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# Nonlinear Dynamics of Continuous Elastic Systems



Springer

# Nonlinear Dynamics Of Continuous Elastic Systems

**David Y. Gao, Vadim A. Krysko**



## **Nonlinear Dynamics Of Continuous Elastic Systems:**

**Nonlinear Dynamics of Continuous Elastic Systems** Jan Awrejcewicz, Vadim Anatol'evich Krysko, Alexander F. Vakakis, 2004-03-23 This monograph is devoted to recent advances in nonlinear dynamics of continuous elastic systems A major part of the book is dedicated to the analysis of non homogeneous continua e g plates and shells characterized by sudden changes in their thickness possessing holes in their bodies or and edges made from different materials with diverse dynamical characteristics and complicated boundary conditions New theoretical and numerical approaches for analyzing the dynamics of such continua are presented such as the method of added masses and the method of proper orthogonal decomposition The presented hybrid approach leads to results that cannot be obtained by other standard theories in the field The demonstrated methods are illustrated by numerous examples of application

*Nonclassical Thermoelastic Problems in Nonlinear Dynamics of Shells* Jan Awrejcewicz, Vadim A. Krysko, 2012-12-06 This monograph describes some approaches to the nonlinear theory of plates and shells By nonclassical approaches we mean the description of problems with mathematical models of different sizes two and three dimensional differential equations and different types differential equations of hyperbolic and parabolic type in the spatial coordinates The nonlinearities investigated are also of various categories geometrical physical elasto plastic and periodic Creating such types of mathematical models and their detailed justification allows us to achieve the most accurate description of the real behaviour of shell type structures These models allow us to include interaction between the strain and temperature fields and coupling between the displacement field and the external influence of a transonic gas flow The mathematical treatment of such models helps us greatly in obtaining reliable results by numerical computation It appears that the most dangerous situation for thin shallow shells is the conjunction of a static load with dynamic interactions Such combined loads very often cause buckling of shell structures and in many cases a series of bucklings which can cause fracture The failure of a structure usually needs a small amount of time Therefore the lifetime of a shell structure depends strongly on nonelastic deflections and it is important to mathematically model shell structures as precisely as possible This monograph is one of several devoted to this subject Now we shall briefly describe the contents of the book Note that not all of the results presented here have been published in textbook format

**Nonsmooth Dynamics of Contacting Thermoelastic Bodies** Jan Awrejcewicz, Yuriy Pyr'yev, 2008-12-10 In this work methods of analysis and models of contacting systems dynamics including heat generation and wear exhibited by such systems are presented It should be emphasised that the methods and mathematical models of contacting systems exhibited by rigid elastic bodies and heat wear processes have been so far applied separately Tribological processes occurring on a contact surface were not taken into consideration in the analysis of the dynamic rigid or elastic body models On the other hand most of the introduced models of bodies in contact that took tribological effects into consideration did not allow for their inertia analysis This study contributes to the development of this field as the models presented here yield prediction of the behaviour of contacting

systems taking into account both mentioned aspects simultaneously When considered from the mathematical point of view the method of analysis is reduced to the solution of the system of differential equations describing the velocities of contacting bodies and Volterra integral equation modelling contact pressure The latter equation is obtained with the use of the Laplace integral transform

**Nonlinear Dynamics of Piecewise Constant Systems and Implementation of Piecewise Constant Arguments** Liming Dai, 2008 Piecewise constant systems exist in widely expanded areas such as engineering physics and mathematics Extraordinary and complex characteristics of piecewise constant systems have been reported in recent years This book provides the methodologies for analyzing and assessing nonlinear piecewise constant systems on a theoretically and practically sound basis Recently developed approaches for theoretically analyzing and numerically solving the nonlinear piecewise constant dynamic systems are reviewed A new greatest integer argument with a piecewise constant function is utilized for nonlinear dynamic analyses and for establishing a novel criterion in diagnosing irregular and chaotic solutions from the regular solutions of a nonlinear dynamic system The newly established piecewise constantization methodology and its implementation in analytically solving for nonlinear dynamic problems are also presented

