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An Introduction to Computer Simulation Methods: Applications to Physical Systems, Part 1 and Part 2 FREE

Harvey Gould; Jan Tobochnik; Don E. Harrison, Jr.

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capabilities of present and planned supercomputers along with the computational requirements of current and proposed research projects. This dramatically highlights the order of magnitude gap that lies between today's state of the art and the simulation of more realistic systems.

The examples are not limited to academic research. At least half are from applications in which supercomputing has a direct and beneficial impact on the profit line, e.g., oil exploration, aeronautical engineering, and computer design. The authors' emphasis is on the competitive edge afforded by supercomputers, in keeping with their expectation that supercomputers "will be a fundamental tool of science and business."

The idea of competitive edge takes on a more serious tenor in the chapter on the international aspects of supercomputing. Primarily this chapter concerns the threat to U.S. leadership in supercomputer design and production, as well as predominance in scientific research and industrial development dependent on large scale computations. The specter raised most often is that of the Japanese: "Japanese manufacturers, working closely with universities and the Japanese government, are pursuing ambitious goals with characteristic persistence and ingenuity. Complacence or inattention in the United States could lead to quick erosion of the American lead." The book documents just what such a loss would mean, while prescribing a course of action: continued government, industry, and university support for supercomputing.

Given its role as a manifesto on the importance of supercomputers to the national interest, the book seems best suited to readers from the general public, specifically those who shape public opinion and policy. Most of the book is easily accessible to the educated, nonspecialist reader. Topics are discussed in terms of analogies, and the use of technical jargon is kept to a minimum. A glossary provides further help, although some may be frustrated by its brevity.

The book's role as advocate extends not only to policy leaders who must be persuaded to maintain the funding, but also to potential supercomputer users. Neophytes and people lodged in a VAX-class mentality (compared by the authors to a farmer unwilling to give up his familiar ox for a new-fangled tractor) are led to recognize that while the capabilities of supercomputers are daunting, using them needn't be. Supercomputing must necessarily compete for a significant fraction of the science budget, and the authors present a strong case that it benefits a full range of disciplines as diverse as theoretical physics, agriculture, and the arts. That it could be a fundamental tool for such a disparate group makes the supercomputer almost unique among big science projects.

People already in computing will probably not find anything unfamiliar in this book; after all, they scarcely need to be convinced of the importance of supercomputers. While the sections describing other research may be of some interest, these are not discussions of algorithm and technique. An appendix listing academic supercomputer facilities, their application criteria, and where to write for more information will be a handy reference for people beginning to search for supercomputer cycles. However, computational researchers may find that best use for this book is to give it to colleagues and friends, thereby providing a much better idea of what it is they do for a living.

John F. Hawley is assistant professor of astronomy at the University of Virginia, Charlottesville.

An Introduction to Computer Simulation Methods: Applications to Physical Systems,
Part 1 and Part 2
Harvey Gould and Jan Tobochnik
695 pp. (parts 1 & 2 combined),
Addison-Wesley,
Reading, Mass., 1988. $12.95 each.

Reviewed by Don E. Harrison Jr.

As the authors indicate in their preface, these books were designed to serve as the manual for a computational physics laboratory which might well supplement a simultaneous lecture course on computer simulation. Part 1 is devoted to classical physics problems. The authors recommend a prerequisite of at least one semester of physics and one semester of calculus. More realistically, most of the chapters would be accessible to a student who had completed a comprehensive introductory physics course with calculus. Part 2, which deals primarily with Monte Carlo (stochastic) simulations, requires some familiarity with thermodynamics and statistical mechanics including the Ising Model, and considers some more specialized modern topics such as fractals, and cellular automata. Honors students and advanced undergraduates should have no difficulty with any of the material.

Each chapter deals with a single physical system; beginning with a short introduction to the relevant physics. The required program then is described, and a complete program listing in True BASIC is provided. The student is expected to enter and exercise the program, answering questions during the process. Next, problems are stated which require that the student modify the program and investigate the consequences of the modifications. The final section suggests references for the physics, numerical methods, and programming techniques used in that chapter. Appendices provide listings of some of the programs in FORTRAN and Pascal.

A background in computer programmming is not required. The books are designed for curricula which integrate the first computer programming course with a course in computational physics. In Part 1 problems are ordered in increasing difficulty. Attention is paid to the introduction of programming techniques, but the emphasis is on problem solving with well structured programs, not on programming concepts as taught in computer science.

Numerical methods used in simulation are introduced and discussed as required; so that the texts are self-contained in this respect. In Part 2 some limited attention is paid to the problems associated with the generation and testing of pseudo-random variants. The concept of variance reduction is introduced by the use of control variants, but other techniques are not mentioned.

