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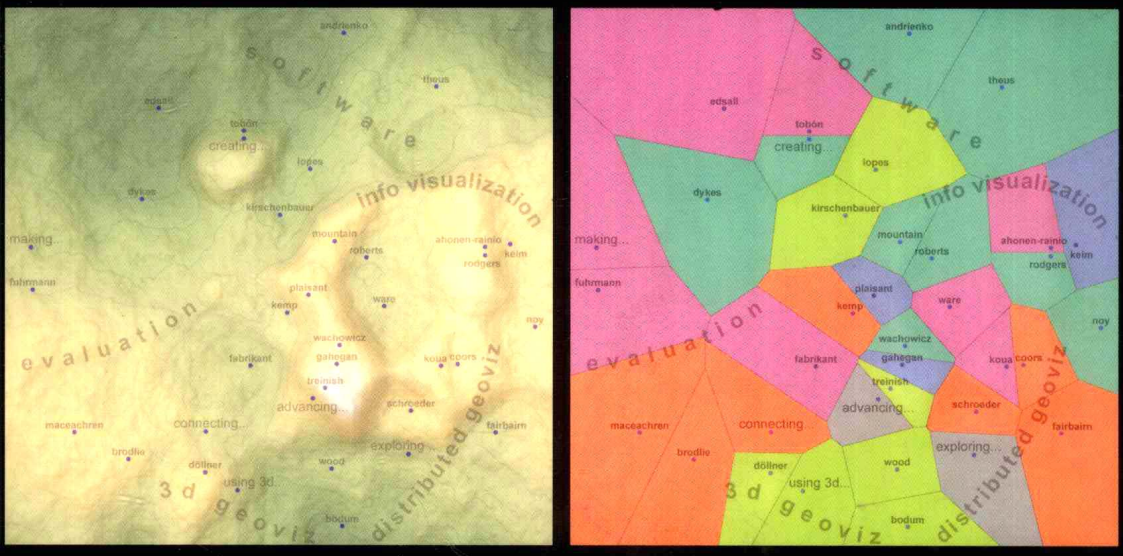
# EXPLORING GEOVISUALIZATION

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# EXPLORING GEOVISUALIZATION

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# EXPLORING GEOVISUALIZATION

The maps on the cover are spatializations that use the landscape metaphor to represent the information in this book. The symbols represent the chapters, the relationships between them and the themes that they address as described in the Preface. Maps by Sara Fabrikant, Jo Wood and Jason Dykes.

# Preface

Can you judge a book by its cover? "Exploring Geovisualization" draws upon perspectives from disciplines including information science, computer science and cartography to discuss and advance the emerging field of geovisualization and maps the contributions from these fields on the cover of the book.

One of the areas in which expertise from these domains has been usefully combined to develop techniques and augment knowledge is in the generation and mapping of information spaces or spatializations. These are maps that show the relationships between a series of documents in a collection according to the information contained in each.

The cover of this book contains two such maps, on each of which the chapters within are displayed as a landmark. These are represented on the maps with a point symbol and a label identifying the first author of the chapter. The landmarks are arranged using a technique that places documents with more similar contents closer together on the page. The maps themselves fill a continuous information space in which a variety of topics are organized according to their semantic relationships. Where chapters are more closely related, landmarks are clustered in the information space and we can consider the document collection (the book in this case) to have a particular focus on the themes that the chapters address.

It seems plausible to draw upon the metaphor of the landscape to map the presence or absence of information relating to themes within the information space. This can be achieved by representing the various thematic foci of the book as an undulating semantic surface with continually varying magnitudes. Where a number of chapters are relatively closely related the information landscape metaphorically piles up into mountains of information about a particular theme. The valleys between information peaks occur in areas of the information landscape associated with topics about which the book focuses less explicitly. The topographic shading scheme used in the map on the left draws further upon the metaphor to represent the "thematic density" of the book across our information landscape.

Note however that the landscape and the distribution of the documents represent contributions to this book, and the documents themselves are only discrete samples of possible information sources within the information space – there are likely to be alternative information sources beyond the scope of this volume that can fill

the information valleys. Indeed it could be argued that whilst the chapters that are clustered in our information space represent current research foci (as reported here), those in information valleys and isolated locations may represent topics that require additional research efforts and are the most 'cutting edge'.

The map on the right splits the landscape up into discrete units and shades the information space according to the section of the book in which the chapter represented by the closest landmark occurs. This allows us to see how the sections of the book map into our information space and the themes that are represented by areas within it. The map also allows us to consider the ways in which the chapters within the sections relate to each other according to our spatialization.

We hope that these graphics and the metaphor are interesting and that they will prompt some thought about both the book and the nature of maps and information spaces.

