



Valentin L. Popov

Contact Mechanics and Friction

Physical Principles
and Applications



Springer

Contact Mechanics And Friction Physical Principles And Applications

Alexander Konyukhov, Ridvan Izi



Contact Mechanics And Friction Physical Principles And Applications:

Contact Mechanics and Friction Valentin L. Popov, 2010-03-10 The English edition of *Contact Mechanics and Friction* lying before you is for st the most part the text of the 1 German edition Springer Publishing 2009 The book was expanded by the addition of a chapter on frictional problems in ear quake research Additionally Chapter 15 was supplemented by a section on elasto hydrodynamics The problem sections of several chapters were enriched by the addition of new examples This book would not have been possible without the active support of J Gray who translated it from the German edition I would like to thank Prof G G charyan and Prof S Sobolev for discussions and critical comments on the chapter over earthquake dynamics Dr R Heise made significant contributions to the velopment and correction of new problems I would like to convey my affecti ate thanks to Dr J Starcevic for her complete support during the composition of this book I want to thank Ms Ch Koll for her patience in creating figures and Dr R Heise M Popov M He S K rscher and B Grzemba for their help in pro reading Berlin November 2009 V L Popov Preface to the German Edition *Contact Mechanics and Friction* Valentin L. Popov, 2017-03-10 This application oriented book introduces readers to the associations and relationships between contact mechanics and friction providing them with a deeper understanding of tribology It addresses the related phenomena of contacts adhesion capillary forces friction lubrication and wear from a consistent point of view The author presents 1 methods for rough estimates of tribological quantities 2 simple and general methods for analytical calculations and 3 the crossover into numerical simulation methods the goal being to convey a consistent view of tribological processes at various scales of magnitude from nanotribology to earthquake research The book also explores the system dynamic aspects of tribological systems such as squeal and its suppression as well as other types of instabilities and spatial patterns It includes problems and worked out solutions for the respective chapters giving readers ample opportunity to apply the theory to practical situations and to deepen their understanding of the material discussed The second edition has been extended with a more detailed exposition of elastohydrodynamic lubrication an updated chapter on numerical simulation methods in contact mechanics a new section on fretting in the chapter on wear as well as numerous new exercises and examples which help to make the book an excellent reference guide *Contact Mechanics and Friction : Physical Principles and Applications* Valentin L. Popov, 2010 Dry Friction Friction induced Vibrations Thermal Effects in Contacts Lubricated Systems Viscoelastic Properties of Elastomers Rubber Friction and Contact Mechanics of Rubber Wear Friction under the Influence of Ultrasound Numerical Simulation Methods in the Physics of Friction Earthquakes and Friction Appendix Further Reading Index of Figures Index of Subjects **Review of "Contact Mechanics and Friction: Physical Principles and Applications" by Valentin L. Popov** , 2011 *Method of Dimensionality Reduction in Contact Mechanics and Friction* Valentin L. Popov, Markus Heß, 2014-08-19 This book describes for the first time a simulation method for the fast calculation of contact properties and friction between rough surfaces in a complete form In contrast to existing simulation methods the method of

dimensionality reduction MDR is based on the exact mapping of various types of three dimensional contact problems onto contacts of one dimensional foundations Within the confines of MDR not only are three dimensional systems reduced to one dimensional but also the resulting degrees of freedom are independent from another Therefore MDR results in an enormous reduction of the development time for the numerical implementation of contact problems as well as the direct computation time and can ultimately assume a similar role in tribology as FEM has in structure mechanics or CFD methods in hydrodynamics Furthermore it substantially simplifies analytical calculation and presents a sort of pocket book edition of the entirety contact mechanics Measurements of the rheology of bodies in contact as well as their surface topography and adhesive properties are the inputs of the calculations In particular it is possible to capture the entire dynamics of a system beginning with the macroscopic dynamic contact calculation all the way down to the influence of roughness in a single numerical simulation model Accordingly MDR allows for the unification of the methods of solving contact problems on different scales The goals of this book are on the one hand to prove the applicability and reliability of the method and on the other hand to explain its extremely simple application to those interested

Method of Dimensionality Reduction in Contact Mechanics Valentin L. Popov, Markus Hess, Emanuel Willert, 2018-08-08 The present book is a collection of open access papers describing the foundations and applications of the Method of Dimensionality Reduction MDR first published in the Journal Facta Universitatis Series Mechanical Engineering in the years 2014 2018 The Method of Dimensionality Reduction MDR is a method of calculation and simulation of contacts of elastic and viscoelastic bodies It consists essentially of two simple steps a substitution of the three dimensional continuum by a uniquely defined one dimensional linearly elastic or viscoelastic foundation Winkler foundation and b transformation of the three dimensional profile of the contacting bodies by means of the MDR transformation As soon as these two steps are done the contact problem can be considered to be solved For axial symmetric contacts only a small calculation by hand is required which does not exceed elementary calculus and will not be a barrier for any practically oriented engineer Alternatively the MDR can be implemented numerically which is almost trivial due to the independence of the foundation elements In spite of its simplicity all results are exact The present book brings together papers covering the most important aspects of the MDR and providing a practical guide for its use

