# Time Reversibility, Computer Simulation, Algorithms, Chaos (Advanced Series in Nonlinear Dynamics) (Advanced Series on Mathematical Psychology)

*William Graham Hoover, Carol Griswold Hoover*

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A small army of physicists, chemists, mathematicians, and engineers has joined forces to attack a classic problem, the "reversibility paradox", with modern tools. This book describes their work from the perspective of computer simulation, emphasizing the authors' approach to the problem of understanding the compatibility, and even inevitability, of the irreversible second law of thermodynamics with an underlying time-reversible mechanics. Computer simulation has made it possible to probe reversibility from a variety of directions and "chaos theory" or "nonlinear dynamics" has supplied a useful vocabulary and a set of concepts, which allow a fuller explanation of irreversibility than that available to Boltzmann or to Green, Kubo and Onsager. Clear illustration of concepts is emphasized throughout, and reinforced with a glossary of technical terms from the specialized fields which have been combined here to focus on a common theme.

The book begins with a discussion, contrasting the idealized reversibility of basic physics against the pragmatic irreversibility of real life. Computer models, and simulation, are next discussed and illustrated. Simulations provide the means to assimilate concepts through worked-out examples. State-of-the-art analyses, from the point of view of dynamical systems, are applied to many-body examples from nonequilibrium molecular dynamics and to chaotic irreversible flows from finite-difference, finite-element, and particle-based continuum simulations. Two necessary concepts from dynamical-systems theory — fractals and Lyapunov instability — are fundamental to the approach.

Undergraduate-level physics, calculus, and ordinary differential equations are sufficient background for a full appreciation of this book, which is intended for advanced undergraduates, graduates, and research workers. The generous assortment of examples worked out in the text will stimulate readers to explore the rich and fruitful field of study which links fundamental reversible laws of physics to the irreversibility surrounding us all.

This expanded edition stresses and illustrates computer algorithms with many new worked-out examples, and includes considerable new material on shockwaves, Lyapunov instability and fluctuations.

Readership: Students of statistical physics and computer simulation.

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The book untitled Time Reversibility, Computer Simulation, Algorithms, Chaos (Advanced Series in Nonlinear Dynamics) (Advanced Series on Mathematical Psychology) contain a lot of information on that.

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