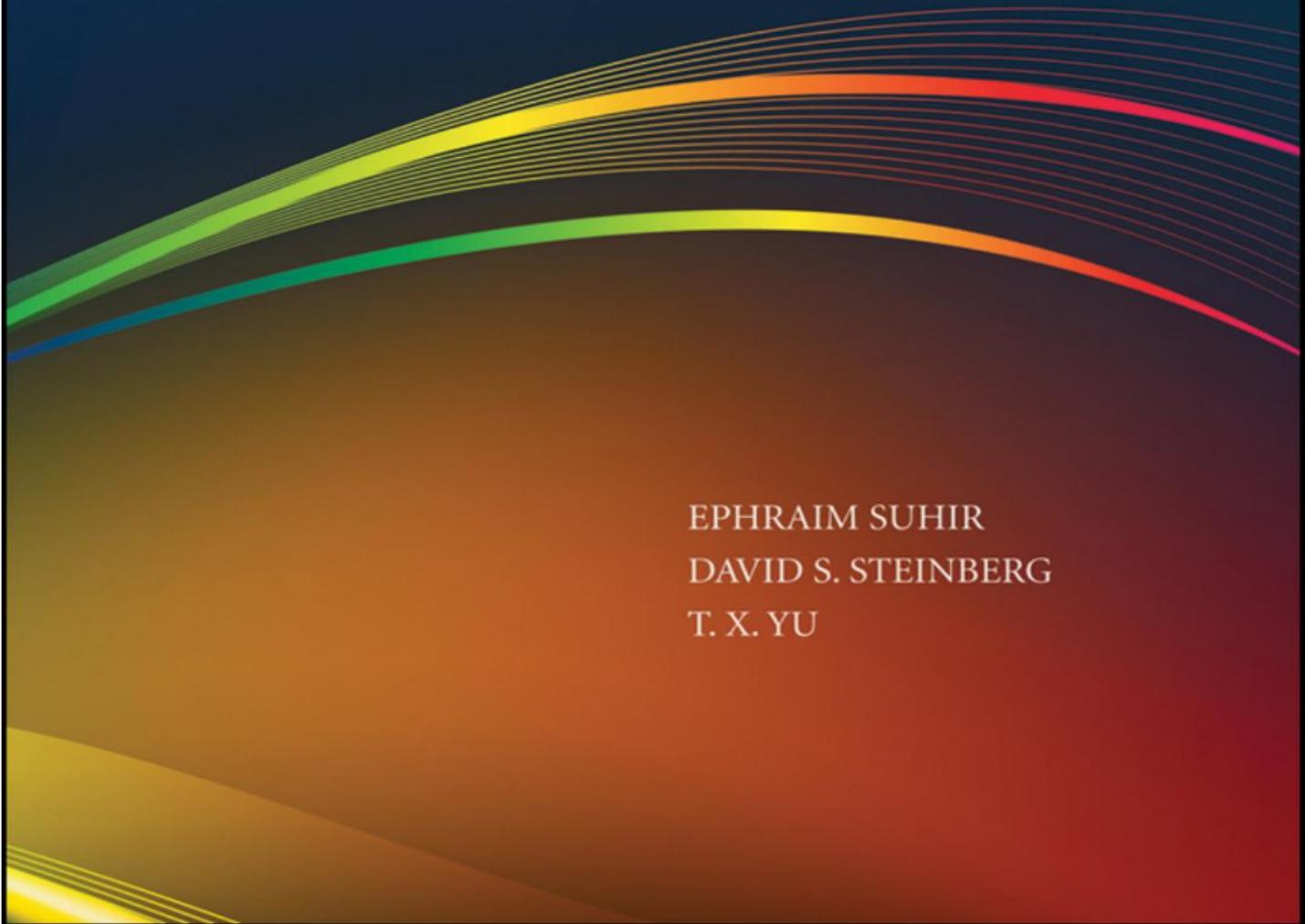


# Structural Dynamics *of Electronic and* Photonic Systems



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# Table of Contents

[Title Page](#)