Principles of Engineering Tribology Ahmed Abdelbary, Li Chang, 2023-05-26 Principles of Engineering Tribology Fundamentals and Applications introduces readers to the core theories and fundamentals of the field its basic terminology and concepts as well as advanced topics such as the tribological properties of various engineering surfaces roughness measurements and the mechanics of surface contact The fundamentals of friction and wear of metallic and non metallic materials such as polymers ceramics rubbers and composites are discussed as are fluidic gaseous grease and solid media lubrication techniques In addition the properties of lubricants and various types of additives incorporated are discussed along with a methodology for conducting friction wear and lubrication laboratory testing and an overview of simulation and

modeling methods for various tribosystems Case studies and applications are featured throughout with a particular emphasis on analyzing failure modes of tribosystems Introduces the basic concepts of tribology building a comprehensive understanding for readers and then covering more advanced topics Discusses tribological properties of various engineering surfaces roughness measurements and mechanics of surface contact Covers more advanced topics such as fluidic gaseous grease and solid media lubricants methods for conducting friction and wear laboratory tests and more Includes a wide range of both traditional and state of the art applications and case studies *Tribology in Materials and Applications* Jitendra Kumar Katiyar,P. Ramkumar,T. V. V. L. N. Rao,J. Paulo Davim,2020-05-23 This book broadens the knowledge of tribology This book is evolved out of current research trends on tribological performance of systems related to nano tribology rheology engines polymer brushes composite materials erosive wear and lubrication The book deals with enhancing the ideas on tribological properties the different types of wear phenomenon and lubrication enhancement Further the tribological performance of systems whether nano micro or macro scale depends upon a large number of external parameters and important among them are temperature contact pressure and relative speed Thus the book focus on the theoretical aspects to industrial applications of tribology **Introduction to Computational Contact Mechanics** Alexander Konyukhov,Ridvan Izi,2015-04-24 Introduction to Computational Contact Mechanics A GeometricalApproach covers the fundamentals of computational contactmechanics and focuses on its practical implementation Part one ofthis textbook focuses on the underlying theory and covers essentialinformation about differential geometry and mathematical methodswhich are necessary to build the computational algorithmindependently from other courses in mechanics The geometricallyexact theory for the computational contact mechanics is describedin step by step manner using examples of strict derivation from amathematical point of view The final goal of the theory is toconstruct in the independent approximation form so calledcovariant form including application to high order andisogeometric finite elements The second part of a book is a practical guide for programming ofcontact elements and is written in such a way that makes it easyfor a programmer to implement using any programming language Allprogramming examples are accompanied by a set of verificationexamples allowing the user to learn the research verificationtechnique essential for the computational contact analysis Key features Covers the fundamentals of computational contact mechanics Covers practical programming verification and analysis ofcontact problems Presents the geometrically exact theory for computationalcontact mechanics Describes algorithms used in well known finite element softwarepackages Describes modeling of forces as an inverse contactalgorithm Includes practical exercises Contains unique verification examples such as the generalizedEuler formula for a rope on a surface and the impact problem andverification of th percussion center Accompanied by a website hosting software Introduction to Computational Contact Mechanics A GeometricalApproach is an ideal textbook for graduates and seniorundergraduates and is also a useful reference for researchers andpractitioners working in computational mechanics

Computational Granular Mechanics and Its Engineering Applications Shunying Ji, Lu Liu, 2020-03-18 This book systematically introduces readers to computational granular mechanics and its relative engineering applications. Part I describes the fundamentals such as the generation of irregular particle shapes, contact models, macro-micro theory, DEM-FEM coupling, and solid-fluid coupling of granular materials. It also discusses the theory behind various numerical methods developed in recent years. Further, it provides the GPU-based parallel algorithm to guide the programming of DEM and examines commercial and open source codes and software for the analysis of granular materials. Part II focuses on engineering applications including the latest advances in sea ice engineering, railway ballast dynamics, and lunar landers. It also presents a rational method of parameter calibration and thorough analyses of DEM simulations which illustrate the capabilities of DEM. The computational mechanics method for granular materials can be applied widely in various engineering fields such as rock and soil mechanics, ocean engineering, and chemical process engineering.

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