BOOK REVIEWS

Cooling Techniques for Computers
W. Aung, Editor
Hemisphere Publishing Corp., 1991, 420 pp., $99.50

In the past decade, as the size of electronic components has decreased, greater importance has been placed on the application of advanced thermal control techniques. The increase in the number of technical sessions at conferences, articles in technical journals, and reference texts attests to this observation.

Cooling Techniques for Computers provides another state-of-the-art review of conduction, air, single-phase and two-phase liquid cooling techniques, and experimental methods applicable to design and thermal management of electronic chips, boards, and cabinets. With chapters on electronic cooling written by acknowledged experts from both industry and academia, the book provides the electronic design engineer with a survey of the methodology, covering a wide variety of cooling applications that are currently used in both the United States and Japan. Positive features of the text include: extensive reviews of Japanese air cooling research and design approaches utilized in Japanese computers; design procedures for predicting thermal contact resistance in microelectronic components; and experimental methods used in prediction of velocities and temperatures at the component, board, and cabinet levels.

As components become smaller, the interface thermal resistance between chip and boards, and boards and racks becomes more significant. This text includes a review of design procedures for estimating thermal contact conductance and provides an extensive reference list for additional information. The text contains recent experimentally and numerically obtained design data on both free and forced air cooling through obstructed channels and enclosures. The reviews include references to recent Japanese research.

There is, however, one area in which the text falls short. The chapter on methods of thermal conduction analysis in electronic chips seems more appropriate for an advanced level course on analytical methods in heat transfer. There are probably few thermal design engineers who have any familiarity with the "Greens Function Solution Method." It would have been more appropriate to provide a brief review of finite element or finite difference techniques and discuss modeling approaches to solve the conduction problems in chips or chips on boards with anisotropic transport properties or the conjugate problem with surrounding airflow and radiation.

In conclusion, *Cooling Techniques for Computers* provides practicing electronic design engineers an additional reference for experimentally and numerically obtained design data for air and liquid cooling applications for thermal management. It also provides relatively inexperienced electronics thermal design engineers with thermal management responsibilities and academics new in the field of electronic cooling a review of thermal design practices currently in commercial use.

Dennis Torok

Engineering Applications of Unsteady Fluid Flow
by P.H. Azoury
John Wiley & Sons, 1992, 383 pp., $89.95

This book is one of very few that deals entirely with unsteady flow. It is primarily a review of the fundamentals, equations and applications of such flows. As intended the book is a review of the field of unsteady flow. Such a book is required to stimulate technical interest in the development of the applications of such flows. In this sense the book discusses in sufficient depth applications of unsteady flow to practical devices. With this book researchers and engineers can further develop and design these devices for useful applications.

Furthermore, this book demonstrates the fact that unsteady flows can provide a more efficient and simple means of converting energy to work. Many of the unsteady flow applications given by Foa (Foa, J. V. 1960. *Elements of Flight Propulsion*. Wiley, New York) have been updated with developments in the field since 1960. In contrast with this reviewed book, Foa's book treats both steady and unsteady flow applications of thermodynamics and fluid dynamics.

The effects of changing the spatial frame of reference is formally shown in this book. Many applications are reviewed. One of the most successful applications of unsteady flow is the dynamic pressure exchanger, which, with a change of the frame of reference, converts thermal energy to pressure increase. The frame of reference is changed from a stationary (stator) to a rotating (rotor) frame of reference. This process is utilized in the Comprex, developed by Brown-Bavari, which is a wave supercharger for internal combustion engines. Other applications of unsteady flow discussed include the tuned exhaust and inlet pipes for internal combustion engines and the cryptosteady energy exchange. Additional applications are too numerous to include in this review.

Sufficient information is given on each application discussed so that the reader understands the process involved. Analysis of the process is outlined, but no preliminary design is completed. Some efficiencies and properties are calculated. However, the reader must decide on a calculation procedure to complete a given design. The book intended this to be the case. It contains sufficient information to stimulate and interest researchers and developers to pursue development of applications of unsteady flow.

Helmut E. Weber