



Код: 10239

Douglas E. Adams

Health Monitoring of Structural Materials and Components

Издательство John Wiley & Sons Ltd, Chichester, 2007 год

475 стр; формат: 25 x 17 см; библиографический список: 173 единицы
ISBN: 978-0-470-03313-5 (HB)

This textbook presents a set of methods and applications in three areas of health monitoring for structural materials and components: (1) loads identification, (2) in situ damage identification (diagnostics), and (3) damage and performance prediction (prognostics). The applications focus on using vibration and wave propagation measurements for health monitoring as opposed to electromagnetic, thermal, or other measurement variables that are also indicative of component health.

The book aims to provide readers with a summary of the technical skills and practical understanding required to solve new problems encountered in this emerging field. It is written for newcomers who would like a review of the basics in modeling, measurement, signal processing, and data analysis. The book should also appeal to more experienced readers who are looking for a reference text to address current and future challenges. The book is a manual for conceptualizing, designing, and operating health-monitoring systems for mechanical and structural systems.

Ключевые слова:

Содержание.

- Preface /
- Acknowledgments /
- 1. Introduction /
 - 1.1. Basics of Health Monitoring /
 - 1.2. Commercial Needs for Health Monitoring Technology /
 - 1.3. Defense Needs for Health Monitoring Technology /
 - 1.4. Technical Approach to Health Monitoring /
 - 1.5. Definitions of Common Terminology /
 - 1.6. Comparison of Nondestructive Testing (NDT) and Health Monitoring Techniques /
 - 1.7. Potential Impact of Health Monitoring Technologies /
 - 1.8. Overview of Technical Areas in Health Monitoring /
 - 1.9. Summary /
 - References /
 - Problems /
- 2. Modeling Components /
 - 2.1. Modeling Needs /
 - 2.2. First-Principle Models /
 - 2.2.1. Component Vibration Models /
 - 2.2.2. Vibration Natural Frequencies and Modal Deflection Shapes /
 - 2.2.3. Free Vibration Response /
 - 2.2.4. Forced Vibration Response (Frequency Response Models) /
 - 2.2.5. Impedance and Compliance Models /
 - 2.2.6. Transmissibility Forced Response Models /
 - 2.2.7. Nonlinear Dynamic Models /
 - 2.2.8. Wave Propagation Models (One Dimensional) /
 - 2.2.9. Wave Propagation Models (Two Dimensional) /
 - 2.3. Data-Driven Models /
 - 2.3.1. Experimental Time Domain Models /
 - 2.3.2. Experimental Frequency Response Models /
 - 2.3.3. Experimental Modal Vibration Models /
 - 2.3.4. Other Data-Driven Models /
 - 2.4. Load Models /
 - 4.4.1. External Mechanical Excitations /
 - 4.4.2. Acoustic Pressure, Temperature and Other Environmental Loads /
 - 2.5. Summary /
 - References /
 - Problems /
- 3. Modeling Damage /

