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seem a little daunting to the GIS novice, but the author goes to great pains to assure that each point is carefully explained, demonstrated, and explained again within a different context. In contrast, unit 5 on "GIS output" is a straightforward synopsis of standard cartographic representations. This unit however lacks more contemporary GIS display, such as progress in the plethora of visualisation techniques, and interactive decision-support scenarios. Moreover, this cartographic bias seems indicative of the underlying theme of the whole book. Although I applaud the recognition of cartography as a forerunner, and indeed as part of the spine, of GIS, at the same time there is the danger of suffocating the technology of GIS under heavy cartographic grounding. The final unit on "GIS design" is conspicuously uncommon in other general GIS books. For me, any book on a technology that has conceptual underpinnings from divergent disciplines, is based on diverse algorithms, makes use of disparate data, and is constantly improving, should only be considered complete if these various strands are tied by careful planning. This book gives an excellent and engaging account of the systems approach to GIS-design considerations. Throughout, there is a liberal use of diagrams, many of which are small, compact, and, more importantly, to the point in hand.

The objectives of the book are clearly stated and adhered to most vigorously. The text is most palatable and precisely aimed at the novice, and although it can be a little wordy at times this may be owing to the complexity of the GIS discipline which many people involved in it have taken for granted. Besides, any introductory hardback that costs under £20 is a serious contender for use as a course text.

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Editor's note Since this review was written, the second edition of this book has appeared: Burrough P A, McDonnell R A, 1998 *Principles of Geographical Information Systems* 2nd edition (Oxford University Press, Oxford) ISBN 0 19 823366 3, 0 19 823365 5

Principles of geographical information systems 2nd edition, by P A Burrough, R A McDonnell; Oxford University Press, Oxford, 1998, 333 pages, £60.00 cloth, £24.99 paper (US \$95.00, \$45.00) ISBN 0 19 832266 3, 0 19 823365 5

Peter Burrough's *Principles of Geographical Information Systems for Land Resources Assessment* appeared in 1986, and quickly established itself as the first major text in the new field of geographic information systems (GIS). It was rigorous, with a wealth of technical detail that was hard to find in the published literature of the time. It reflected Burrough's background and interests in the use of GIS in scientific applications in resource management, particularly soils, and in related topics such as data quality.

An enormous amount has happened in GIS in the intervening twelve years, and one wonders if someone who had left the field in 1986 would recognise it today. So it is to Burrough's credit that the principles he identified then are still largely the principles that students of today need to assimilate to understand GIS. The first edition was a book about principles, not about the buttons one needs to push to make some particular software environment perform, and readers familiar with that book will find much that is familiar, as well as an abundance of new material, in the second. In this second edition, Burrough has been joined by Rachael McDonnell of Oxford University, and the book is one of the growing series on *Spatial Information Systems and Geostatistics* from Oxford University Press, for which Burrough is also a general editor.

As with the first edition, the emphasis is on natural-resource applications of GIS. There are plenty of examples of soil properties, land evaluation, terrain analysis, hydrology, and related topics. There is a very strong section on raster modelling, and much technical detail on the basis for GIS operations in these application areas. A powerful and useful new feature is the introduction of the continuous field-discrete entity dichotomy at the outset, and its use to organise much of the book. Consequently there is a relative paucity of applications in transportation, infrastructure maintenance, real estate and insurance, geodemographics, and the social end of the GIS-application spectrum, and the associated principles. Readers will also find little mention of location analysis and site selection, or vehicle routing and scheduling.

The opening chapter is titled "Geographic information: society, science, and systems", and the first section is a brief history of 'the geographic information sciences', so it occurred to me to wonder whether this might stand as the first text on geographic information science, given its emphasis on principles. In the end I was not sure, though this may be the closest text yet. There are pieces of geographic information science that are covered very strongly, including geostatistics, accuracy, and the organising principles of representations, but there is little coverage of other areas that currently rank highly in geographic information-science research agendas—spatial cognition, or societal impacts, to name two. There is excellent coverage of applications to illustrate the basic principles, but not much on principles of cartographic design, though there is an excellent section of colour plates. Some space is devoted to networks, but by and large the user is conceived as an analyst seated at a workstation, using software to process data that have been assembled for that purpose.

The book is aimed at students who have a fair level of understanding of basic statistics, and an ability to interpret equations. The most technical chapters are those on spatial interpolation from points, and geostatistics, where readers will need to have a basic knowledge of statistical principles and methods. These are excellent chapters: I used the worked example of ordinary Kriging in my spatial-statistics class in preference to the one in the class text. But the level of technical treatment throughout the book is, if anything, more demanding than in the first edition.

Besides a thorough new treatment of geostatistics, including co-Kriging and conditional simulation, readers familiar with the first edition will find several other welcome additions. There is much more on error propagation, including a very useful section on traditional error analysis. There is a complete chapter devoted to fuzzy methods, with abundant examples. In other ways the book follows the outline of the first edition, proceeding from principles of representation through data input to analysis.

In the final analysis this is a book written by two scientists who use GIS every day to further their understanding of the physical world. That makes it an ideal text for courses in environmental science, for students who need to know the principles on which a GIS operates, because to them GIS is valuable as a tool to perform certain operations. It is important to know something about what goes on inside the black box, because good scientists must ultimately take personal responsibility for their results. This book devotes almost four pages to techniques for calculation of slope, for example, so that students can see something of the effects of various methods, and be encouraged to find out exactly what their favourite GIS does when they push the 'slope' button.

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Reference

Burrough P, 1986 *Principles of Geographical Information Systems for Land Resources Assessment* (Clarendon Press, Oxford)

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