**Advanced Computational Vibroacoustics** Roger Ohayon, Christian Soize, 2014-08-11 Advanced Computational Vibroacoustics presents an advanced computational method for the prediction of sound and structural vibrations in low and medium frequency ranges complex structural acoustics and fluid structure interaction systems encountered in aerospace automotive railway naval and energy production industries The formulations are presented within a unified computational strategy and are adapted for the present and future generation of massively parallel computers A reduced order computational model is constructed using the finite element method for the damped structure and the dissipative internal acoustic fluid gas or liquid with or without free surface and using an appropriate symmetric boundary element method for the external acoustic fluid gas or liquid This book allows direct access to computational methods that have been adapted for the future evolution of general commercial software Written for the global market it is an invaluable resource for academic researchers graduate students and practising engineers

**Introduction to Asymptotic Methods** David Y. Gao, Vadim A. Krysko, 2006-05-03 Among the theoretical methods for solving many problems of applied mathematics physics and technology asymptotic methods often provide results that lead to obtaining more effective algorithms of numerical evaluation Presenting the mathematical methods of perturbation theory Introduction to Asymptotic Methods reviews the most important methods

**Nonlinear Dynamics** Valery N. Pilipchuk, 2010-05-09 Nonlinear Dynamics represents a wide interdisciplinary area of research dealing with a variety of unusual physical phenomena by means of nonlinear differential equations discrete mappings and related mathematical algorithms However with no real substitute for the linear superposition principle the methods of Nonlinear Dynamics appeared to be very diverse individual and technically complicated This book makes an attempt to find a common ground for nonlinear dynamic analyses based on the existence of strongly nonlinear but quite simple counterparts to the

linear models and tools It is shown that since the subgroup of rotations harmonic oscillators and the conventional complex analysis generate linear and weakly nonlinear approaches then translations and reflections impact oscillators and hyperbolic Clifford's algebras must give rise to some quasi impact methodology Such strongly nonlinear methods are developed in several chapters of this book based on the idea of non smooth time substitutions Although most of the illustrations are based on mechanical oscillators the area of applications may include also electric electro mechanical electrochemical and other physical models generating strongly anharmonic temporal signals or spatial distributions Possible applications to periodic elastic structures with non smooth or discontinuous characteristics are outlined in the final chapter of the book *Advances in Nonlinear Dynamics* Walter Lacarbonara, Balakumar Balachandran, Michael J. Leamy, Jun Ma, J. A. Tenreiro Machado, Gabor Stepan, 2022-03-01 This second of three volumes includes papers from the second series of NODYCON which was held virtually in February of 2021 The conference papers reflect a broad coverage of topics in nonlinear dynamics ranging from traditional topics from established streams of research to those from relatively unexplored and emerging venues of research These include Nonlinear vibration control Control of nonlinear systems and synchronization Experimental dynamics System identification and SHM Multibody dynamics Classical Mechanics Jan Awrejcewicz, 2012-07-12 This is the second volume of three books devoted to Mechanics In this book dynamical and advanced mechanics problems are stated illustrated and discussed including a few novel concepts in comparison to standard text books and monographs Apart from being addressed to a wide spectrum of graduate students postgraduate students researchers and teachers from the fields of mechanical and civil engineering this volume is also intended to be used as a self contained material for applied mathematicians and physical scientists and researchers IUTAM Symposium on Interaction between Dynamics and Control in Advanced Mechanical Systems Dick H. van Campen, 2012-12-06 During the last decades applications of dynamical analysis in advanced often nonlinear engineering systems have been evolved in a revolutionary way In this context one can think of applications in aerospace engineering like satellites in naval engineering like ship motion in mechanical engineering like rotating machinery vehicle systems robots and biomechanics and in civil engineering like earthquake dynamics and offshore technology One could continue with this list for a long time The application of advanced dynamics in the above fields has been possible due to the use of sophisticated computational techniques employing powerful concepts of nonlinear dynamics These concepts have been and are being developed in mathematics mechanics and physics It should be remarked that careful experimental studies are vitally needed to establish the real existence and observability of the predicted dynamical phenomena The interaction between nonlinear dynamics and nonlinear control in advanced engineering systems is becoming of increasing importance because of several reasons Firstly control strategies in nonlinear systems are used to obtain desired dynamic behaviour and improved reliability during operation Applications include power plant rotating machinery vehicle systems robotics etc Terms like motion control optimal control and adaptive control are used in this field of interest Since mechanical

and electronic components are often necessary to realize the desired action in practice the engineers use the term mechatronics to indicate this field If the desired dynamic behaviour is achieved by changing design variables mostly called system parameters one can think of fields like control of chaos

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