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[Preface](#)

[Contributors](#)

[Chapter 1: Some Major Structural Dynamics-Related Failure Modes and Mechanisms in Micro- and Opto-Electronic Systems and Dynamic Stability of These Systems](#)

[1 Physics of Electronic Failures in Vibration and Shock](#)

[2 Case History for Design, Analysis, and Testing of Electronic Chassis Required to Operate in Severe Sine Vibration Environment and Effects of Using Viscoelastic Damping Material on PCBs to Increase Fatigue Life](#)

[3 What Happens When 20 Plug-in PCBs Are Tied Together, Then Installed in a Chassis That Is Subjected to a 5G Peak Sine Vibration Input Level?](#)

[4 Consider Using Snubbers to Increase Fatigue Life of Electronic Systems Required](#)

**to Operate in Severe Vibration and Shock Environments**

**5 Sample Problem: Calculating Forces, Stresses, and Fatigue Life of the End Aluminum Plates in Previous Housing Enclosure**

**6 How Displacements Are Related to Frequency and Acceleration**

**7 Sample Problem: Find Dynamic Displacement of PCB Exposed to Sine Vibration Using English Units and Metric Units**

**8 Octave Rule Can Avoid Vibration Failures due to Resonance Coupling of Outer Housing Enclosure with Internal PCBs**

**9 Another Application Where Snubbers Can Be Used To Improve Fatigue Life of PCBs in Severe Vibration and Shock Environments**

**10 Vibration Failures due to Connector Fretting Corrosion in Random Vibration**

**11 Why Some Failures May Be Difficult to Solve or May Never Be Solved**

**12 Companies with Financial Problems May Reduce Quality to Save Money**

**13 Why Some People Will Ship Electronic Equipment They Know Will Fail Just to Get Their Shipping Bonus**

**14 Can Vibration Alone Produce a V-Shaped Deep Hole in a 65-Pound Aluminum Casting**

**12 Inches in Diameter That Is 0.25 Inch Thick?**

## 15 Failure Modes in Opto-Electronic Fiber-Optic Systems Related to Structural Dynamics

## 16 How Electronics Are Being Used to Control Structural Dynamics and Dynamic Stability of Systems for Improved Reliability and Safety

### References

## Chapter 2: Linear Response to Shocks and Vibrations

### 1 Single-Degree-of-Freedom (SDOF) System

### 2 SDOF System Subjected to Harmonic Excitation

### 3 Systems with Multiple Degrees of Freedom (MDOF)

### 4 Forced Vibrations of Elongated PCB due to Harmonic Oscillations of Its Support Contour

### 5 Forced Vibrations of a Heavy Electronic Component Subjected to Harmonic Excitation

### A.1 Appendix: Natural Vibration Frequency of a Heavy Electronic Component

### References

## Chapter 3: Linear and Nonlinear Vibrations Caused by Periodic Impulses

### 1 Introduction

**2 Review**

**3 Shock-Excited Vibrations**

**References**

## **Chapter 4: Random Vibrations of Structural Elements in Electronic and Photonic Systems**

**1 Introduction**

**2 Elongated PCB Subjected to External Loading: Nonlinear Equations**

**3 Dynamic Response of Multi-Degree-of-Freedom Linear System to External Loading**

**4 Solution Using Duhamel Integral**

**5 Solution Using Fourier Integral**

**6 Complex-Frequency Characteristic as Spectrum of Impulse Response**

**7 Duration of a Process and Width of Its Spectrum**

**8 Correlation Theory and Spectral Theory of Random Processes**

**9 Spectral Theory of Transformation of Stationary Random Processes by Linear Dynamic Systems**

**10 White Noise**

**11 Bivariate Correlation Function and Bivariate Spectral Density in PCB Random Vibrations**

**12 Probability of Exceeding the Given Level**

**13 Role of Higher Modes (Harmonics)**

**14 Optimized Damping**

## References

# Chapter 5: Natural Frequencies and Failure Mechanisms of Electronic and Photonic Structures Subjected to Sinusoidal or Random Vibrations

