Structural Dynamics *of* Electronic *and* Photonic Systems

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Sensors for Evaluating Electronic Equipment

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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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