areas with which I am familiar, most of the authors are at the forefront of research in their fields and are articulate and clear.

One irritating feature, however, is the number of typographical mistakes. This may be expected in a first edition, and many are obvious errors that even a novice would probably catch. Some errors, however, are important and not easy to catch unless you already know the concept or fact being introduced. For example, in a discussion of rare-earth ions and the electronic angular momentum, the relation between J, L and S is wrong: Rather than being $J = L + S$ for the light rare earths, as the text states, it is in fact $J = |L - S|$ (page 2208). Annoying typos include the "bracket" notation for an electronic state "$|\,\rangle$" as "$1\,\rangle$" (page 2216), the mass magnetic susceptibility referred to as the "massic" magnetic susceptibility (page 1668) and Nb_3Sn written as NB_3Sn, which would be a completely different compound if it existed. Depending on how familiar you are with a topic, it is possible to be misled by such typos. I hope that a mechanism to catch most of the typos will be instituted for the second edition.

In spite of these errors, the encyclopedia is well worth having in your library reference section, although the suggested retail price is probably too much for the average personal collection. David Bloor, Richard Brook, Merton Flemings and Subhash Mahajan, who undertook the enormous task of compiling important topics and finding suitable advisory editors (18 of them), not to mention the hundreds of topical authors, have done a superb job.

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Physics Experiments Using PCs: A Guide for Instructors and Students

Edited by H. M. Staudenmaier
Springer-Verlag, New York, 1995. 312 pp. $39.95 pb ISBN 3-540-58801-9

In his introduction to *Physics Experiments Using PCs*, H. M. Staudenmaier points out that despite the increasing importance of computers in both academic and industrial laboratories, the standard undergraduate physics curriculum fails to provide formal instruction or extensive experience in using them. The experiments described in this volume use computers to collect and analyze data in a variety of physics subfields at various levels of difficulty. As the US physics community mobilizes to better prepare its students for today's competitive job markets, a new emphasis on practical skills and flexible training is appearing in American colleges and universities. Faculty will need resources such as these experiments to broaden the physics curriculum and increase the emphasis on practical applications.

As in any multiauthor collection, the quality of the contributions varies. The material on introductory mechanics using a form of video capture lags considerably behind state-of-the-art educational software available in the US. Similarly the material on converting a personal computer to a multichannel analyzer for use in nuclear physics concentrates on programming details that are not particularly useful in a climate where technology changes quickly. However, the experiments on thermal physics contain very nice discussions of measurement and control theory suitable for upper-level undergraduates, and the experiments on optical transfer functions and parity violation in weak interactions will provide a stimulating challenge to such students. The scheme for collecting and analyzing data from an orbiting satellite will appeal to almost any inventive undergraduate, and the experiment is inexpensive for a relatively glamorous undertaking.

The descriptions of the experiments contain sufficient detail to allow either a student or a faculty member to set them up from scratch. The specific pieces of equipment described may be a bit dated, but the text gives enough information to allow substitutions or reconstructions. The sections on theory generally provide adequate background for the experiments.

Unfortunately, none of the authors addresses the conduct of the lab from an instructional point of view. Students need to learn experimental design—selecting measuring devices, interfacing them to a computer, programming the computer or adapting existing software for a particular problem. They must figure out how to calibrate their systems and estimate their experimental errors. But if the instructor simply provides students with the texts of the experiments in *Physics Experiments Using PCs*, or sets up and tests the equipment for a class, the students may well grow accustomed to working with the computer as a useful black box, but they will have little chance to develop vital skills in experimental design, construction and analysis.

To prepare for industrial careers, students need to practice working in design groups. They must hone their communication skills by both working out a design with a team and presenting experimental results to their peers. In an ideal world, advanced lab courses provide an opportunity for students to explain their results to nonscience audiences, perhaps by writing press releases on results.

By supplying ideas for sophisticated new experiments, this volume makes a useful contribution to the ongoing revision of the undergraduate physics curriculum. Had it dealt with the changes needed in instructional strategies as well, it would have been outstanding.

