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Contact

Niedersächsische Staats- und Universitätsbibliothek Göttingen
Georg-August-Universität Göttingen
Platz der Göttinger Sieben 1
37073 Göttingen
Germany
Email: gdz@sub.uni-goettingen.de

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Book Review

Wang, Herbert F. and Anderson, Mary P.: Introduction to Groundwater Modeling. Finite Difference and Finite Element Methods. X+237 pp., W.H. Freeman and Company, San Francisco, 1982.

The authors' goal is "to enable readers to solve groundwater flow problems with the digital computer ... developed with the aim of conveying a full understanding of the steps leading to the short sample computer programs included as part of the text" This goal was realized throughout the book in a very good manner.

The book is divided into eight chapters. The first gives the basic physics of groundwater flow. It is a short description of the governing equations without any complications. The second chapter introduces Finite Difference models in general and especially solving Laplace's equation for steady-state flow. The chapter leads to a five-point star FD-approximation computer program solved by the iterative Gauss-Seidel method. The third chapter considers sources and sinks through the use of Poisson's equation including also the development of the equations for an unconfined aquifer with Dupuit assumptions. In the fourth chapter the authors present explicit and implicit FD solving methods for the transient (unsteady) flow. The fifth chapter points out other solution methods than the iterative methods used in the foregoing chapters. Presented are e.g. the short Thomas algorithm and the Alternating Direction Implicit method. The sixth chapter introduces the Finite Element method for the steady-state problem. Galerkin's method with triangular elements is used to develop the matrix equation. In the seventh chapter the transient (unsteady) flow is solved using the FE-method with rectangular elements for space and the FD-method for time. The eighth chapter is a short introduction to the physical concepts of advective-dispersive transport and leads to the FE-example of solute dispersion in uniform flow field. The appendix consists of short notes on anisotropy and tensors, variational method, isoparametric quadrilateral elements and analogies.

In my view this book is not only a good introduction to numerical groundwater modeling but also to Finite Difference- and Finite Element-methods in general. It can readily be understood by all newcomers to numerical methods requiring only basic mathematical techniques. The presentation of short FORTRAN-computer programs for almost every problem of the context is a great advantage of the book. The reader has a tool for solving his own problem much easier than from theory-books. The book is completed by several notes and problems to the reader after every chapter reinforcing the principles presented in the foregoing chapter. Because of the aim of the book some simplifications of the mathematical theory of the Finite Difference- and Finite Element-method had to be made. But it is quite difficult to draw the line between exactness and application. To me, especially the validity of the numerical methods seems to have been neglected. More attention should be drawn to these problems than two little notes and a problem to the reader.

I think this book should be recommended to all, students as well as professionals, who want to be introduced to numerical groundwater modeling. This book is as good as a complete and very detailed university course.

Nikolaus Klever