

# Elastodynamic crack problems

Solutions to problems in dynamic crack propagation useful in structural design and testing

edited by  
**George C. Sih**

**Mechanics of fracture**

# Elastodynamic Crack Problems

**L. B. Freund**



## **Elastodynamic Crack Problems:**

Elastodynamic Crack Problems George C. Sih, 1977-03-31      Analytic and Experimental Methods in Elastodynamic Crack Problems R. A. W. Mines, 1990      **A Boundary Element Method for Elastostatic and Elastodynamic Crack Problems in Two and Three Dimensions** Zhenhong Jia, 1990      Scientific and Technical Aerospace Reports, 1991 Lists citations with abstracts for aerospace related reports obtained from world wide sources and announces documents that have recently been entered into the NASA Scientific and Technical Information Database      Cracks in composite materials George C. Sih, E.P. Chen, 2012-12-06 Composites offer great promise as light weight and strong materials for high performance structures One of the major advantages of these materials as compared with metals is the basic way in which heterogeneity resist crack extension In a fiber matrix composite system the fibers tend to cause cracks to form at closer spacing and delay the formation of a large crack The enhancement of local failure such as fiber breaking matrix cracking and interface debonding further reduces the energy level which might have otherwise reached the point of catastrophic failure Even though substantial tests have been made on composite materials little has been gained in the understanding and development of a predictive procedure for composite failure There are fundamental difficulties associated with incorporating the nonhomogeneous and anisotropic properties of the composite into the continuum mechanics analysis Additional uncertainties arise from voids and defects that are introduced in the composite during manufacturing Even a small quantity of mechanical imperfections can cause a marked influence on the composite strength Moreover the interface properties between the fibers and matrix or bonded laminae can also affect the load transmission characteristics significantly It would be impossible to establish predictive procedures for composite failure unless realistic guidelines could be developed to control the manufacturing quality of composite systems      **Dynamic Fracture Mechanics** Arun Shukla, 2006 Covering a wide variety of topics in dynamic fracture mechanics this volume presents state of the art experimental techniques and theoretical analysis on dynamic fracture in standard and exotic materials Written by world renowned researchers this valuable compendium contains eleven chapters on crack initiation crack propagation crack arrest crack stress wave interactions and experimental analytical and numerical methods in dynamic fracture mechanics Contents Modeling Dynamic Fracture Using Large Scale Atomistic Simulations H J Gao Dynamic Crack Initiation Toughness D Rittel The Dynamics of Rapidly Moving Tensile Cracks in Brittle Amorphous Material J Fineberg Optical Methods for Dynamic Fracture Mechanics H V Tippur On the Use of Strain Gages in Dynamic Fracture V Parameswaran Dynamic and Crack Arrest Fracture Toughness R E Link Dynamic Fracture in Graded Materials A Shukla Dynamic Fracture Initiation Toughness at Elevated Temperatures with Application to the New Generation of Titanium Aluminides Alloys M Shazly et al Dynamic Fracture of Nanocomposite Materials A Shukla et al Readership Researchers practitioners and graduate students in fracture mechanics and materials science      **Issues in Computation: 2011 Edition**, 2012-01-09 Issues in Computation 2011 Edition is a ScholarlyEditions

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*Methods of the Classical Theory of Elastodynamics* Vladimir B. Poruchikov, 2012-12-06 *Methods of the Classical Theory of Elastodynamics* deals not only with classical methods as developed in the past decades but presents also very recent approaches Applications and solutions to specific problems serve to illustrate the theoretical presentation Keywords Smirnov Sobolev method with further developments integral transforms Wiener Hopf technique mixed boundary value problems time dependent boundaries solutions for unisotropic media Willis method 3 d dynamical problems for mixed boundary conditions

*Cracks and Fracture* K. Bertram Broberg, 1999-02-24 *Cracks and Fracture* consists of nine chapters in logical sequence In two introductory chapters physical processes in the vicinity of the crack edge are discussed and the fracture process is described Chapter 3 develops general basic concepts and relations in crack mechanics such as path independent integrals stress intensity factors and energy flux into the crack edge region Chapters 4 7 deal with elastostatic cracks stationary or slowly moving elastic plastic cracks elastodynamic crack mechanics and elastoplastic aspects of fracture including dynamic fracture mechanics Appendices include general formulae the basic theory of analytic functions introduction to Laplace and Hankel transforms and description of certain basic relations for instance for stress waves in solids There is an extensive bibliography containing references to both classical and recent work and a comprehensive index Presents an extensive bibliography containing references to both classical and recent works and a comprehensive index Appendices include general formulas the basic theory of analytic functions introduction to Laplace and Hankel transforms and descriptions of certain basic relations for instance for stress waves in solids

**The Evaluation of Materials and Structures by Quantitative**

**Ultrasonics** J.D. Achenbach, 2014-05-04 Nondestructive evaluation NDE procedures are needed for materials processing as well as for post process materials testing They play important roles in product design analysis of service life expectancy manufacturing and quality control of manufactured products They are also essential to on line monitoring of the integrity of structural elements and complex systems Rational accept and reject criteria should be based on NDE tests Critical safety efficiency and operational features of large scale structures depend on adequate NDE capabilities The lectures presented in this volume are concerned with quantitative ultrasonic NDE They present fundamental concepts and basic theory as well as applications to the detection of cracks and the evaluation of material properties The following topics are discussed basic

wave propagation theory for ultrasonic NDE piezoelectric transducers EMATS and ultrasonic spectroscopy laser based ultrasonics acoustoelasticity ultrasound in solids with porosity microcracking and polycrystalline structuring the determination of mechanical properties of composite materials inverse problems and imaging

