might be a problem on a field trip, what with spilled coffee and lunch.

Is this a collection of maps a cartographer would enjoy perusing for their artistic qualities? Certainly, this work is a major undertaking for a single person. The patience necessary to draw the maps and the steady hand for filling in the details on hundreds of them (this is the 5th volume after all) is unlikely to be found again, killed by the very technology we wish might have been used. That being said, there is much more one could wish for in details and references.

As a railroad nut (the polite term is "railfan"), I randomly examined some of the voluminous literature of railroad history and there is nothing of this scope even at the state level. Individual volumes may present more history (Carr 1989; Whitehouse 1988) but the maps are of secondary importance or non-existent. Most are in black and white and not particularly easy to decipher. Authors tend to concentrate on specific railroads or locales. Internet collections are not comprehensive and have only short histories, perhaps one or two photographs, and uncertain scholarship.

Mr. Carpenter has begun a vast undertaking—more than three fourths of our land mass remains to be serviced. This 5th volume is part of the Johns Hopkins University Press series *Creating the North American Landscape* which covers such esoteric topics as alley houses, the development of public courthouses, and the evolution of the mobile home. I look forward to further volumes that encompass the West—a vast railroad landscape for mining and public transportation, the remains of which are still visible to those that will look.

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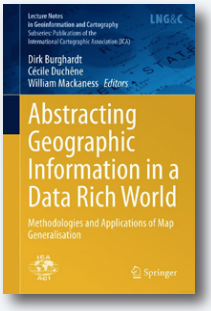
ABSTRACTING GEOGRAPHIC INFORMATION IN A DATA RICH WORLD: METHODOLOGIES AND APPLICATIONS OF MAP GENERALISATION



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Abstracting Geographic Information in a Data Rich World is an ambitious work that presents cutting edge achievements in one of the most complicated areas of professional cartography: map generalization. The ten hot research topics that comprise this 400-page volume are tightly fitted into a synoptic observation format that makes you feel the variety, depth, and breadth of contemporary map generalization research. While the fundamental work edited by Buttenfield and McMaster (1991; glorified by Dr. Anne Ruas as a "generalization bible" in its preface) [1] concentrated on generalization rules and knowledge engineering, this book follows the direction established by the 2007 ICA volume *Generalisation of geographic information: Cartographic modeling and applications* (Mackaness et al. 2007). It discussed the possibilities of on-demand mapping, real-time generalization, and agent-based systems that allow simultaneous generalization of a set of objects from different themes. The current volume is significantly more user-centric, wider in scope, and primarily addresses solving complex high-level methodological and technological problems, while leaving the many technical implementation details to the bibliography list that is available to inquisitive readers.

The main body of the book stretches from Chapters 2 to 11. Each chapter consists of two parts: the first part states the problem and reviews current approaches to solving it, the second part consists of three case studies (except Chapter 11, which includes results from seven national

mapping agencies and the INSPIRE program). This format allows the reader to quickly assess the significance of the problem and the effectiveness of its particular solutions. As the authors of Chapter 5 "Generalisation operators" state, they did not make an exhaustive review of generalization operators, concentrating instead on network generalization aspects in the "case studies" part. However the brief synoptic overview of operators is still here in the theoretical part of the chapter. This principle is true for every part of the book. The focus is on current problems, and historical overview is kept to a minimum. It gives the reader quick access to current achievements of map generalization research instead of a long slog through a boring textbook that mentions all previous contributions to the problem and its surroundings.

The concept of *data enrichment* is woven through almost every chapter of the book and seems to be one of the most important generalization tools. The editors emphasize the necessity of a very rich geographical model for a high level of automation in Chapter 1. Enrichment is a key to extraction of high-level structural properties of geographical distributions, which is important for *generalization of object groups* and systems. Data enrichment shows its usefulness both in tasks of generalization itself and in *evaluation* of generalization results. This is illustrated by case studies concerning hydrography networks and building patterns generalization in Chapters 6 and 9 respectively.