Some of the decisions taken in developing these spatializations are subjective (though each was thoroughly discussed and we have been through a number of redesigns!) and any number of graphical realizations of the contents of the book might be developed. There are clear parallels here with conventional cartography that depicts the world around us as all map-makers draw upon the three major tenets of map design: theme, purpose and audience, to develop their products. The main difference with spatialization is that it is perhaps more difficult to compare maps of information to an objective truth than is the case with traditional cartography. Despite the complex transformations and abstractions that occur and are imbued with the influence of personal and socio-cultural preference and bias, most cartographers would accept the existence of a 'reality' that they are mapping, that shapes their work, and upon which to develop their design and assess error. When generating spatializations we do not have the notion of a physical standard upon which to base and evaluate our maps.

In addition to their role in inspiring metaphors and stimulating thought and discussion we also hope that the maps on the cover provide both a pertinent starting point for the book and an overview of some aspects of its contents. Perhaps they offer a relatively novel opportunity to view and assess the scope of a book, or at least the relationships between the chapters within it, from its cover.

## Details on the Cover Map

The maps that we have used on the cover of the book utilize a topical or thematic density surface. The surface was produced by Sara Fabrikant and developed through discussions with the editors and a number of other colleagues. Jason Dykes and Jo Wood then used the LandSerf software to generate the maps, in discussion with Sara and others, by applying symbolism, shading and some cartographic exaggeration.

The process consisted of a number of stages. Initially Latent Semantic Indexing (Deerwester et al., 1990) was used to determine the similarities between all chapters by comparing the chapter titles and keywords submitted by the authors.

This seemed to produce more meaningful results than a comparison of the full-text of the abstracts. Principal Coordinate Ordination was then used to collapse the document similarity matrix into two-dimensional spatial coordinates. To generate a topical density surface that reflects the discrete nature of the input data (the book chapters in this case) a pycnophylactic surface was interpolated from these point locations (Tobler, 1979). The pycnophylactic reallocation approach is an areal interpolation technique that permits the construction of smooth density surfaces from more abrupt continuous data, such as those recorded in area-based enumeration units. The chapters represent such discrete boundaries within the information landscape of "Exploring Geovisualization". A voronoi tessellation was derived from the point locations to represent the maximal zone of influence for each of the 36 chapters. The voronoi boundaries were then used as break lines in the process of pycnophylactic interpolation to generate an estimation of the information landscape of the book. Full details on using the method to generate cognitively plausible information spaces are provided in the literature (see Fabrikant, 2001) and the development and application of a framework for doing so is presented later in Chapter 35 (Fabrikant and Skupin, this volume).

The resultant density surface was further manipulated in LandSerf (Wood, 2004) to add structured noise and to apply shading and some cartographic enhancements. The noise was designed to add visual interest, to draw attention to the uncertainty inherent in the surface and to reinforce the landscape metaphor of information 'hills' and 'valleys'. This was achieved by combining the density surface with a random fractal surface of fractal dimension 2.1. The original surface was smoothed and rescaled so that the total fractal noise was approximately 4% of the 'true' variation. LandSerf was then used to generate vector contour lines at a vertical interval of approximately 10% of the total variation in relief. The colour scheme applied to the surface is based upon the work of the Swiss cartographer Eduard Imhof for the representation of relief (Imhof, 1965). Relief shading was also computed in LandSerf and the combination of the original surface with the noise, contours, topographic colour scheme and hill shading emphasizes the use of the landscape metaphor to represent density of information about the themes in our landscape.

The voronoi polygons are shaded using a colour scheme derived from the examples, guidelines, and considerations suggested by Brewer (1994) and implemented in ColorBrewer (Harrower and Brewer, 2003). The colour scheme is also employed to differentiate between sections of the book in the digital appendices which provide a number of spatializations through which "Exploring Geovisualization" may be explored.

The labels were added using the comprehensive text elements in SVG. LandSerf will export raster surfaces to PNG, JPEG and other graphics formats and vectors directly to SVG.

Jason Dykes
Sara Fabrikant
Jo Wood

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# Digital Appendices

It is quite a challenge to produce a book on geovisualization as colour, animation and dynamism are so important in the field and yet we are severely limited in terms of the extent to which we can draw upon these essential features of digital cartography when publishing on paper.

We have therefore produced a series of digital appendices, included on the CD that accompanies this book.

These contain the colour imagery submitted by each of the authors and should be used in conjunction with your reading of the book and consideration of the figures (particularly those that rely upon colour).

The digital appendices are accessed through an interactive interface that draws upon a number of alternative spatializations of the contents of the book. These include those shown on the cover and discussed in the Preface. We also draw upon a network representation, rather than one that uses a continuous space to represent relationships between the chapters. The networks and their derivation are described in the introduction to the book (Dykes et al., this volume (Chapter 1)).

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