Book Review

Structural Integrity & Durability
Satya N: Atluri; Tech Science Press; Forsyth; GA; 1997; 865 pp:; $175:00

Professor Atluri's book is divided into three main parts: The first part; comprising slightly more than one third of the book; is devoted primarily to analytical solutions and computational methods associated with fracture mechanics: Specifically; Professor Atluri concentrates on analytical and computational methods for obtaining stress intensity solutions for complex problems: He does not discuss material property issues associated with damage tolerance; nor does he discuss; in any depth; crack growth computational methods: However; the coverage of the stress intensity solution is adequate for a damage tolerance assessment of both fail-safe and monolithic aircraft structures: In these sections; he develops much of the basis for the remainder of the book: These sections are quite extensive and in most cases are complete enough to be understood without further explanation; although numerous references are provided: Considerable emphasis is placed on development of the finite element alternating method that is the centerpiece for the second part of the book:

The second part; covering approximately one half of the book; is devoted to the development of methods for ensuring damage tolerance and durability of built-up metallic structures: Much of the motivation of this part comes from Professor Atluri's role at the Georgia Institute of Technology when it was designated by the Federal Aviation Administration (FAA) Technical Center as a Center of Excellence: Consequently; the emphasis in the examples is on transport aircraft fuselages: This focus derives from concern about widespread fatigue damage that has jeopardized the safety of several aircraft: The analysis of transport aircraft fuselages is a very difficult problem: Therefore; technologies that are applicable to fuselages can usually be transitioned to other structures without additional development: Professor Atluri's approach for this problem is to generate models he classifies as global; intermediate; and local: The global model is a rather coarse model of the entire structure; whereas the local model includes considerable detail of the structure in the vicinity of the damage: This attacks the problem systematically and avoids the obvious numerical problems: Another major emphasis in this section is on the inclusion of plasticity effects in the finite element analysis: He makes a strong case that; in the assessment of an aircraft for loss of fail-safety because of widespread fatigue damage; one must include the effects of plasticity: He also discusses the virtues of the T^*-resistance function that is used to control crack extension: This part of the book also contains a section on composite patching of metallic structures: It is particularly illuminating because it provides an in-depth assessment of current knowledge in composite patching; as well as approaches suitable to single- and multiple-cracking scenarios: The approach is shown to provide excellent correlation with experimental results for partially disbonded patches: This part of the book also covers assessment of the dynamic effects of engine disintegration: An off-the-shelf code used for this appeared to produce results that were in fair agreement with experimental results:

The final part of the book is on composite structures and is a bonus to the reader: The book would have been complete without this section; but it does treat a very important problem: It deals with buckling of composite structures that have suffered delaminations: The approaches used employ some of the same techniques discussed in the first part of the book: However; much of the methodology developed is new because of the nature of composite structures: The robustness of the developed methods is demonstrated through comparisons with experimental results:

The book is a significant effort in that Professor Atluri collects under a single cover many of the current approaches for ensuring the structural integrity of fixed-wing aircraft structures: He has accomplished his purpose by capturing his contributions to aircraft safety through his work for the FAA in the Center of Excellence: For those working in the field; it is a valuable reference for the many methods that can be applied: For others; it provides considerable insight into the scope of the effort needed to maintain aircraft structural integrity:

John W: Lincoln
Aeronautical Systems Center; U:S: Air Force

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1) Journals: Walker, R. E., Stone, A. R., and Shandor, M., "Secondary Gas Injection in a Conical Rocket Nozzle," *AIAA Journal,* Vol. 1, No. 2, 1963, pp. 334–338.

2) Books: Turner, M. J., Martin, H. C., and Leible, R. C., "Further Development and Applications of Stiffness Method," *Matrix Methods of Structural Analysis,* 1st ed., Vol. 1, Wiley, New York, 1963, pp. 6–10.

3) AIAA Book Series: Sutton, K., "Air Radiation Revisited," *Thermal Design of Aeroassisted Orbital Transfer Vehicles,* edited by H. F. Nelson, Vol. 96, Progress in Astronautics and Aeronautics, AIAA, New York, 1985, pp. 419–441.

4) Reports: Book, E., and Bratman, H., "Using Compilers to Build Compilers," Systems Development Corp., SP-176, Santa Monica, CA, Aug. 1960.

5) Transactions/Proceedings: Soo, S. L., "Boundary-Layer Motion of a Gas-Solid Suspension," *Proceedings of the Symposium on Interaction Between Fluids and Particles*, Vol. 1, Inst. of Chemical Engineers, New York, 1962, pp. 50–63.

6) AIAA Meeting Papers: Bhutta, V. A., and Lewis, C. H., "Aerothermodynamic Performance of 3-D and Bent-Nose RVs under Hypersonic Conditions," AIAA Paper 90-3068, Aug. 1990.

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