The book largely avoids digging into the innards of particular generalization operators and relationship measures between features, while concentrating on *generalization process modeling* (Chapter 7) and *spatial relationship ontologies* (Chapter 3) instead. These help users to formalize the knowledge about execution sequences of generalization operators and underlying spatial reasoning that is based on data analysis. Introduction of fuzzy relationships (Chapter 3) is important for effective data enrichment, because it allows for detecting patterns in not-ideally-arranged object groups. These patterns are then harmonized during generalization.

Evaluation is important for the description of spatial relationships and characteristics of objects that are altered by the generalization process. The book stresses the necessity of automated evaluation of generalization due to requirements of contemporary map production environments and on-demand mapping. Coupled with increasing demand for a user-centric approach, this points to a need for methods that estimate map quality from the point of view of an abstract reader. Map readability formulas presented in Chapter 9 are an example of one possible approach to this task. Overall, the eligibility of every generalization solution depends on the *user requirements* that result in *map specifications*, which can be discovered through knowledge-based systems and wizards in case of on-demand mapping systems. This task is investigated in Chapter 2.

Chapters 4 and partly 7 are more concerned with the technological base of generalization. In Chapter 4 a variety of *topological data structures* including tGAP and SSC (Space-Scale cube) are presented. These technological means are supposed to be effective in progressive data transfer and continuous zooming. The concept of 5D space-scale is vividly illustrated here and it possibly has a big potential not only in generalization but in multiscale data analysis too. A significant part of Chapter 7 is dedicated to usage of *web services* to provide generalization *geoprocessing tools*—another technological advancement that will cover requirements of web-based generalization systems in the near future.

Four application topics are singled out in separate chapters—integrating and visualizing volunteered geographic information (VGI; Chapter 5), terrain generalization (Chapter 8), generalization in context of schematized maps (Chapter 10), and generalization in practice within national mapping agencies (Chapter 11).

It is not a surprise that VGI received a great deal of attention in the book—2014 celebrated ten years of the OpenStreetMap (OSM) project, which has shown fantastic results providing an overwhelming amount of detailed and useful spatial data. However research in OSM generalization is still in its infancy, a fact emphasized in Chapter 5, which shows the simplicity of applied operators. Geosensor networks and popular social media also produce a large amount of spatial information that should be integrated with existing data for their usage in exploratory research. Some experiments in this area are also presented here. Overall, this chapter leaves the feeling that it more states problems than solves them, and I am sure that the topic of VGI generalization will be one of the hottest in the forthcoming decade.

Three interesting issues of *terrain generalization* mentioned in Chapter 8 are worth drawing attention to. The first is *visualization-oriented DEM generalization*, in which

terrain models are generated for a specific method of representation: hypsometric coloring and hillshading. The second is the possibility of including terrain in multi-agent models to make adjustments to surface geometry during generalizations to preserve topology and avoid conflicts. The third aspect is *security* of maps derived after generalization—specifically for generalization of isobathic maps. All these contexts are well illustrated by case studies.

Schematized maps represent the highest level of abstraction and are interesting both as a quintessence of generalization and as a vivid representation of main structural features. Some specific approaches to their creation and applications as well are presented in Chapter 9.

The final chapter "Generalisation in practice within *national mapping agencies*" is quite impressive. It demonstrates the variety of approaches to automated map production workflows in seven different countries (six European and USA) and international activity (INSPIRE). The difference between digital cartographic model (DCM) and digital landscape model (DLM) is shown here even more prominently than in the previous methodological chapters, being illustrated by real production examples. In this chapter the reader will find fully automated production workflows proudly presented by the Ordnance Survey, IGN France, and Kadaster NL—probably the most exciting result contained in this book. If you have read the book straight through from the beginning, at this point you will be satisfied to read these examples of real-world applications that prove that the previous investigations now have practical output, and the dream of automated generalization is becoming a reality. However, much is to be done in the world of abstracting of geographic information. Every chapter of the book states its own problems that are also summarized in the concluding chapter of the book.

