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BOOK REVIEW

B.S. Daya Sagar: Mathematical Morphology in Geomorphology and GISci

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I read with great interest B.S. Daya Sagar's book "Mathematical Morphology in Geomorphology and GISci". Indeed, the definition of Mathematical Morphology concepts and tools has drawn inspiration from topographical, geological and geomorphological analogies: images are often considered as topographic surfaces and the names of certain basic or more complex operators (erosion, watershed transform, waterfalls, etc.) clearly show their affiliation with the phenomena that gave them rise (although we should be careful with these analogies). It is therefore interesting to see what can be achieved using mathematical morphology in a field of earth sciences that inspired it.

D. Sagar's work is very dense (500 pages). It is divided into 14 sections, much of which is devoted to the description of case studies using morphological operators. The second chapter deals with the recall of definitions of mathematical morphology concepts and tools used by the author. A whole chapter is also devoted to the description of analyzed data: digital elevation models (DEM), digital bathymetric maps (DBM), satellite images, thematic maps, and more. This is particularly worthwhile as it is very important to always keep in mind the true nature of the images analyzed, so as not to lose touch with the physical reality and the scale of the phenomena studied. Beside those real data, D. Sagar also uses fractal representations simulated using morphological operators (this section leaves the reviewer a little confused because the fractal approach seems to be only loosely related to the mathematical morphology field). The other chapters (4–8) present a compilation of case studies illustrating the use of various mathematical morphology tools for feature extraction (mountains, piedmonts, valleys, water bodies, river networks, etc.) and characterization (shape, size, size distribution). The last part of the book (Chaps. 9–14) describes tools quantifying the spatial relationships between these features and/or clusters of features, with a final

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chapter devoted to morphological approaches to move from point data to spatial data (maps). The applications and studies described are numerous. The huge number of examples will certainly help the reader find interesting ideas and suggestions to solve similar problems with, it is true, the risk of drowning under this pile of tools without allowing her/him to discern the most convenient ones. D. Sagar's desire to convince his readers about the utility and power of mathematical morphology in geosciences is evident and commendable (a conviction I completely share!).

However, the reader will not find in this book much support, grip and keys allowing him to go beyond the initial interest generated by this description of available mathematical morphology tools. Indeed, the presented algorithms do not provide enough details to overcome inevitable difficulties of implementation. A good example of this type of problem is given by the skeleton by openings where the reader discovers that this operator suffers from a major defect: it is not connected. This fact can be very disturbing, even if a patch to correct this defect is described afterwards. If the reader wants to go further he will turn to more practical descriptions and (open) software libraries providing these ready-made tools.

I was also a little bit unsatisfied by the choice of concepts and morphological tools presented and used in this book. Of course, these tools are perfectly adequate and they bring appropriate solutions to the problems, therefore introducing them was obviously compulsory and legitimate. But they are representative of mathematical morphology as practiced in the 1980s. The more recent morphological concepts and operators specific to functions (grey tone images) are introduced but they are described through the use of image thresholdings and sets decompositions, making them quite heavy and slow. Geodesic operators are very briefly discussed (only the geodesic dilation is described), while their potential is widely recognized. Similarly, important segmentation operators such as the watershed transformation are only mentioned. I recognize, however, that this appreciation is largely due to my own perception of mathematical morphology progress. The author has simply make choices different from those I would have favored.

Despite the previous small reservations, I am sure that this very dense and useful work will appeal to geomorphologists, structural geologists and geographers open to new research ideas and approaches. They will find in this book a rich source of inspiration for their own research that, I expect, will foster their desire to deepen their knowledge of mathematical morphology. As a mathematical morphologist myself, I found the many case studies presented stimulating; they have aroused my thinking on morphological tools and approaches that would further refine the solutions proposed. As such, this book can also be considered as an efficient instrument of dialogue, a bridge between image processing and geosciences, giving rise to fruitful discussions and exchanges about emerging issues and possible solutions, thereby contributing to disseminate mathematical morphology. Thanks to Daya Sagar!