1 Introduction

2 Natural Frequencies for Beam Types of Structures

3 Sample Problem: Calculating the Natural Frequency of a Uniform Beam

4 Simple Method for Finding the Natural Frequency of Complex Structures

5 Sample Problem

6 Sample Problem

7 Effects of Sine Vibrations on Forces, Stresses, and Fatigue Life of Lead Wires and Solder Joints on Electronic Components Soldered to PCBs

8 Sample Problem

9 Sample Problem

10 Sample Problem

11 Octave Rule for Reducing Severe Sine Vibration Dynamic Coupling with a Chassis Housing and Reducing Failures in Internal PCBs

12 Sinusoidal Vibrations

13 Large Dynamic Displacements in PCBs

14 Sample Problem: Vibration Fatigue Life of Large Ball Grid Array

**15 Using Sine Sweeps through a Resonance to Evaluate Electronic Equipment**

**16 Sample Problem: Fatigue Damage Accumulated by a Sine Sweep through the Half-Power Points**

**17 Properties of Various Types of Enclosures and PCBs**

**18 When Octave Rule Cannot Be Followed, Other Options Such as Snubbers or Ultrasmall Ping-Pong Balls or Isolation Systems Are Available**

**19 Isolation Systems for Improved Fatigue Life in Vibration and Shock**

**20 Determining Natural Frequencies of Uniform Flat Plates and PCBs**

**21 Sample Problem**

**22 Natural Frequency Equations**

**23 Effects of Loose Edge Guides on Plug-in Types of Rectangular Circuit Boards**

**24 Additional Details**

**25 Sample Problem: Finding Minimum Desired PCB Natural Frequency**

**26 How Bending Curvature of PCB Can Affect PCB Fatigue Life**

**27 Vibration Characteristics of Box Structures and Frame Structures**

**28 Sample Problem**

**29 Effects of Random Vibration on Various Types of Electronics and Their Structures**

**30 Differences between Random Vibration and Sinusoidal Vibration**

**31 Log-Log Input and Response Curves Used for Random Vibration**

**32 Sample Problem**

**33 Random Vibration PSD in Terms of Mean-Squared Acceleration Density**

**34 Simplified Method for Calculating Areas under Different-Shaped Random Vibration Input PSD Curves**

**35 Sample Problem**

**36 Locating Break Points on PSD Random Vibration Curve**

**37 Sample Problem**

**38 Gaussian and Rayleigh Probability Distribution Functions for Estimating Fatigue Life of Different Types of Electronic Equipment Exposed to Random Vibration**