- 3.1. Static Damage Models /
 - 3.1.1. Fasteners and Joints /
 - 3.1.2. Cracking /
 - 3.1.3. Plastic Deformation, Penetration and Erosion /
 - 3.1.4. Delamination, Debonding and Separation /
 - 3.1.5. Creep and Buckling /
 - 3.1.6. Corrosion and Oxidation /
 - 3.1.7. Matrix Cracking /
 - 3.1.8. Microstructural Changes /
- 3.2. Dynamic Models for Damage /
 - 3.2.1. Phenomenological Models /
 - 3.2.2. Generalized Damage Growth Models /
- 3.3. Failure Models /
- 3.4. Performance Models /
- 3.5. Summary /
- References /
- Problems /
- 4. Measurements /
 - 4.1. Measurement Needs /
 - 4.2. Data Environment /
 - 4.3.1. Amplitude and Frequency Ranges /
 - 4.3.2. Nature of Data /
 - 4.3.3. Environmental Factors /
 - 4.3. Transducer Attachment Methods /
 - 4.3.1. Durability /
 - 4.3.2. Stability /
 - 4.3.3. Directionality /
 - 4.3.4. Frequency Range (Wavelength) /
 - 4.4. Transducers /
 - 4.4.1. Overview of Sensors and Actuators /
 - 4.4.2. Passive Sensors /
 - 4.4.3. Active Piezoelectric Transducers (Actuators) /
 - 4.4.4. Other Types of Sensors /
 - 4.4.5. Transducer Placement and Orientation /
 - 4.5. Data Acquisition /
 - 4.5.1. Common Errors /
 - 4.5.2. Aliasing /
 - 4.5.3. Leakage /
 - 4.5.4. Channel Limitations in Data Acquisition /
 - 4.6. Summary /
 - References /
 - Problems /
- 5. Data Analysis /
 - 5.1. Data Analysis Needs and Framework /
 - 5.2. Filter Data /
 - 5.2.1. Time Domain Filters /
 - 5.2.2. Frequency Domain Filters /
 - 5.2.3. Spatial Filters /
 - 5.3. Estimation of Unmeasured Variables (State Inference) /
 - 5.4. Temporal Analysis /
 - 5.4.1. Statistical (Nondeterministic) Analysis /
 - 5.4.2. Deterministic Analysis /
 - 5.5. Transformation of Data /
 - 5.5.1. Spectral (Frequency) Analysis /
 - 5.5.2. Higher-Order Spectral Analysis /
 - 5.5.3. Analysis Using Other Spectral Transformations /
 - 5.5.4. Time-Frequency Analysis /
 - 5.6. Averaging of Data /
 - 5.6.1. Cyclic Averaging /
 - 5.6.2. Frequency Response Function Estimation /
 - 5.6.3. Averaging of Data in Rotating Systems /
 - 5.7. Spatial Data Analysis /
 - 5.7.1. Modal and Operational Deflection Patterns /
 - 5.7.2. Transfer Path Analysis /
 - 5.7.3. Multidirectional Data /
 - 5.7.4. Triangulation /
 - 5.8. Feature Extraction /
 - 5.8.1. Model-Based Feature Extraction (Damage) /
 - 5.8.2. Model-Based Feature Extraction (Loading) /
 - 5.8.3. Dimensionality of Feature Sets /
 - 5.8.4. Statistical Models for Features /
 - 5.9. Variability Analysis /
 - 5.10. Loads Identification /
 - 5.10.1. Overview /
 - 5.10.2. Estimation Errors /
 - 5.10.3. Conditioning of Loads Identification Algorithms /
 - 5.11. Damage Identification /
 - 5.11.1. Damage Detection /
 - 5.11.2. Damage Localization /

5.11.3. Damage Quantification /	
5.12. Regression Analysis for Prognosis /	
5.12.1. Physics-Based Methods /	
5.12.2. Data-Driven Methods /	
5.13. Combining Measurement and Data Analysis /	
5.14. Summary /	
References /	
Problems /	
6. Case Studies: Loads Identification /	
6.1. Metallic Thermal Protection System Panel /	
6.1.1. Data-Driven /	
6.1.2. Physics-Based /	
6.2. Gas Turbine Engine Wire Harness and Connector /	
6.3. Fuselage Rivet Process Monitoring /	
6.4. Large Engine Valve Assembly /	
6.5. Suspension with Loosening Bolt /	
6.6. Sandwich Panel Undergoing Combined Thermo-Acoustic Loading /	
6.7. Summary /	
References /	
Problems /	
7. Case Studies: Damage Identification /	
7.1. Vibration-Based Methods /	
7.1.1. Metallic Thermal Protection System Panel /	
7.1.2. Gas Turbine Engine Wire Harness and Connector /	
7.1.3. Suspension System /	
7.2. Wave Propagation-Based Methods /	
7.2.1. Wheel Spindle /	
7.2.2. Ceramic Tile /	
7.2.3. Gamma Titanium Aluminide Sheet /	
7.2.4. Aluminum Plate /	
7.3. Damage Identification Under Load /	
7.3.1. Metallic Panel Under Thermo-Acoustic Loading /	
7.3.2. Aluminum Plate Under Vibration Loading /	
7.4. Summary /	
References /	
Problems /	
8. Case Studies: Damage and Performance Prediction (Prognosis) /	
8.1. S2 Glass Cylinder (Performance Prediction) /	
8.2. Stability Bar Linkage (Damage Growth Modeling) /	
8.3. Summary /	
References /	
Problems /	
Appendix A /	
Appendix B /	
Index /	