



Computer
Simulations
with MATHEMATICA[®]

*Explorations in Complex
Physical and Biological
Systems*

RICHARD J. GAYLORD

PAUL R. WELLIN



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Computer Simulations with MATHEMATICA®

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The study of natural phenomena using computer simulation is a major new research tool in the physical, chemical, biological and social sciences. It is useful for studying simple systems, and it is essential for the study of complex systems. Using Mathematica, an integrated software environment for scientific programming, numerical analysis and visualization, this book describes computer simulations applicable to a wide range of phenomena, including, but not limited to:

PHYSICS: critical phenomena, spin glasses, turbulence, fluid flow through porous media

BIOLOGY: animal locomotion, slime mold growth, evolution, immunological reactions, biological rhythms, tumor growth, epidemics, neuron activity, ecological balance

CHEMISTRY: polymerization, oscillatory chemical reactions, diffusion-reaction systems, colloidal aggregation

MATERIALS: diffusion, polymer viscoelasticity, crystallization, molecular beam epitaxy, surface roughening and weathering

GEOLOGY: earthquakes, volcanos, landscape formation

ASTRONOMY: spiral disk galaxies, pulsar glitches, solar flares

ECONOMICS: financial market fluctuations, booms and busts

SOCIOLOGY: rumor-mongering, imitative behavior, vehicular traffic



The CD-ROM accompanying this book is a cross-platform disc that can be used on Macintosh, DOS/Windows, or Unix platforms. The CD contains dozens of QuickTime® animations and Mathematica® notebooks covering many of the computer simulations described in the book. In addition, hundreds of graphical images of large-scale simulations are depicted. The CD also includes third-party software to enable the user to view all of the images, animations, and Mathematica® notebooks.

Minimum System Requirements

Apple Macintosh II or later; System 7.1 or later; 8 MB RAM; QuickTime 2.0 or later (included on the CD).
DOS/Windows; Windows 3.1 or later; DOS 6.0 or later; QuickTime for Windows (included on the CD).

About the Authors

RICHARD J. GAYLORD is a Professor in the Department of Materials Science and Engineering at the University of Illinois at Urbana-Champaign. He is a member of the editorial board of "The Mathematica® Journal", "Mathematica® in Education", "Mathematica® World", and is the author of "Introduction to Programming with Mathematica®", along with Paul Wellin and Samuel Kamin. After working for 20 years in theoretical polymer physics, he became involved in the beta-testing of Mathematica® prior to its release in 1988. While using Mathematica® to perform symbolic computations, he discovered its underlying programming language. As a result of this epiphany, he switched his work from theoretical physics, which uses equations, to algorithmic physics, which uses computer programs to model various phenomena.

PAUL R. WELLIN is Adjunct Professor of Mathematics at California State University, Sonoma. He is Editor-in-Chief of the journal "Mathematica® in Education", and is the author of "Introduction to Programming with Mathematica®" along with Richard Gaylord and Samuel Kamin. He has given talks and seminars throughout the world on the use of technology in the mathematics curriculum and on computational mathematics.

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