Mathematical Modeling and Simulation. Introduction for Scientists and Engineers

Description: This concise and clear introduction to the topic requires only basic knowledge of calculus and linear algebra – all other concepts and ideas are developed in the course of the book. Lucidly written so as to appeal to undergraduates and practitioners alike, it enables readers to set up simple mathematical models on their own and to interpret their results and those of others critically. To achieve this, many examples have been chosen from various fields, such as biology, ecology, economics, medicine, agricultural, chemical, electrical, mechanical and process engineering, which are subsequently discussed in detail.

Based on the author’s modeling and simulation experience in science and engineering and as a consultant, the book answers such basic questions as: What is a mathematical model? What types of models do exist? Which model is appropriate for a particular problem? What are simulation, parameter estimation, and validation?

The book relies exclusively upon open-source software which is available to everybody free of charge. The entire book software – including 3D CFD and structural mechanics simulation software – can be used based on a free CAELinux–Live–DVD that is available in the Internet (works on most machines and operating systems).

From the Contents:

– Principles of mathematical modeling

– Phenomenological and mechanistic models

– Differential equation models (ODE's and PDE's)

– Open-Source Software, e.g. for 3D CFD and structural mechanics

– Introduction into CAELinux, Calc, Code-Saturne, Maxima, R, Salome-Meca

Kai Velten is a professor of mathematics at the University of Applied Sciences, Wiesbaden, Germany, and a modeling and simulation consultant. Having studied mathematics, physics and economics at the Universities of Göttingen and Bonn, he worked at Braunschweig Technical University (Institute of Geoeconomy, 1990–93) and at Erlangen University (Institute of Applied Mathematics, 1994–95). From 1996–2000, he held a post as project manager and group leader at the Fraunhofer–ITWM in Kaiserslautern (consultant projects for the industry). His research emphasizes differential equation models and is documented in 34 scientific publications and one patent.

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A CAELinux and the book software
B R (programming language and software environment)
C Maxima

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