# System Reliability Modelling and Evaluation

C. Singh and R. Billinton

# Preface

The general area of reliability engineering is extremely wide and in fact encompasses all aspects of engineering technology. Conventional intuitive approaches to the evaluation of system adequacy are not sufficient in modern engineering applications and are gradually being replaced by consistent quantitative techniques. A basic and common requirement in any quantitative procedure is the development of a suitable mathematical model to describe the system. The model may be relatively simple or extremely complex and should be capable of numerical manipulation. This book is devoted entirely to this area and deals with the concepts, philosophy and techniques for reliability model building and evaluation.

The book begins by outlining the elements of reliability planning and discusses the role of modelling in the reliability program plan. Chapter 2 reviews the basic probability theory required in subsequent chapters with emphasis on utilization in system reliability modelling and evaluation. The reader will find that some previous background in probability mathematics is helpful but not necessary. Chapter 3 is the key chapter in the book and discusses the concepts of the frequency balancing approach. These concepts have been used with considerable success in the reliability analysis of repairable systems. This chapter emphasizes the calculation of several measures of system reliability. Chapter 4 is concerned with determining the system reliability characteristics from the statistical information available on the failure and repair cycles of the constituent components. Non-maintained systems have been discussed extensively in the available literature and, therefore, this book is directed towards maintained systems. The theory and procedures are, however, quite general and can be equally applied to non-maintained systems. Chapter 5 is devoted to the utilization of these concepts in the reliability analysis of relatively large systems and some possible problem areas and solutions are presented. The available books generally assume constant transition rates and give a cursory treatment to non-Markovian models. Chapter 6 is devoted to non-Markovian modelling with special emphasis on the device of stages which is a very practical approach. The emphasis in the book is on direct analytical methods. A discussion of system reliability modelling would, however, be incomplete without a discussion on simulation methods as given in Chapter 7.

The scope of application of the concepts outlined in the book encompasses virtually all engineering disciplines. The book is therefore intended as a general treatise and is not aimed at any specific area of application.

C. Singh
R. Billinton

# Contents

Major Subject: Electrical Engineering. Reliability modeling and evaluation in aging power systems. A Thesis by. HAG-KWEN KIM.Â  This is called perfect repair and is what is commonly assumed in power system reliability modeling and analysis. This can be modeled by a renewal process whose inter-failure times are independently and identically distributed. Further when these inter-failure times are exponentially distributed, the process becomes a HPP and the intensity function is constant. System reliability evaluation is accomplished under different maintenance strategies. Finally, with a high-speed train system as an example background, the proposed method is verified by combining the actual failure data with the maintenance data. 2. Reliability Modeling and Calculation for the System with Independent Components. 2.1. Reliability Network Modeling for the System with Independent Components.Â  . If we did related research along this thought, some better methods may be obtained to solve the issue of system reliability modeling and estimating on complex electromechanical integration. 8. Conclusion. This paper presents a new method to estimate the system reliability based on convex combination considering operation and maintenance strategy.