This volume is probably not for all cartographers; it is deeply focused and is particularly oriented toward specialists in generalization problems. This focus makes it unsuitable for a novice reader who is unfamiliar with the technological and methodological complexities around abstraction of geographic information. All topics of the current generalization agenda are discussed, which makes this book invaluable for those who want to remain up to date in this area. The questions raised here are not the kind that can be quickly implemented from description. They concern high-level architecture of generalization systems and will take time to reconstruct. The authors of the book assume that the reader will be familiar with a variety of functions, such as line simplification, measuring distances, constructing triangulations etc., which are just atomic components in the presented methodologies.

Though it comes close, the book does not quite feel like a fully integrated monograph. It is still more like a compilation of topics, sometimes written independently of one another—little nuances betray it. For example, the design of schemes is dissimilar across chapters (compare, for example, Figures 3.19, 10.15, and 11.11—three completely different points of view to design!). In Chapter 5, the authors use the term "Dimensional change" (p130), whereas the term "Collapse" is almost universally recognized and is used to denote this operation in Chapter 6, which provides the observation of generalization operators. Information redundancy is not completely avoided, either. When you approach Chapter 8 in the second part of the book, you may note Figure 8.1, which illustrates the difference between model and cartographic generalization, despite the fact that this dichotomy was discussed more than once earlier.

There are also a few methodological aspects in the book that I found to be insufficiently developed or missing important conditions. In Chapter 4 the authors explain advantages of smooth tGAP/SSC structure while not mentioning that it can result in too narrow polygonal features. This is unacceptable in map generalization and can be clearly seen in Figure 4.7d (middle gray polygon). Some constraints in feature width should be introduced here and maybe a combination of classic and smooth structure should be tested. There are also real cases in which aggregation of polygons and their removal is invalid (administrative units, or countries, for example).

The Quadtree-based point generalization case study (Chapter 6), while being very interesting overall, misses analysis of the artificial regularity of some results. It also provides a strange explanation of priority between displacement in horizontal/vertical directions vs. diagonal—as if it is not known how the algorithm works and its influence has been discovered just from results of data processing. But possibly, this explanation is a consequence of the limited text space available for explanation. In Chapter 9, the authors discuss schematized maps and mention cartographic line frequency (OLLpA), then suggest the new Bertin (Bt) unit for its measurement. It seems strained and artificial to me, since by definition the OLLpA (as it is

given in the book) is simply *line density* measure in *cm* per cm^2 for example (see equation in Chapter 10.4.1).

In the introduction chapter the authors, trying to describe the full scope of problems in a limited text frame, sometimes become inaccurate in their statements. For example, they mention Hausdorff distance as a shape characteristic (6), but Hausdorff distance is more likely a measure that can be applied to estimate the proximity relationship (Chapter 3) between two groups of points or between two lines or two polygons, but is not a direct shape characteristic. In some places, more details would be better for understanding the material. The procedure of harmonizing requirements in the EuroSDR case study (Chapter 1) remains a black box; how it was performed in particular is unclear. An explanation of the algorithm for matching GPS trajectories with incomplete user-generated road data (Case 3 in Chapter 5) is too short and difficult to understand. The same concern comes up again in Chapter 9, in which map readability formulas are discussed but ironically not one formula is provided.

However that may be, these issues are inconsequential and very few in number. Overall this book provides a really critical contribution to summarizing, conceptualizing, and discussing the main problems and solutions in map generalization to date. Many questions that arise during the reading of the book can be cleared up via detailed inspection of the bibliography lists at the end of each chapter. I recommend this book to everyone who works with map generalization and wants to be productive in solving his or her tasks, as well as those who are interested in understanding short- and mid-term perspectives in map generalization developments.

Fifteen years passed between the founding of the ICA working group and the appearance of their 2007 book. This follow-up volume required only half as long to be published. This is a clear indication of increased activity in the field and of the necessity of spreading knowledge, noting problems, and initiating new discussions in the map generalization community. I hope that this accelerating rate of publications means that we will see the next book in a few years with even more impressive results.

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