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Geophysical Inverse Theory

Robert L. Parker
Princeton U. P., Princeton, N.J., 1994. 386 pp. $39.50 hc ISBN 0-691-03634-9

Our knowledge of the physical properties of the Earth's interior—except for the few kilometers at the top—depends on our ability to infer their values at depth from functionals measured at the surface. This is called the inverse problem; a specific example would be the determination from an anomalous gravity field of the shape of an ore body causing it. In this case there is an infinity of possible models; such an inverse problem is called nonunique. The direct problem consists of evaluating the functionals for a specific model; in general there is no difficulty in solving those.

The geophysical inverse problems were brought to the attention of the geophysical community in the 1960s, largely as a result of the accumulation of vast amounts of new seismological data that could not be satisfactorily explained by a manual adjustment of the model parameters. For example, the eigenfrequencies of the normal modes of the Earth were first measured from the records of the great Chilean earthquake of 1960. These eigenfrequencies are nonlinear functionals of the distribution of the shear and bulk elastic moduli and density throughout the Earth's volume, and their observed values disagreed by 1–2% with the predictions of the existing models of the Earth's interior.

In this context George Backus and Freeman Gilbert published a series of classical papers between 1967 and 1970 that represent the basis of the approach described by Robert L. Parker in *Geophysical Inverse Theory*. The book is an expanded set of lecture notes by Parker, who himself has become an important contributor in the area of the inverse problems associated with the potential fields. It is clearly organized, with the material divided into five sizable chapters.

The first chapter outlines the mathematical formalism needed to follow the remaining material in the book. It requires a knowledge of functional analysis much beyond that common to most graduate students in geophysics.

Chapter 2 is a very lucid account of the simplest case: the linear inverse problem with exact data. Perhaps because of this initial assumption that the data are exact, Parker sets up the formalism of the inverse problem in the data space, which allows him to match the data exactly. He retains this approach even after introducing measurement errors, although other approaches become feasible then. Several examples of geophysical inverse problems are introduced here and again in later chapters, which is very useful from a pedagogical point of view.

In chapter 3, cases appear in which the data acquire errors and therefore need not be matched exactly. But this means that there is an infinity of possible answers; of these, Parker recommends that we choose the smoothest model that satisfies the data within their tolerances. While this is an eminently reasonable mathematical condition, we know that it does not always reflect reality. An alternative approach is the model space representation. Using an appropriately chosen set of basis functions, we can determine the coefficients of their linear combination that produce a model satisfying the data within their tolerances. Such a model can be obtained subject to a smoothness criterion.

In the data space method, the model is built by the linear combination of the data kernels (called "representers" in the book); it allows us to obtain an answer without any knowledge of the model properties. In the model space approach, it is necessary to choose the class of the parameters describing the model, which requires some prior knowledge of the general characteristics of the solution sought. The model space approach is important in testing hypotheses regarding the possible properties of the model; such testing is impossible using the data space method.

Chapter 4 deals with the resolution of the model parameters and the model errors. It sets the problem differently from the original presentation by Backus and Gilbert. The chapter illustrates well the difficulty of arriving at a definitive estimation of the error bounds to be imposed on a model.

The last chapter treats the nonlinear problems, which cover nearly all questions of interest in seismology, for example. Because the nonlinearity requires that we must begin with a starting model (initial guess), the data space approach becomes academic, since the starting model must be formulated in the model space. This is true even if the starting model is as trivial as a constant value along the profile, which may be inadequate in many cases. In my opinion, the exposition of the issues related to the nonlinear inverse problems is insufficient given their relative importance in geophysics.

Despite these reservations, which to a large extent reflect my own experiences with mostly seismological inverse problems, I enjoyed very much reading the book. It is well written and reflects the author's delightful sense of humor. I found it useful in teaching, although students being exposed to inverse problems for the first time should be told that there are other ways in which an informative solution can be obtained.

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Correction

October, page 68—The hardcover price of *Fractal Concepts in Surface Growth* by Albert László Barabási and H. Eugene Stanley (Cambridge U. P., 1995) is $69.95 (ISBN 0-521-48308-5); the paperback (ISBN 0-521-48318-2) is $27.95.

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