**Reciprocity in Elastodynamics** J. D. Achenbach, 2003 The reciprocity theorem has been used for over 100 years to establish interesting and useful relations between different loading states of a body This book discusses current and novel uses of reciprocity relations for the determination of elastodynamic fields The author who is internationally distinguished for his contributions to theoretical and applied mechanics presents a novel method to solve for wave fields shedding new light on the use of reciprocity relations for dynamic fields in an elastic body The material presented in the book is relevant to several fields in engineering and applied physics Examples are ultrasonics for medical imaging and non destructive evaluation acoustic microscopy seismology exploratory geophysics structural acoustics and the response of structures to high rate loads and the determination of material properties by ultrasonic techniques

**Mechanics of Fracture Initiation and Propagation** George C. Sih, 2012-12-06 The assessment of crack initiation and or propagation has been the subject of many past discussions on fracture mechanics Depending on how the chosen failure criterion is combined with the solution of a particular theory of continuum mechanics the outcome could vary over a wide range Modelling of the material damage process could be elusive if the scale level of observation is left undefined The specification of physical dimension alone is not sufficient because time and temperature also play an intimate role It is only when the latter two variables are fixed that failure predictions can be simplified The sudden fracture of material with a pre existing crack is a case in point Barring changes in the local temperature the energy released to create a unit surface area of an existing crack can be obtained by considering the change in elastic energy of the system before and after crack extension Such a quantity has been referred to as the critical energy release rate  $G_c$  or stress intensity factor  $K_{Ic}$  Other parameters such as the crack opening displacement COD path independent J integral etc have been proposed their relation to the fracture process is also based on the energy release concept These one parameter approaches however are unable simultaneously to account for the failure process of crack initiation propagation and onset of rapid fracture A review on the use of  $G$   $K_I$  COD J etc has been made by Sih 1 2

**Seismic Wave Propagation in Non-Homogeneous Elastic Media by Boundary Elements** George D. Manolis, Petia S. Dineva, Tsviatko V. Rangelov, Frank Wuttke, 2016-09-23 This book focuses on the mathematical potential and computational efficiency of the Boundary Element Method BEM for modeling seismic wave propagation in either continuous or discrete inhomogeneous elastic viscoelastic isotropic anisotropic media containing multiple cavities cracks inclusions and surface topography BEM models may take into account the entire seismic wave path from the seismic source through the geological deposits all the way up to the local site under consideration The general presentation of the theoretical basis of elastodynamics for inhomogeneous and heterogeneous continua in the first part is followed by the analytical derivation of

fundamental solutions and Green's functions for the governing field equations by the usage of Fourier and Radon transforms. The numerical implementation of the BEM is for antiplane in the second part as well as for plane strain boundary value problems in the third part. Verification studies and parametric analysis appear throughout the book as do both recent references and seminal ones from the past. Since the background of the authors is in solid mechanics and mathematical physics, the presented BEM formulations are valid for many areas such as civil engineering, geophysics, material science and all others concerning elastic wave propagation through inhomogeneous and heterogeneous media. The material presented in this book is suitable for self study. The book is written at a level suitable for advanced undergraduates or beginning graduate students in solid mechanics, computational mechanics and fracture mechanics.

***Strength of Structural Elements*** Zbigniew Brzoska, 2013-10-22. This volume describes engineering applications of the mechanics of deformable bodies and the elasticity theory relevant to them. It is concerned mainly with one dimensional problems which arise because either one of the dimensions of a body is much greater than the remaining two or the functions of two or three variables may be reduced to one variable. Problems of this type are of twofold importance. Firstly many engineering problems can be described with sufficient accuracy just in this way. Secondly unidimensional problems with known analytical solutions may serve either for testing numerical methods or for the analysis of fundamental concepts and phenomena whose physical nature in three dimensional approach might be obscured by the analytical numerical aspect. The authors have confined themselves for the most part to the analysis of elastic behaviour of structures however some attention is also given to elastic problems. A deterministic approach has been applied throughout the book. It will serve as a springboard for further work with stochastic approaches which are being increasingly used in engineering practice today.

**Dynamic Fracture Mechanics** L. B. Freund, 1998-03-28. This volume focuses on the development and analysis of mathematical models of fracture phenomena.

***Multiscale Solid Mechanics*** Holm Altenbach, Victor A. Eremeyev, Leonid A. Igumnov, 2020-11-09. This book provides an overview of the current of the state of the art in the multiscale mechanics of solids and structures. It comprehensively discusses new materials including theoretical and experimental investigations, their durability and strength as well as fractures and damage.

**Applied Mechanics Reviews**, 1979      **Rock Fracture Mechanics** H.P. Rossmann, 2014-05-04

**Boundary Element Methods** Q. Du, Mana Tanaka, 2014-05-23. Significant developments in the boundary element method during the last two decades have made it a powerful alternative to the domain type numerical methods of solution such as the finite element method. The advances made in the BEM are more or less due to the innovation of efficient computational techniques by introducing boundary elements for discretization of the boundary integral equations resulting from the so called direct formulation. BEM has therefore become an efficient tool for optimal design and other inverse problems. These proceedings include discussion of the applications of BEM in mechanical engineering and the principles that have developed to make it an increasingly useful method of problem solving.

**The Shock and Vibration Digest**, 1982

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