigate endless product pages but also assists shoppers in the decision-making process involved in analytically selecting which product(s) to buy.

One limitation of the current approach involves the use of parallel coordinates. If too many product lines are tagged, it is likely that the parallel coordinates plot would be rather complicated and the shopper’s ability to make good comparison decisions might be decreased. A possible solution to this problem is to integrate a product-scoring scheme into the VOPC model for filtering products before visualizing them using parallel coordinates. For example, if a shopper’s search criteria match more

than 20 products, the VOPC displays only the top 20 products as ranked by the product scoring method. This simplifies the comparison of product lines since the shopper does not have to review the lower-ranked products that have been filtered out. Also, one of the weaknesses of the scoring method mentioned in Section 3 is taken care of by the visualization involved in parallel coordinates since individual attribute values are showed in addition to the scores.

Another limitation involves the type of products that VOPC supports. VOPC is most ideal for products that have at least a handful of key attributes that have concrete most ideal values so that the parallel coordinates plot would provide a sufficient comparison of two or more products. For products with more complex attributes that are key factors in product selection, the shopper would still have to view this "additional information" on a separate Web page (outside the parallel coordinates plot) for all products s/he is even somewhat interested in. The idea is for the parallel coordinates plot to provide most of the comparison data, with the shopper probably choosing to view additional information on just a few products that s/he has narrowed her/his search down to using the parallel coordinates plot.

Also, VOPC is most ideal for homogeneous product sets in which member products share a common set of product attributes, because product lines are plotted over coordinates representing products sharing common attributes. In fact, this feature makes the VOPC model fit well with bid evaluation and the selection process in reverse auctions such as RFQs (Request For Quotes) or RFPs (Request For Proposals) where relevant attributes such as product/service specification and supplier qualification are given by the buyer for bids. Such auctions are popular in industrial procurement environments supported by business-to-business marketplaces on the Internet. However, support for analytical bid evaluation in most existing marketplaces is currently rather primitive.

We plan to do more work on the VOPC prototype. First, we will add more operations to the prototype. One operation is zooming, with which shoppers can view additional product information in multimedia forms (e.g., image, animation or text) on zoomed-in data point objects. In addition, we will add an operation that helps shoppers find products with similar attribute values. For this operation, we will incorporate a product-scoring scheme that is based on "nearness" among products (or more specifically, product attribute value sets). With this operation, a shopper can locate products that best fit

the desirable attribute values that s/he specified. Second, we plan to add the "target area" of desirable attribute values, which we briefly mentioned in Section 5, to the product catalog view. Shoppers will be prompted to provide target attribute values during the initial product catalog request session, and will be able to dynamically modify them during the analysis session. Third, we will incorporate the drag and drop operation into the user interface, so that shoppers can use the operation to reorder attribute lines instead of the current attribute checkboxes. As we complete the VOPC prototype with these new features, we plan to perform a more structured usability study for the prototype to understand how the system would influence buyer perceptions, and also experiment with the VOPC model on the Web sites of operating online retailers and marketplaces.

REFERENCES

- J. C. Anderson and J. A. Narus, *Business Market Management: Understanding, Creating and Delivering Value*, 1st Ed, Prentice Hall, Inc., 1998.
- E. Callahan and J. Koenemann, 'A Comparative Usability Evaluation of User Interfaces for Online Product Catalog', *Proc. of the 2nd ACM Conference on Electronic Commerce*, 2000, pp. 197 – 206.
- A. Inselberg and B. Dimsdale, 'Parallel Coordinates A Tool for Visualizing Multivariate Relations', *Human-Machine Interactive Systems*, Plenum Publishing Corporation, 1991, pp. 199-233.
- J. Lee and M. Podlaseck, 'Using a Starfield Visualization for Analyzing Product Performance of Online Stores', *Proc. of the 2nd ACM Conference on Electronic Commerce*, 2000, pp. 168-175.
- H. Manning, J. C. McCarthy, and R. K. Souza, 'Why Most Web Sites Fail', *Interactive Technology Series*, 3(10), Forrester Research, Inc., Cambridge, MA, 1998.
- A. Neumann, 'A Better Mousetrap Catalog', *Business 2.0*, February 2000, pp. 117-118.
- B. F. Schmid, 'Requirements for Electronic Markets Architecture', *Electronic Markets*, 7(1): 3-6, 1997.
- M. Stolze, 'Soft Navigation in Product Catalogs', *Proc. of the 2nd European Conference on Research and Advanced Technology for Digital Libraries*, Heraklion, GR, 1998, pp. 385-396.
- M. Stolze, 'Comparative Study of Analytical Product Selection Support Mechanisms', *Proc. Of INTERACT 99*, Edinborough, UK, 1999.
- F. E. Webster, *Industrial Marketing Strategy*, 3rd Edition, John Wiley & Sons, April 1995.