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# Book Reviews

## *Engineering Against Fatigue*

Edited by J. H. Beynon, M. W. Brown, T. C. Lindley, R. A. Smith, and B. Tomkins, A. A. Balkema Publishers, Rotterdam, The Netherlands, 1998, 600 pp., $120.00

This is a collection of 79 papers on fatigue assembled by the editors to recognize the contributions of Professor Keith Miller to research in fatigue over the past 30 years. The authors presented these papers at an international conference held in March 1997 in Sheffield in the United Kingdom. The first paper, by K. Miller, sets the stage for the remainder of the papers by clearly identifying the historical background and the main issues relative to stages of fatigue. The collection of papers, with very few exceptions, is the result of the work of university professors and research personnel in this field. Consequently, the reader is exposed to the latest thought processes on the phenomena related to fatigue. The reader of the book should be impressed by the progress made in this field over the past 30 years, as reflected by the contributed papers. However, the papers also reveal how reluctantly Mother Nature reveals her secrets in this complex discipline. One may wonder whether there are more questions raised than answered. Many of the papers are discussions of work in progress. Therefore, in these papers, the researcher describes only his theory and work to date to support the theory. The papers are surprisingly international in scope. A contribution can be found from essentially all countries with research in this area. There is understandably a slight tendency to emphasize the work in the United Kingdom because this is the home of Professor Miller and the editors. However, under one cover, the reader is able to sample the work being done around the world. This is one of the main attributes of the book. The papers cover practically all conceivable problems relating to fatigue. The problems discussed stem primarily from those found in airplanes, including engines and the rail industry. Consequently, there is considerable range in the materials assessed for fatigue damage. The coverage is primarily aimed at metallic structures; however, there are some papers on fatigue in composite structures. The editors carefully group the papers so that common themes are located together. The papers on "Short Cracks" are particularly interesting. There is also significant attention given to the microstructural aspects relating to fatigue because this was an interest of Professor Miller. The editors are generally successful in their selection of papers published in this book. Some of the papers, fortunately only a few, could have been omitted without harm to the coverage. It falls to the reader to determine whether this broad coverage is valuable. Some readers might prefer to have the topics more focused on their particular interest.

The papers are generally aimed at an audience that is actively working on problems associated with fatigue. Most of the authors assumed that the reader had a working acquaintance with the terminology used. In most cases, the cited references could be used to augment the knowledge base of the reader. Many of the papers, however, include descriptions of the fatigue mechanisms that would be very helpful for those wanting to become familiar with the fatigue processes.

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## *Engineering Turbulence Modeling and Experiments 4*

Edited by W. Rodi and D. Laurence, Elsevier, Amsterdam, 1999, 955 pp., $246.00

This book is a compendium of papers presented at the 4th International Symposium on Engineering Turbulence Modeling and Experiments organized by Professors Rodi and Laurence and held at Ajaccio, Corsica, France, 24–26 May 1999. As such it is an excellent summary of the current state of research in turbulence modeling and experiments. It consists of 90 papers organized into 13 different subtopics or sections and spans almost 1000 pages.

The initial section consists of five invited papers by well-known authorities in the field. A section on the theoretical aspects of turbulence modeling for Reynolds-averaged Navier–Stokes (RANS) equations is included, and connected to this are four sections on various applications of classical turbulence modeling in industry, aeronautics, turbomachinery, and heat transfer. In addition, there are three related sections addressed to modeling and its applications in transition, combustion systems and two-phase flows. There also are sections on direct and large eddy simulation (LES), experimental techniques, experimental studies, and turbulence control. It is beyond the scope of this review to give a complete evaluation of all of the papers included in the volume. Instead, a brief summary is presented of a few contributions that are considered important and representative of the volume.

In the section on invited papers, P. R. Spalart discusses strategies for turbulence modeling and simulations. A variety of approaches is discussed, ranging from direct numerical simulation (DNS) to RANS, including estimates of computer costs, as well as the time frame when a particular approach might become practical for engineering application. This paper advocates a relatively new approach to turbulence modeling and simulation called detached eddy simulation, which Spalart and his coworkers have recently developed and which looks very promising for practical computations. They have a paper in the section on aerodynamic flows describing initial applications of this approach.

There is a large number of papers dealing with conventional turbulence models. Many represent comparisons of simple eddy viscosity models with more advanced nonlinear algebraic and Reynolds stress models for a wide range of flow conditions. Representative of these efforts is the invited paper by M. A. Leschziner, P. Batten, and H. Loyau, in which model predictions for several compressible flow applications are compared. The authors conclude that advanced models, which more accurately model Reynolds stress anisotropy, are generally better than the simple eddy viscosity models, although in some cases carefully corrected eddy viscosity models can approach the performance of the best nonlinear algebraic and Reynolds stress models. These conclusions are generally in conformity with those of the other papers on conventional turbulence modeling.

The section on transition contains several interesting contributions. One of these is an important paper by B. J. Abu-Ghannam, H. H. Nigim, and P. Kavanagh, in which experiments involving transition in the presence of freestream turbulence, surface curvature, and pressure gradient are described. The authors show that, at high turbulence levels, favorable pressure gradients have little influence on transition location, a result that is counter to conventional wisdom. A second paper on transition modeling by I. Hadzic and K. Hanjalic shows promising results for the prediction of transition over separation bubbles using a second moment closure model.

An invited paper by N. Peters describes new results in the modeling of flame propagation of premixed fuels in turbulent combustion. The development of the model for turbulent flame velocity is very clearly described in this paper, even for a novice in turbulent combustion, and the results are shown to be in good agreement with experiment. There are a number of other good papers on turbulent combustion; notable among these is a paper by J. Xu and S. B. Pope that reports on pressure transport modeling of piloted jet nonpremixed flames using probability density function methods.

The invited paper by D. Besnard describes modeling of turbulence in the nuclear energy industry in France. Here modeling problems involve complex internal flow problems that are addressed using both conventional RANS models and LES modeling. The modeling of two-phase flows is important in these applications, and efforts in this direction are also described. There are a number of papers on DNS and LES modeling and applications. Notable among these is the paper by T. J. Huttl and R. Fredrich on the parametric influence of curvature and torsion on turbulent flow in helically coiled pipes using DNS. These results should be of considerable use to researchers in RANS modeling.

Finally there are a number of good papers on measurement and control of turbulence. The invited paper by W. Merzkirch, T. Rettich, F. Schneider, and W. Xoing describes techniques for measuring and visualizing turbulent pipe flows using proper orthogonal decomposition methods. They apply their methodology to the design of a flowmeter that utilizes ultrasound to measure fluid flow rates.

In summary, the volume is an excellent collection of papers describing the state of the art in turbulence modeling and experiments and should be of great use to researchers in the field.

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