**39 Characteristics of Single-Degree-of-Freedom System and Fatigue Life in Random Vibration**

**40 Sample Problem**

**41 Response of Cantilever Beam to Random Vibration**

**42 Miner's Cumulative Fatigue Damage Ratio Can Be Used to Estimate Fatigue Life**

**43 A Bit of History Regarding Random Vibration Methods of Analysis and Testing**

**44 Quick Method for Finding Approximate Fatigue Life for Structures Exposed to**

**Random Vibration Using Three-Band Technique**

**45 Special Applications for Designing PCB to Operate in Random Vibration**

**46 Sample Problem**

**47 Effects of Shock on Various Types of Electronic Systems and Structures**

**References**

**Chapter 6: Drop/Impact of Typical Portable Electronic Devices: Experimentation and Modeling**

**1 Introduction**

**2 Experimental Set-Up**

**3 Repeatability of Impact Tests**

**4 Experimental Results and Discussion**

**5 Dynamic Model**

**6 Conclusions**

**References**

**Chapter 7: Shock Test Methods and Test Standards for Portable Electronic Devices**

**1 Introduction: Necessity of Drop/Impact Testing of Portable Electronic Products**

**2 Test Criteria and Specifications**

**3 Shock Test Machine**

**4 Comparison of Different Test Methods**

**5 Discussion**

## 6 Conclusions References

# Chapter 8: Dynamic Response of Solder Joint Interconnections to Vibration and Shock

- 1 Solderers Must Be Carefully Attached to Structural Members to Avoid Failures
- 2 Vibration Problems with Electronic Components Mounted on PCBs
- 3 Problems with Lead-Free Solders
- 4 Methods for Predicting Fatigue Life of Solder Joints
- 5 How Poor Manufacturing and Poor Assembly Methods Might Affect Reliability
- 6 Typical Tolerances in Electronic Components and Effects on Vibration and Thermal Cycling and Fatigue Life
- 7 Problems Associated with Thermal Cycling on Solder Joints and Lead Wires
- 8 Vibration and Thermal Cycling Environments on Lead Wires and Solder Joints
- 9 Comparing Reliability Perspective Mean Time between Failures (MTBF) with Failure-Free Operating Period (FFOP)

# Chapter 9: Test Equipment, Test Methods, Test Fixtures, and Test

# **Sensors for Evaluating Electronic Equipment**

- 1 Component Failures Produced by Thermal Cycling and Vibration Cycling**
- 2 How Manufacturing Methods and Material Properties Can Produce Failures in Electronic Equipment**
- 3 Viscoelastic Damping Materials Cause Problems If They Are Not Used Carefully**
- 4 Different Types of Test Equipment Are Often Required**
- 5 Vibration Test Fixtures and Adapters**
- 6 Basic Vibration Fixture Design Considerations**
- 7 Oil Film Slider Table Vibration Fixtures**
- 8 Vibration Fixture Counterweights**
- 9 Summary for Good Vibration Fixture Design**
- 10 Effects of Shock on Electronic Equipment**
- 11 Specifying the Shock Motion and Environment**
- 12 Pulse Shocks in Electronic Equipment**
- 13 How PCBs Respond to Shock Pulses**
- 14 Case Histories of Failures and Failure Analyses**
- 15 Failures in Small Cantilever Shafts of Spinning Gyro**

# **Chapter 10: Correlation between Package-Level High-Speed Solder Ball Shear/Pull and Board-Level Mechanical Drop Tests with Brittle Fracture Failure Mode, Strength, and Energy**

