

Preface

Growing international competition has increased the need for all engineers and designers to ensure the level of quality and reliability of their products before release, and for all manufacturers to produce products at their best reliability level at the lowest cost. This implies that the interest in reliability and quality will continue to grow for many years to come.

This book comprises 25 chapters, organized in five parts: System Reliability Computing, Reliability Engineering in Design, Software Reliability and Testing, Quality Engineering in Design, and Applications in Engineering Design. It aims to present the latest theories and methods of reliability and quality, with emphasis on systems design, models and applications. The subjects covered include reliability engineering, maintenance, quality in design, failure analysis, robust design, software reliability and engineering, engineering reliability in design, software development process and improvement, reliability computing, software measurements, software cost effectiveness, applications in reliability design, stress-strength probabilistic, statistical process control, stochastic process modeling, repairable systems, safety analysis, accelerated life modeling, probabilistic modeling and risk analysis. Each chapter will be written by active researchers and/or experienced practitioners with international reputations in the field and with the hope of bridging the gap between theory and practice in reliability and quality in design. Authors of many outstanding papers from the 12th *ISSAT Conference Proceedings of the International Conference on Reliability and Quality in Design* (2006) have been invited to expand their conference papers for contribution as chapters to this book.

The book consists of five parts. Part I of the book contains five papers, deals with different aspects of *System Reliability Computing*. Chapter 1 by Zeepongsekul describes in detail the characteristic of central limit theorem for a reliability measure, called gauge measure, which is based on a marked point process. It also discusses directions of applications related to this new reliability measure. Chapter 2 by Tian, Li, and Zuo discusses a recent advance in the modeling and reliability evaluation of multi-state k out of n systems and its applications in engineering. Chapter 3 by Zhang, Xie, and Tang discusses a method for the parameter estimation of Weibull distribution when there is no censoring using weighted least squares estima-

tion. They also present a simple approximation formula to calculate the weights for a small sample of size. Chapter 4 by Nakagawa and Mizutani discusses several characteristics of periodic cumulative damage models where the total damage is additive. The derivations of obtaining the optimum replacement policies along with numerical examples are also discussed. Chapter 5 by Filus and Filus presents an overview and the development concepts of stochastic reliability modeling approaches. Some analytical description and application of stochastic dependences such as conditioning method and transformations method are also discussed. Chapter 6 by Liu and Mazzuchi discusses a comprehensive literature review on the various burn-in aspects respect to cost functions. The authors also discuss various cost optimization models and their warranty policies considering the concept of “per-item-output”.

Part II of the book contains five papers, and focuses on *Reliability Engineering in Design*.

Chapter 7 by Elsayed and Zhang presents a predictive maintenance model addressing multiple imperfect maintenance actions and optimization procedures to determine the optimum system maintenance threshold level that achieves the maximum system availability. Chapter 8 by Lu and Wang presents a method to estimate the reliability and its confidence limits for the Weibull distribution, when there are only few or no failure data available. The Monte Carlo simulation technique with only three failure samples was also discussed to obtain the estimates of a two-parameter Weibull distribution. Chapter 9 by Xie and Wang presents an extended stress-strength interference analysis method to calculate the fatigue reliability under constant cyclic load with uncertainty in stress amplitude. For a specified cyclic load amplitude distribution, fatigue reliability can be calculated using the statistical average of the probabilities. Applications of the methods are also discussed to show the effect of load uncertainty on reliability analysis. Chapter 10 by Fukuda, Tokuno, and Yamada presents a method to evaluate the performance of the software systems considering real-time properties including time-dependent debugging activities using Markov process. Chapter 11 by Xie, Wang, Hao and Zhang provides a general review of the load-component strength interference relationship and then presents a time-dependent strength function to estimate the failure probability of series pipeline systems under randomly multiple load actions.

Part III of the book contains five papers, focuses on *Software Reliability and Testing*.

Chapter 12 by Folleco, Khoshgoftaar and Van Hulse discusses the impact of noise based on the incomplete measurement data on the evaluation of software quality imputation techniques including Bayesian multiple imputation, nearest neighbor imputation, decision tree imputation, and regression imputation. Chapter 13 by Kimura presents a linearized growth curve model and its parameter estimation using the method of two-parameter numerical differentiation. Chapter 14 by Hwang and Pham discusses a generalized time-delay software reliability model addressing the time required to identify and prioritize the detected faults before removing them optimal policies using the method of steps. Numerical examples based on software failure data are presented to illustrate the use of the proposed model when it is applied in practice. Chapter 15 by Lipton and Gokhale presents architecture-based software

reliability analysis and optimization methods for software systems addressing interface failures on application reliability using simulated annealing approach. Chapter 16 by Fujiwara, Inoue and Yamada discusses various software reliability growth models considering the time-dependent behavior of the fault-detection rate functions and the characteristics of module composition of the software system. Several applications also discussed to illustrate the methods.

Part IV of the book contains four papers, focuses on *Quality Engineering in Design*.

Chapter 17 by Yamada and Takahashi presents a description of rubber product and defect phenomena and discusses several design of experiments based on quality engineering approaches to identify the causes as well as enhance the product's quality and the process productivity. Chapter 18 by Son and Savage discusses an integrated mean and tolerance economic design model consisting of the production cost and the expected loss of quality cost over a planned horizon at the customer's discount rate based on present worth of loss of quality. They also demonstrate the methods using an application in automotive industry.

Chapter 19 by Castagliola, Celano and Fichera discusses a logarithmic transformed EWMA chart that monitors a statistic that depends on the sample variance and presents sensitivity analysis of the economic-statistical design to the implementation of a S^2 Shewhart chart. Chapter 20 by Fukushima and Yamada aims to prevent project failures by developing the risk management methods based on real-world experience and software development practices. It also analyzes the effects of project management factors using the multiple linear regression technique.

Part V of the book contains five papers, on *Applications in Engineering Design*.

Chapter 21 by Wanpracha, Pham, Hwang, Liang and Pham discusses the state-of-the-art approaches such as support vector machine, natural language processing, classification regression tree etc. in data mining that may be applicable to analyzing complex categorizing text records. The chapter also discusses several research challenges and directions in analyzing text records and mining. Chapter 22 by Siu briefly discusses the needs of visually impaired people in using public toilets and then identifies several key areas that worth to consider in designing the facilities, using the concept *friendly, informative, safe, and hygienic*. Chapter 23 by Miller and Gupta discusses assurance cases for critical infrastructures with a concentration on reliability and safety for Supervisory, Control, and Data Acquisition systems and presents a risk management structure based on a goal-based assurance approach to improve the return on investment. Chapter 24 by Fukuda discusses various detecting driver's emotion perspectives and context-dependent approaches in terms of human errors due to the rapid and frequent changes in real-world environments. Chapter 25 by Pham discusses some recent research and modeling in the area of aging and mortality modeling in demography. The chapter also presents several common distribution functions and the force of mortality functions that used in the field.

All the chapters are written by 50 leading experts in the field in academia and industry. I am deeply indebted and wish to thank all of them for their contributions and cooperation. Thanks are also due to the Springer staff for their editorial work. I hope that the readers including engineers, teachers, scientists, postgraduates, re-

searchers, and practitioners in the areas of both engineering and applied science, will find this book a state-of-the-references survey and a valuable resource for understanding the latest developments in reliability and quality and its applications in engineering design.

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