

Overview

This is the third symposium on Applications of Automation Technology to Fatigue and Fracture Testing and Analysis. The papers in this book exemplify the typical evolution of computers and their applications. The simpler applications of past years are becoming more sophisticated, the hardware is becoming smaller and more powerful, and computers are doing things now that weren't even considered previously.

Data acquisition was a natural application of computers, even before the invention of the microprocessor. The microprocessor has made data acquisition application in fatigue applications ubiquitous. The paper "Networked Data Acquisition Systems for Strain Data Collection," by G. McLean, B. Prescott, and M. Ellens, brings computer networking to the field of portable fatigue data acquisition. With an innovative application of networking technology they have created a very small modular expandable data acquisition, which can collect field strain data, pre-process it, and forward it for further analysis and storage. This permits use of the system on applications where previous larger systems would have inhibited the natural use of the device under study. In the paper "Fatigue and Reliability Assessment Incorporating Computer Strain Gage Network Data," by M. Ellens, J. Provan, G. McLean, and M. Sanders, the authors made use of the system to make fatigue life prediction on the unique application of racing mountain bicycles.

The paper "Cycle-by-Cycle Compliance Based Crack Length Measurement," by R. Sunder, points up one of the problems related to the ubiquitous nature of computer data acquisition. There is a natural tendency to assume that newer and faster computers and computer hardware will always give better information. This paper clearly points out that computer hardware is a tool. A tool that must be intelligently and appropriately applied, and verified.

Robert Tregoning highlights, in the paper "Feasibility Study of Alternating Current Potential Drop Techniques for Elastic-Plastic Fracture Toughness Testing," the capability of computer systems to combine more than one sensory input and previously developed calibration data to calculate a near real time data output.

Another major category of computer use in Fatigue is in simulation. The paper "Fatigue Life Contours from Elastic FEM Considering Multiaxial Plasticity" by T. Langlais, J. Vogel, D. Socie, and T. Cordes, combines multiaxial fatigue damage rules with finite element analysis to predict fatigue damage. The authors then take it one step further by using high-quality computer graphics to help designers more easily understand the damage analysis.

The paper "Computer Modeling and Simulation in a Full-Scale Aircraft Structural Test Laboratory," by R. Hewitt and J. Albright, presents a new idea for using computers to improve the economics of fatigue testing itself. They have adapted a commercially-available personal computer program to modeling complex structural tests. This enables them to predict the behavior of the complex test control systems and optimize allowing more rapid startup and completion of these complex tests without the danger of damaging one of a kind structures.

The advent of microprocessors has had a large effect on the control capabilities of fatigue test equipment. The control schemes have ranged from hybrid designs where a computer is integrated with an analog controller system to full digital systems where computers replace the

analog control circuitry. The paper "Computer-Controlled High Strain Rate Compression Test System," by C. Venkatesh, T. Prakash, and R. Sunder takes a specialized hybrid approach to a control problem. The computer controls the servo-valve gain on a dual servovalve system in order to get the response speed required for the application.

Another similar hybrid control application is covered in the paper "Adaptive PID Control of Dynamic Materials-Testing Machines Using Remembered Stiffness," by C. Hinton. In this application a computer is used to optimize gain for the current stiffness of the test sample. For applications such as low cycle fatigue it can be set up to use results of the previous cycle where insufficient immediate information is available.

The paper "Characteristics and Automated Control of a Dual-Frequency Servohydraulic Test System," by K. Reifsnider, S. Case, and L. Mosiman contains a discussion of a mostly digital hybrid control system. The system controls two in line actuators to superimpose two independent and widely separated load frequencies on a single sample.

The large increases in the speed and power of microprocessors has enabled the use of calculated control variables in full digital control fatigue test systems. The paper "Materials Characterization Using Calculated Control," by J. Christiansen, R. Oehmke, and A. Schwarzkopf contains a review of requirements for calculating control variables and suggestions for some variables suitable for calculated control.

The final paper, entitled "Control of a Biaxial Test Using Calculated Input Signals and Cascade Control," by F. Albright and L. Johnson, uses calculated control variables to solve a problem in planar biaxial testing. The authors use calculated feedback signals and a hierarchical processing algorithm on multiple inputs in a digital controller to prioritize the effects of the input signals on the resultant output loads. All this to prevent irrelevant movement in the planar test region.

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