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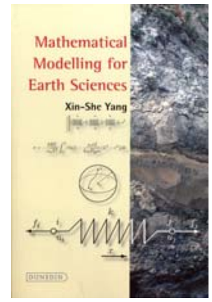

Mathematical Modelling for Earth Sciences, by Xin-She Yang, 2008. Dunedin Academic Press, Ltd., Hudson House, 8 Albany Street, Edinburgh EH1 3QB, Scotland. Paperback, x + 310 pages. Price GBP 25.00; USD 49.95; EUR 39.95. ISBN 978-1-903765-92-0.

Those who frequently not only attend meetings on earth-scientific topics but also have a thorough look at the (often too numerous) posters, will have noticed that modelling is currently one of the most “hot” activities. It is, unfortunately, not always clear how the models have been established, or on the basis of which data the input into the models has been chosen. Even less clear is frequently what kind of mathematics underlie a model that is presented.

One of the main problems is that the mathematical knowledge of many earth-science students is fairly limited. I had myself to teach my sedimentology students what I consider rather basic mathematics. It is my experience that many students who want to specialize in geophysics, oceanography, atmospheric sciences or geochemistry often refrain from doing so because they find out that the mathematics are too complicated for them. This leaves the question what is the mathematical accuracy of all those posters that are presented at conferences and that do not deal with these “mathematics-directed” earth-science disciplines.

It is therefore very fortunate that a book on mathematical modelling for earth sciences has been published. The author is, however, not an earth scientist: he received his Ph.D. from the University of Oxford in applied mathematics. Being a research fellow at the University of Cambridge now, he is in the Structure Group in the Civil, Structural and Environmental Engineering Division. This background, and this current position are certainly a guarantee for a thorough mathematical approach of modelling, but the question arises immediately what is the applicability of the presented material for the ‘average’ earth scientist.

The author is apparently not truly confident that his book is understandable for the average geologist (although he wrote it for both undergraduate and graduate students), considering that he mentions in his Preface (and this is apparently considered so important, also by the publisher, that it is also mentioned on the back-side cover) that the book is designed to be “theorem-free”. This approach could not be followed entirely, however, because section 3.1.6 deals with “Some Important Theorems”.

The book is divided into three parts: after the Preface, there follow Part I Mathematical Methods; Part II Numerical Algorithms; and Part III Applications to Earth Sciences. These parts are followed by two appendixes: Appendix A deals with Mathematical Formulae, and Appendix B deals with Matlab and Octave Programs. The book concludes with a useful Bibliography and a 4-page Index. Taking all this together, it must be concluded that mathematics dominate: the first two parts take 224 pages and the two appendices take jointly 12 pages, whereas the earth-science applications take only 66 pages.

Part I contains 8 chapters: (1) Mathematical Modelling, (2) Calculus abnd Complex Variables, (3) Vectors and Matrices, (4) ODEs and Integral Transforms, (5) PDEs and Solution Techniques, (6) Calculus of Variations, (7) Probability, and (8) Geostatistics. Part II contains 4 chapters: (9) Numerical Integration, (10) Finite Difference Method, (11) Finite Volume Method, and (12) Finite Element Method. Part III has, unfortunately, only 3 chapters: (13) Refraction-Diffusion System, (14) Elasticity and Poroelasticity, and (15) Flow in Porous Media. This Part III is without doubt too restricted for a book that pretends to deal with modelling for the earth sciences; it is obvious that many important subjects (sediment transport, volcanic eruptions, paleobiogeographic developments, etc., etc.) are not dealt with at all. The author seems to restrict himself to the applied earth-sciences, and particularly to engineering geology. Mathematics are clearly more important for the author than the earth as an entity that is to be investigated, unraveled and understood by a combination of all kinds of earth-scientific disciplines.

The domination of the mathematics is also obvious from the numerous formulae: in parts I, II and III together (so, without the appendices) not les than 1048 formulae are present; and that is without the also numerous equations in the examples that the author presents. The book therefore reads as a mathematics book rather than as an earth-science book.

One might therefore wonder whether the book is really useful for earth scientists. Reading the many examples in the book where the author leads the reader step by step in the modelling of practical situations (mainly aimed at finding values for specific properties), I came to two main conclusions. The first is that the book is far too difficult for the average student, certainly for undergraduates who are not typically numerically interested; the second is that the book is hardly aimed at scholarly research, but much more directed to engineering geology. For those who work in this field, the book can be highly recommended: it has thoroughly been composed, it is clearly written for those with sufficient mathematical background, and the cases analysed by the author will be appealing for this group of readers. For others, however, I think that this book will be fairly frustrating, and of little help in modelling.

The publisher has to be congratulated with finding an author who dared tackle the difficult challenge of writing a book on this subject. The book is very well printed (I did not find any typos, but perhaps I was too busy understanding the mathematics) and easily readable. The price is certainly not too high, but for many students the book may be too difficult for the majority of students.

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