

Xingjian Jing - Ziqiang Lang

# Frequency Domain Analysis and Design of Nonlinear Systems based on Volterra Series Expansion

A Parametric Characteristic Approach

# Frequency Domain Analysis And Design Of Nonlinear Systems Based On Volterra Series Expansion A Parametric Characteristic Approach Understanding Complex Systems

**Xingjian Jing**



## **Frequency Domain Analysis And Design Of Nonlinear Systems Based On Volterra Series Expansion A Parametric Characteristic Approach Understanding Complex Systems:**

**Frequency Domain Analysis and Design of Nonlinear Systems based on Volterra Series Expansion** Xingjian Jing, Ziqiang Lang, 2015-02-17 This book is a systematic summary of some new advances in the area of nonlinear analysis and design in the frequency domain focusing on the application oriented theory and methods based on the GFRF concept which is mainly done by the author in the past 8 years The main results are formulated uniformly with a parametric characteristic approach which provides a convenient and novel insight into nonlinear influence on system output response in terms of characteristic parameters and thus facilitate nonlinear analysis and design in the frequency domain The book starts with a brief introduction to the background of nonlinear analysis in the frequency domain followed by recursive algorithms for computation of GFRFs for different parametric models and nonlinear output frequency properties Thereafter the parametric characteristic analysis method is introduced which leads to the new understanding and formulation of the GFRFs and nonlinear characteristic output spectrum nCOS and the nCOS based analysis and design method Based on the parametric characteristic approach nonlinear influence in the frequency domain can be investigated with a novel insight i e alternating series which is followed by some application results in vibration control Magnitude bounds of frequency response functions of nonlinear systems can also be studied with a parametric characteristic approach which result in novel parametric convergence criteria for any given parametric nonlinear model whose input output relationship allows a convergent Volterra series expansion This book targets those readers who are working in the areas related to nonlinear analysis and design nonlinear signal processing nonlinear system identification nonlinear vibration control and so on It particularly serves as a good reference for those who are studying frequency domain methods for nonlinear systems *The Bio-Inspired X-Structure/Mechanism Approach for Exploring Nonlinear Benefits in Engineering* Xingjian Jing, 2025-07-04 This book presents a unique approach to the design and analysis of beneficial nonlinearity which can take an important and critical role in engineering systems and thus cannot be simply ignored in structural design dynamic response analysis and parameter selection A key issue in the area is thus systematically addressed about how to analyze and design potential nonlinearities introduced to or inherent in a system of under study which is a must do task in many practical applications involving vibration control energy harvesting sensor systems and robots etc This book together with several other books in this book series is to present an up to date summary on the most recent development of a cutting edge method for nonlinearity manipulation and employment developed in recent several years named as the X shaped structure or mechanism approach The X shaped structure or mechanism is a generic structure or mechanism representing a class of beneficial geometric nonlinearity with realizable and flexible linkage mechanism or structural design of different variants or forms quadrilateral diamond polygon K Z S V shape or others which all share similar geometric nonlinearity and thus similar nonlinear stiffness

damping properties flexible in design and easy to implement This book is particularly to present a systematic frequency domain analysis design and optimization method of critical structural or control parameters in nonlinear systems including the X structure mechanism dynamics aiming at better dynamic performance and special nonlinear response as expected in engineering practice Cases studies in vehicle suspension energy harvesting fault detection and fuzzy membership optimization are all showcased The new analysis and design method introduced in this book definitely present a totally new and powerful approach to optimization and understanding of a class of nonlinear systems from a special frequency domain point of view

Frequency Domain Nonlinear Vibration Features for Fault Diagnosis in Complex Structures Quankun Li,Xingjian Jing,2025-03-05 This book provides a comprehensive introduction to recent advances in frequency domain nonlinear vibration features utilized for fault diagnosis in complex structures in the field of mechanical civil aeronautical and aerospace engineering It illustrates their basic principles advantages drawbacks and applications in detail through theoretical analysis and simulation experimental study This book focuses on frequency domain nonlinear vibration features and its main contents can be classified into two parts according to the introduced features One is about features based on the SOOS second order output spectrum and the other is about features based on the OS DF output spectrum at the double frequency or the second harmonic frequency Complex structures in this book include satellites aeroengines bridges pipelines frames etc and corresponding multiple degree of freedom MDOF models include chain type beam type ring like grid like unit like and rotating models Detailed theoretical analysis and case demonstration help undergraduates graduates and researchers have a systematical learning process and understand basic dynamic characteristics of complex structures more thoroughly Then some models methods and results in this book can be a valid reference for the design optimization and iteration of next generation complex structures On the other hand this book provides a totally new inspiration for fault diagnosis methods combined with artificial intelligence and machine learning algorithms since frequency domain nonlinear vibration features introduced in this book are more sensitive and effective to faults

*Proceedings of the ASME Dynamic Systems and Control Division* ,1998      Scientific and Technical Aerospace Reports ,1984      Dissertation Abstracts International ,1976      **International Aerospace Abstracts** ,1999      Government reports annual index ,199?      *Conference Proceedings* ,1993      **Electrical & Electronics Abstracts** ,1997      **Science Abstracts** ,1993      *Microwave Journal* ,2001      **Applied Mechanics Reviews** ,1989      **Index to Theses with Abstracts Accepted for Higher Degrees by the Universities of Great Britain and Ireland and the Council for National Academic Awards** ,2001 Theses on any subject submitted by the academic libraries in the UK and Ireland      *Environmental Factors in Electronic Warfare Related to Aerospace Systems* ,1996      **American Doctoral Dissertations** ,1975      *Government Reports Announcements & Index* ,1986-11      Analysis and Design of Nonlinear Systems in the Frequency Domain Yunpeng Zhu,2021-03-25 This book focuses on the development of three novel approaches to build up a framework for the frequency

domain analysis and design of nonlinear systems The concepts are derived from Volterra series representation of nonlinear systems which are described by nonlinear difference or differential equations Occupying the middle ground between traditional linear approaches and more complex nonlinear system theories the book will help readers to have a good start to analyse and exploit the nonlinearities Analysis and Design of Nonlinear Systems in the Frequency Domain provides clear illustrations and examples at the beginning and the end of each chapter respectively making it of interest to both academics and practicing engineers [Index to IEEE Publications](#) Institute of Electrical and Electronics Engineers, 1980 Issues for 1973 cover the entire IEEE technical literature *The Engineering Index Annual*, 1993 Since its creation in 1884 Engineering Index has covered virtually every major engineering innovation from around the world It serves as the historical record of virtually every major engineering innovation of the 20th century Recent content is a vital resource for current awareness new production information technological forecasting and competitive intelligence The world's most comprehensive interdisciplinary engineering database Engineering Index contains over 10.7 million records Each year over 500 000 new abstracts are added from over 5 000 scholarly journals trade magazines and conference proceedings Coverage spans over 175 engineering disciplines from over 80 countries Updated weekly

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