Applied and Computational Complex Analysis, Vol. 3, by Peter Henrici, John Wiley & Sons, Inc., New York, 1986, 637 pp., $59.95.

A rather unique feature of this book is that it blends the analytical, applied, and computational characteristics of complex variables. An attempt is successfully made to reach a broad spectrum of readers: mathematicians interested in elegant mathematical analysis, applied mathematicians (engineers/scientists) interested in applying the analysis to model real physical problems, as well as computational analysts interested in algorithm development. It is therefore natural to expect that some first-time readers, who may belong to one of the groups, may be turned off during their first reading when they happen to encounter materials that are primarily intended for another group. In particular, an engineer at first glance may easily discount the book as "just a mathematics book," because it is written by a mathematician. However, on closer examination, when perhaps the engineer discovers that some of the methods studied in this book are named after famous engineers like Theodorsen, Garrick, and Timman, the engineer may begin to feel more at home.

This book, which is the third and latest volume in a series on the subject of applied and computational complex analysis, basically concentrates on discrete Fourier analysis, Cauchy integrals, construction of conformal maps, univalent (or conformal mapping) functions, and potential theory. Although the topics are generally very well treated (and in a contemporary fashion), it is the opinion of this reviewer that the book will be most appreciated for its contribution to the topic of conformal mapping.

The author has certainly presented the topic of conformal mapping in a very detailed manner. In particular, he has treated the computational aspects of conformal maps in a thorough and somewhat innovative fashion. The significance of this contribution may be better appreciated when one considers the fact that while the brilliant theorem of B. Riemann establishes the existence of conformal maps it basically fails to prescribe a methodology for constructing them. Needless to say, this topic is of current research interest and can be basically divided into two classes: the first deals with the coherence, elegance, and beauty of mathematics, while the second addresses numerical applications. The impetus of the latter results directly from the enormous popularity of computational methods, particularly in the aerospace sciences. For example, in computational fluid dynamics or aerodynamics, it is well known that accurate computational grid generation is critical to the accuracy and efficiency of any particular numerical approach. Unfortunately, accurate grid generation can be a difficult task, particularly for irregularly shaped bodies. This difficulty stems from the need to generate computational grids that must fit a given geometric shape and yet be convenient for computation. Although square or rectangular grids are desirable for computational purposes, they invariably fail to fit the curvatures of irregular geometries. Ideally, this situation calls for the application of conformal mapping for at least two reasons. First, the conformal mapping guarantees at least a unidirectional one-to-one correspondence (dual directional one-to-one correspondence may be guaranteed if an appropriate branch of the inverse mapping function is selected) between the physical space and the computational space. Second, conformal mapping preserves a local angle between two intersecting curves: orthogonal curvilinear or irregular grids in the physical space can be conformally transformed into regular rectangular (or square) grids in the computational space (which is desirable computationally). Other types of mapping of grid generation schemes that are currently in use may lack these features. Such non-conformal mapping (or grid generation) schemes may lead to incorrect and/or multiple numerical solutions, which may already exist in existing computational fluid dynamics (CFD) codes. In fact, this can be a potential explanation for the existence of multiple solutions in some potential flow codes, which have been reported in the computational fluid dynamics literature. The digression in this paragraph is basically an attempt to remind readers of the importance of conformal mapping in computational fluid dynamics (or aerodynamics). Once this importance is realized, it becomes easy to appreciate the author's contributions to conformal mapping techniques as presented in this textbook.

The treatment of the popular complex analysis topic of Cauchy integrals in this book is thorough. Some examples used in the analysis of singular integrals are taken from thin airfoil theory. While these integrals are very well known to aerodynamicists, some of their properties discussed in this book are not readily available from other sources. Also discussed is a method using Cauchy integrals and quadratures to construct a polynomial whose zeros are identical to those of a given transcendental function. Whereas this method is not new, its application has not been as widespread as it should be, perhaps because this method has not been discussed in many textbooks. Aerospace scientists involved with the investigation of flutter and vibrations of aerospace systems would perhaps agree that such a method could be highly desirable, particularly when they have to deal with complex transcendental functions for determining eigenvalues.

The treatment of potential theory in a plane is also thorough and interesting. Dirichlet and Neumann problems and their methods of solution are presented very well. There is an interesting discussion of Poisson's equation, which is a nonhomogeneous form of Laplace's equation (an important equation in potential flow theory). The basic numerical methods for solving partial differential equations are discussed competently. These methods, which include finite differences, finite element, and eigenvalue expansions, are discussed and compared in a manner that is helpful for both experienced and not-so-experienced analysts. Fast algorithms for implementing these methods, like the fast Poisson solvers, are treated in a rather comprehensive fashion.