**1 Introduction**

**2 Experimental Investigation of High-Speed Ball Shear and Pull Tests**

**3 Effects of IMC Growth on High-Speed Ball Shear and Pull Tests after Thermal Aging**

**4 Correlation of High-Speed Ball Shear/Pull Tests and Board-Level Drop Test**

**5 Conclusions**

**References**

# **Chapter 11: Dynamic Mechanical Properties and Microstructural Studies of Lead-Free Solders in Electronic Packaging**

**1 Introduction**

**2 Microstructure of Solder Joints**

**3 Specimen Preparation**

**4 Microstructure of Sn-37Pb Solder Ball Specimens**

**5 Microstructure of Sn-3.5Ag Solder Specimens**

**6 Microstructure of Sn-3.8Ag-0.7Cu Solder Specimens**

**7 Quasi-Static Material Properties of Solder Specimens**

**8 Quasi-Statically Compressed Solder Specimens**

**9 Young's Modulus of Solder Specimens**

**10 Yield of Solder Specimens**

**11 Tangential Modulus of Solder Specimens**

**12 Dynamic Material Properties of Solder Specimens**

**13 Mechanical Properties of Sn-37Pb, Sn-3.5Ag, and Sn-3.8Ag-0.7Cu Solder Balls**

**14 Conclusions**

**Acknowledgments**

**References**

**Chapter 12: Fatigue Damage Evaluation for Microelectronic Components Subjected to Vibration**

**1 Introduction**

**2 Test Vehicle Design**

**3 Experiment**

**4 Failure Analysis**

**5 Methodology Development for Determination of Vibration Fatigue Damage**

**6 Finite Element Analysis**

**7 Vibration Fatigue Damage Model Development and Validation**

## 8 Conclusions Bibliography

# Chapter 13: Vibration Considerations for Sensitive Research and Production Facilities

1 Introduction

2 Planning and Design Guidance

3 Vibration Criteria

4 Design Considerations

5 Testing and Evaluation

Appendix: Vibration Isolation of Sensitive Equipment

Bibliography

# Chapter 14: Applications of Finite Element Analysis: Attributes and Challenges

1 History of Finite Element Analysis

2 Linear and Nonlinear FEA Analyses

3 Commercial FEA Codes

4 Challenges in FEA Modeling and Simulation

5 Types of Simulation

6 Conclusions

# Chapter 15: Shock Simulation of Drop Test of Hard Disk Drives

1 Introduction

2 Finite Element Modeling  
3 Drop Test Simulation and a Pseudoresonance Phenomenon  
4 Pulse Shape Effects and Power Spectrum Analysis  
5 Conclusions  
References

## Chapter 16: Shock Protection of Portable Electronic Devices Using a “Cushion” of an Array of Wires (AOW)

1 Introduction  
2 Analysis  
3 Numerical Example  
Appendix A: Compressed Cantilever Beam of Finite Length Lying on an Elastic Foundation  
Appendix B: Unembedded Cantilever Wire (Beam) Subjected to Axial Compression  
References

## Chapter 17: Board-Level Reliability of Lead-Free Solder under Mechanical Shock and Vibration Loads

1 Introduction  
2 Methods of Shock Impact Testing  
3 Vibration Test as Method to Test to Replace Drop Test

4 Reliability under Combined Loading Conditions  
5 Conclusions  
Appendix  
References

## Chapter 18: Dynamic Response of PCB Structures to Shock Loading in Reliability Tests

1 Introduction  
2 Measured Deformations and Predicted Failures in Assembly Subjected to Shock Loading  
3 Board-Level Shock Tests  
4 Theoretical Considerations  
5 PCB Response in Shock Tests: Experimental Data  
6 Modeling of PCB Shock  
7 Conclusions  
References

## Chapter 19: Linear Response of Single-Degree-of-Freedom System to Impact Load: Could Shock Tests Adequately Mimic Drop Test Conditions?

