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# Numerical Modeling in Open Channel Hydraulics

Open channel hydraulics has always been a very interesting domain of scienti c and engineering activity because of the great importance of water for human l- ing. The free surface ow, which takes place in the oceans, seas and rivers, can be still regarded as one of the most complex physical processes in the environment. The rst source of dif culties is the proper recognition of physical ow processes and their mathematical description. The second one is related to the solution of the derived equations. The equations arising in hydrodynamics are rather comp- cated and, except some much idealized cases, their solution requires application of the numerical methods. For this reason the great progress in open channel ow modeling that took place during last 40 years paralleled the progress in computer technique, informatics and numerical methods. It is well known that even ty- cal hydraulic engineering problems need applications of computer codes. Thus, we witness a rapid development of ready-made packages, which are widely d- seminated and offered for engineers. However, it seems necessary for their users to be familiar with some fundamentals of numerical methods and computational techniques applied for solving the problems of interest. This is helpful for many r- sons. The ready-made packages can be effectively and safely applied on condition that the users know their possibilities and limitations. For instance, such knowledge is indispensable to distinguish in the obtained solutions the effects coming from the considered physical processes and those caused by numerical artifacts.

This book offers a comprehensive approach to the numerical modeling of open channel flow, based on the author's own research in this field, as well as his experience as a lecturer. It provides the reader with: - Coverage of the most important problems of open channel hydraulics, including steady and unsteady flow in a single channel and in a channel network, transport of dissolved substance, transport of energy and more; - Unified derivation of the governing equations for all problems, based on the fundamental laws of mass, momentum and energy conservation; - Comprehensive presentation of the numerical methods applied in open channel flow modeling, with particular regard to the solution of hyperbolic and parabolic partial differential equations, which govern many important flow and transport processes; - Detailed description of the numerical algorithms applied to solve particular problems, with many examples of solutions; - Accuracy analysis of the numerical algorithms using the modified equation approach; - New insights into numerical solution of some classical problems of open channel hydraulics, e.g. steady varied flow in a channel of arbitrary geometry. - In-depth analysis of the simplified flood routing models and their unphysical properties, including a proposition of an alternative Instantaneous Unit Hydrograph, valid for all simplified models. Written in accessible language, Numerical Modeling in Open Channel Hydraulics contains information useful for higher level undergraduate and postgraduate students of civil and environmental engineering faculties, as well as scientists and practitioners in the field of hydraulic engineering, especially those using existing numerical codes or developing their own ones.
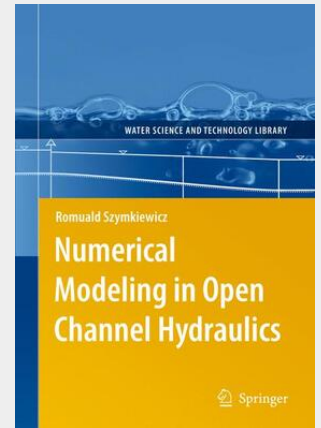
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