Both volumes are oriented toward graphical output. Graphical techniques are introduced early in Part 1, and are used extensively throughout the remainder of the texts.

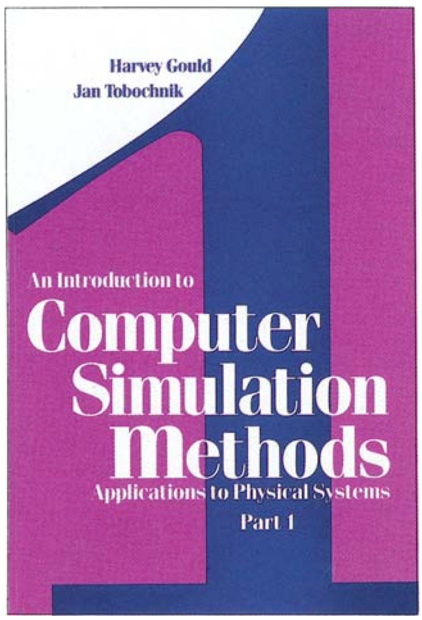
Despite the general success of the presentation, these books may cause problems when used as texts for courses which extend beyond the relatively narrow bounds for which they were designed. For example, the emphasis on graphical output and encouragement toward the use of microcomputers inevitably led to the choice of a dialect of BASIC as the primary language. Despite its many sterling virtues, True BASIC is not so well supported in the marketplace as other BASIC dialects, and therefore probably will be less accessible to students unless supplied in a laboratory environment. Fortunately, when treated as an algorithmic language, True BASIC is readily translatable into almost any other commonly used language; so the choice may be inconvenient, but certainly is not 'lethal.'

On a more serious note, the books do not lend themselves to self-study. Because of the laudable emphasis on 'learning by doing,' the texts raise questions which the student is expected to answer by direct experimentation with the program; therefore answers are never provided. While a student will obtain correct results from a correct program modification, an individual has no way of checking those results unless the instructor is readily available.

Treated as programming texts, there are other problems. In particular: True BASIC may not be the best choice of a first language for students embarking on a scientific career. Also, little attention is paid to questions of program design. The student is shown examples of successful design, but the discussion of the program design process is minimal; so a beginner often might not understand why a specific option is preferable is a specific situation.

The numerical methods techniques introduced are more than adequate for the stated purpose, but are sufficiently limited that the books would need to be supplemented before they could be used as a numerical methods textbook.

Finally, despite the emphasis on simulation in the title, Part 1 deals almost exclusively with computational physics techniques applied to problems for which analytic solutions already exist. While these techniques must be introduced before the simulation of more complex systems can



be considered, the student is never encouraged to consider a choice between theoretical analysis and simulation. Without careful complementary instruction, many students will come away from the course with the impression that all physics problems should be solved computationally, and that analytic theory is superfluous.

On a more abstract level, no consideration is given to the verification of simulation results in situations where no analytic analogs or experimental results exist. If the results 'look right' they often are presumed to be correct without further investigation. Attention is centered on the presentation of successful programs, not on how one would develop such a program for a real problem. The books give no indication that the development of a logically correct and functioning computer program does not guarantee a physically correct simulation. Validation (debugging) and verification are never presented as complementary steps in simulation design.

Despite the stated limitations, which may preclude the use of these books as a primary textbook of simulation, they are a valuable addition to the rapidly developing literature of simulation. They are designed to address a limited set of objectives, and do so successfully.

When used intelligently, these books will provide many useful ideas to anyone who believes with the authors that "Computer simulation is now an integral part of contemporary basic and applied science and is approaching a role equal in importance to the traditional experimental and theoretical approaches." The reviewer supports this position and recommends the books.

CIP *editorial board member Don E. Harrison Jr. is professor of physics at the Naval Postgraduate School, Monterey, Calif.*

The Media Lab:
Inventing the Future at M.I.T.
Stewart Brand
285 pp., Viking Penguin Inc.,
New York, 1987. $20.00

Reviewed by R.E. Crandall

The underlying credo of M.I.T.'s Media Laboratory—essentially that of founder and director Nicholas Negroponte—is that communications technology is "poised for redefinition." The Media Lab's ambitious purpose is to lead that process, or as intimated in Stewart Brand's chronicle of the Lab's ongoing work, to invent the requisite media future. Since its founding in 1985, the Media Lab's staff of some 120 scientists and researchers in Cambridge, Mass., have been endeavoring to apply new technology to enhance or create tomorrow's versions of newspapers, television, sound recordings, desktop workstations, and other communications media.

The Media Lab is a well-written, and at times appropriately witty,