1 Introduction  
2 Analysis

**3 Elongated Rectangular Plate Subjected to Instantaneous Impulse Applied to Its Support Contour**

**4 Error from Substituting an Impact Load with an Instantaneous Impulse**

**5 What If the Applied Acceleration Is not Short Enough?**

**6 Energy Approach**

**7 Probabilistic Approach**

**8 Conclusions**

**References**

**Chapter 20: Shock Isolation of Micromachined Device for High-g Applications**

**1 Introduction**

**2 Fundamentals of Mechanical Vibration System**

**3 Shock Isolation**

**4 Classification of Shock Isolator**

**5 Dynamic Response of Micromachined Device under Shock and Vibration**

**6 Woodpecker-Inspired Microparticle Shock Isolator**

**7 Conclusions**

**References**

**Chapter 21: Reliability Assessment of Microelectronics Packages Using**

## **Dynamic Testing Methods**

**1 Introduction**

**2 Isothermal Mechanical Twisting Testing Method**

**3 Four-Point Dynamic Bending (4PDB) Testing Method**

**4 High-Frequency Dynamic Vibration Testing Method**

**5 Conclusions**

**References**

## **Chapter 22: Thermal Cycle and Vibration/Drop Reliability of Area Array Package Assemblies**

**1 Summary**

**2 Technology Trend for Area Array Packages**

**3 PBGA Thermal Cycle Solder Joint Reliability**

**4 Test Results for TC Reliability of High I/O PBGA Assemblies**

**5 Cycles-to-Failure of PBGA 676 I/Os**

**6 CSP-TC and Vibration Behavior (Sn<sub>37</sub>Pb)**

**7 BGA 225-I/O Vibration: Sn<sub>37</sub>Pb and SAC397**

**8 CBGA Assemblies: Vibration and Thermal Cycle Synergism**

**9 Drop Shock Behavior with/without Isothermal Aging of Sn<sub>37</sub>Pb and Lead-free BGA/CSPs**

**10 Drop Behavior with/without a Priori Thermal Cycle**

**11 Summary**

**Acknowledgments**

**Acronyms**

**References**

**Chapter 23: Could an Impact Load of Finite Duration Be Substituted with an Instantaneous Impulse?**

**1 Introduction**

**2 Analysis**

**3 Numerical Example**

**4 Conclusions**

**References**

**Index**

# **Structural Dynamics of Electronic and Photonic Systems**

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# **Preface**

Electronic, optoelectronic, and photonic components and systems often experience dynamic loading. In commercial electronics, such loading can take place during handling or transportation of the equipment. In military, avionic, space, automotive, and marine electronics, dynamic loading, whether deterministic or random, is expected to occur even during normal operation of the system. On the other hand, random vibrations are sometimes applied (in addition to, or even instead of, thermal cycling or environmental testing) as an effective and fast means to detect and weed out infant mortalities. In addition, the necessity to protect portable electronics from shock loading (typically, because of an accidental drop) resulted in an elevated interest in the development of theoretical and experimental techniques for the prediction of the consequences of an accidental shock, as well as for an adequate shock protection of portable products. Development of new shock absorbing materials is regarded equally important. Finally, owing to numerous optoelectronic and photonic technologies emerged during the last decade or so, the ability to evaluate and possibly optimize the dynamic response of various photonic devices to shocks and vibrations is becoming increasingly important.

The following objectives are pursued in this book:

- familiarize the readers with the major problems related to the dynamic behavior of electronic and photonic components, devices, and systems;
- examine typical failure modes and mechanisms in electronic and photonic structures experiencing dynamic loading;
- address the basic concepts and fundamentals of dynamics and vibration analysis, including analytical, computer-aided, and experimental methods, and

demonstrate how these methods can be effectively used to adequately approach the above problems;

- discuss and solve particular problems of the dynamic response of electronic and photonic systems to shocks and vibrations, and
- suggest how to choose the appropriate mechanical design and materials to create a viable and reliable product.

The reader of the book will become familiar with the mechanical, materials, and reliability related problems encountered in systems experiencing shocks and/or vibrations and will learn about the theoretical and experimental methods, approaches, and techniques which are used to solve these problems. This will enable those in the field to enhance their knowledge and skills in their profession and will teach those not in the field yet how to apply their background in mechanics, materials, and structures to this exciting and rapidly developing area of “high-tech” engineering.

The book is unique: it is the first time that a book of such a broad scope is written. The content of the book covers some of the most important mechanical, materials, and reliability aspects of the dynamic response, stability, and optimal design of electronic and photonic components, devices, and structural elements experiencing dynamic loading. The book contains 23 chapters written by leading specialists in the field. After getting familiar with the book's chapters, readers will better understand the reliability problems in, and mechanical behavior of, typical microelectronic, optoelectronic, and photonic structures subjected to dynamic loading, as well as be able to select the most appropriate materials for, and geometries of, such structures. Some of the design decision could be made based on simple and easy-to-apply formulas which will be provided in the book. These formulas indicate the role of

different materials and geometrical factors affecting the mechanical behavior and reliability of a structure and can be effectively used prior to, and quite often even instead of, computer-aided modeling or experimental analyses.

The technical emphasis of the book is on the application of the basic principles of the dynamic structural analysis to understand, analyze, and improve the dynamic behavior and reliability of microelectronic and photonic structures operating in dynamic environments. The book will enable a design and reliability engineer, who did not work before in the field of electronics and photonics, to apply his/her knowledge in dynamical analysis to this new and exciting field. At the same time, physicists, materials scientists, chemical or reliability engineers who deal with “high-technology” components and devices for many years will learn how methods and approaches of mechanical and structural engineering can be effectively used to design a viable and reliable product.

The book is written with the emphasis on the physics of the phenomena. No in-depth knowledge of the mechanical, materials, or structural engineering is required. The needed information is given in the book chapters, when appropriate. Nonetheless, some knowledge of the basic calculus, strength of materials, and theory of vibrations is desirable to better understand the contents of the book.

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