A somewhat minor problem that readers may run into the course of using this book may be terminology. The author appears to have tried to unify both the Eastern and Western mathematical terminologies. For example, some theorems that are referred to in the Western literature by certain names are sometimes referred to in this book by their Eastern names, perhaps in an attempt to be chronological. However, he has also tried in many cases to explain such a situation; therefore, this should not distract the reader too much. More practical examples of the applications of the fine theorems and methods could have been presented, particularly the application of methods of constructing conformal mapping functions to computational nonlinear fluid dynamics. Another possible criticism of this fine book is its lack of treatment or mention of the method of characteristics for treating partial differential equations. In particular, a book of this caliber might be expected to discuss some aspects of complex characteristics, a relatively new analytical complex, and computational method, developed in the 1960's at the Courant Institute of Mathematical Sciences. It was found to be not only elegant mathematically, but also a powerful computational tool (in conjunction with the hodograph transformation) in the computation of two-dimensional transonic flow. However, because of the current size of this book, it may be argued that the addition of such a topic to the material currently covered in the book would have made the book too long. Therefore, since the author seems to be suggesting that another new volume in this series may be forthcoming in the future, he may have a legitimate reason for leaving out such a topic at this time.

A review of this book cannot be complete without pointing out another of its unique features; it contains informative notes giving the chronology and other dimensions of the topics treated, as well as references, for most of the sections of the book. Judging from the quality of its contents, it is clear that a lot of effort has gone into preparing this book. It is very informative and up-to-date. Therefore, this reviewer would recommend it to mathematicians, engineers, scientists, researchers, and graduate students of these disciplines.

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Hydrodynamic Instabilities and the Transition to Turbulence, Second Edition, H. L. Swinney and J. P. Gollub, Editors, Springer-Verlag, Inc., New York, 1985, 306 pp., $19.50.

The first edition of this book appeared in 1981 and it consisted of an introduction by the editors and eight well-written review articles by recognized authorities. It was published in a hardcover edition with 292 pages at a substantial price. The new edition is a high-quality paperback at a much reduced price and the original articles are unchanged from the first edition. To update the book, a final article entitled "Recent Progress" has been added. This article, by F. H. Busse, J. P. Gollub, S. A. Maslowe, and H. L. Swinney, consists of nine pages of text, including one figure, and 131 references. In my opinion this addition, although welcome, is not sufficient reason for an owner of the first edition to rush out and purchase the second edition. It does, however, make the book more timely, and together with the lower price gives someone who does not have the first edition an incentive to acquire the second edition. As there may be many readers of the *AIAA Journal* who are not acquainted with the first edition, a few comments on what it contains are in order.

An idea of the scope of the book may be obtained by listing the eight articles that make up the bulk of both editions. They are 1) "Strange Attractors and Turbulence" by O. E. Lanford, 2) "Hydrodynamic Stability and Bifurcation" by D. D. Joseph, 3) "Chaotic Behavior and Fluid Dynamics" by J. A. Yorke and E. D. Yorke, 4) "Transition to Turbulence in Rayleigh-Benard Convection" by F. H. Busse, 5) "Instabilities and Transition in Flow Between Concentric Rotating Cylinders" by R. C. Di Prima and H. L. Swinney, 6) "Shear Flow Instabilities and Transition" by S. A. Maslowe, 7) "Instabilities in Geophysical Fluid Dynamics" by D. J. Tritton and P. A. Davies, and 8) "Instabilities and Chaos in Nonhydrodynamic Systems" by J. M. Guckenheimer. The approach to instability from the abstract mathematical ideas of nonlinear dynamical systems, rather than from the Navier-Stokes equations, is presented in the articles by Lanford and by Yorke and Yorke. This approach, that quite loosely can be referred to as chaos theory, is shown by Guckenheimer to have applications beyond fluid dynamics. Another qualitative approach to instability and transition is that of bifurcation theory, and this theory is well presented in the detailed and enthusiastic article by Joseph. Of the four applications articles, the one by Tritton and Davies is firmly based on laboratory experiments and traditional theories. The article by Maslowe, which covers mainly boundary layers and free-shear flows, is more mathematical, but again the theories are the traditional linear and nonlinear theories, as these technically important flows still await a contribution from chaos theory. The comprehensive articles by Busse and by Di Prima and Swinney cover both theory and experiment, but again, except for one section in the latter on numerical solutions of model systems with a small number of degrees of freedom, the theories are