

# Lecture Notes in Engineering

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A. S. Jovanović,  
K. F. Kussmaul, A. C. Lucia,  
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## Expert Systems in Structural Safety Assessment

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# Expert Systems In Structural Safety Assessment Lecture Notes In Engineering Volume 53

**R. Winston Revie**



## **Expert Systems In Structural Safety Assessment Lecture Notes In Engineering Volume 53:**

**Expert Systems in Structural Safety Assessment** Aleksandar S. Jovanovic, Karl F. Kussmaul, Alfredo C. Lucia, Piero P. Bonissone, 2013-03-08 Structural safety of industrial systems and components raises a steadily growing public scientific and engineering interest and causes permanent development of methods and techniques used for its assessment In addition to the well established engineering methods applied in the field several new methods and tools have emerged recently Among them the most novel ones are probably those related to expert system applications appearing as an important possible improvement of the current engineering practice The issue has been addressed by the international course EXPERT SYSTEMS IN STRUCTURAL SAFETY ASSESSMENT organized by MPA Stuttgart and JRC Ispra Stuttgart October 2 4 1989 and the proceedings of the course are contained in this volume of the Lecture Notes in Engineering The contributions invited lectures tackle the issues usually confronting developers and users of expert systems applied in structural engineering i e in structural safety and integrity assessment Both the book and the course are a combination of a tutorial and of presentation of the current achievements in the field Starting from the basic elements of expert systems knowledge based systems the book should guide the reader up to the applications in various particular sub domains **Engineering Optimization in Design**

**Processes** Hans A. Eschenauer, Claus Mattheck, Niels Olhoff, 2012-12-06 These proceedings contain the texts of 37 contributions presented at the International Conference on Engineering Optimization in an Industrial Environment which took place on 3 4 September 1990 at the Karlsruhe Nuclear Research Center I H Germany The presentations consisted of oral and poster contributions arranged in five sessions Shape and layout optimization Structural optimization with advanced materials Optimal designs with special structural and material behaviour Sensitivity analysis Programme systems Optimization with stability constraints Special problems The editors wish to express their appreciation to all authors and invited speakers for their interesting contributions The proceedings cover a wide range of topics in structural optimization representing the present state of the art in the fields of research and in the industrial environment as well The editors hope that this book will also contribute towards new ideas and concepts in a world of ever decreasing natural resources and ever increasing demands for lighter and yet stronger and safer technical components Finally the editors wish to thank all colleagues who helped in the organisation of the conference especially Mrs E Schroder and Dr K Iethge as well as Mr A von Ilagen and Mrs E Haufelder Springer Publishing Company Heidelberg for the good cooperation and help in the publication of these proceedings *Reliability and Optimization of Structural Systems '90* A. Der Kiureghian, P.

Thoft-Christensen, 2012-12-06 This proceedings volume contains papers presented at the Third Scientific Meeting of the IFIP Working Group on Reliability and Optimization of Structural Systems The contributions reflect recent developments in the field of modern structural systems optimization and reliability theory and point out directions for further research Also perspectives for the education in this field were discussed *Reliability and Optimization of Structural Systems '91* Rüdiger

Rackwitz, Palle Thoft-Christensen, 2012-12-06 This proceedings volume contains 38 papers presented at the 4th Working Conference on Reliability and Optimization of Structural Systems held at the Technical University of Munich Germany September 11-13 1991 The Working Conference was organised by the IFIP International Federation for Information Processing Working Group 7.5 of Technical Committee 7 and was the fourth in a series following similar conferences held at the University of Aalborg Denmark May 1987 at the Imperial College London UK September 1988 and at the University of California Berkeley California USA March 1990 The Working Conference was attended by 54 participants from 16 countries The objectives of Working Group 7.5 are to promote modern structural systems optimization and reliability theory to advance international cooperation in the field of structural system optimization and reliability theory to stimulate research development and application of structural system optimization and reliability theory to further the dissemination and exchange of information on reliability and optimization of structural systems to encourage education in structural system optimization and reliability theory At present the members of the Working Group are A.H.S. Ang U.S.A. M. Grimmelt FRG G. Augli Italy N.C. Lind Canada M.J. Baker UK H.O. Maden Denmark P. Bjerager Norway R.E. Melcher Australia C.A. Cornell U.S.A. F. Moen U.S.A.

**A New Boundary Element Formulation in Engineering** Tania G.B. DeFigueiredo, 2013-03-12 1 1 The Hybrid Displacement Boundary Element Model This work is concerned with the derivation of a numerical model for the solution of boundary value problems in potential theory and linear elasticity It is considered a boundary element model because the final integral equation involves some boundary integrals whose evaluation requires a boundary discretization Furthermore all the unknowns are boundary variables The model is completely new it differs from the classical boundary element formulation in the way it is generated and consequently in the final equations A generalized variational principle is used as a basis for its derivation whereas the conventional boundary element formulation is based on Green's formula potential problems and on Somigliana's identity elasticity or alternatively through the weighted residual technique 2 The multi field variational principle which generates the formulation involves three independent variables For potential problems these are the potential in the domain and the potential and its normal derivative on the boundary In the case of elasticity these variables are displacements in the domain and displacements and tractions on the boundary For this reason by analogy with the assumed displacement hybrid finite element model initially proposed by Tong 1 in 1970 it can be called a hybrid displacement model The final system of equations to be solved is similar to that found in a stiffness formulation The stiffness matrix for this model is symmetric and can be evaluated by only performing integrations along the boundary

**Oil and Gas Pipelines** R. Winston Revie, 2025-03-18 Discover the integrity safety and security of new and aging oil and gas pipelines in this comprehensive reference guide Oil and gas pipelines are typically used to transport oil and gas but can be adapted to transport ethanol carbon dioxide hydrogen and more A pipeline network is an efficient method for transporting any number of energy providing products but safety and integrity are critical aspects of pipeline integrity management The demand for

pipeline safety and security is increasing in the face of more stringent standards and deepening environmental concerns including those related to climate change Oil and Gas Pipelines Integrity Safety and Security Handbook provides a comprehensive introduction to the integrity of new and aging pipelines and their management repair and maintenance All major varieties of pipeline are included along with all pertinent public safety and environmental protections Now fully updated to reflect the latest research and technological developments the book is a critical contribution to the reliability and safety of the global energy grid and ongoing efforts at carbon capture utilization and storage Readers of the second edition of Oil and Gas Pipelines will also find 26 new chapters including a new section on the digitalization of pipelines Detailed discussion of topics including management of geohazards mechanical damage internal corrosion monitoring and many more Extensive case histories with practical accompanying solutions Oil and Gas Pipelines is ideal for engineers scientists technologists environmentalists students and others who need to understand the basics of pipeline technology as it pertains to energy deliverability environmental protection public safety and the important role of pipelines and pipeline security to ensure energy security during the energy transition

#### **Reliability and Structural Integrity of Advanced Materials**

Stojan Sedmak,A. Sedmak,D. Ružić,1992 The Boundary Element Method for Groundwater Flow Erwin K.

Bruch,2012-12-06 In this book the application of the boundary element method to the solution of the Laplace equation is examined This equation is of fundamental importance in engineering and science as it describes different types of phenomena including the groundwater flow applications highlighted in this book Special subjects such as numerical integration subdivision of the domain into regions and other computational aspects are discussed in detail in the first chapters To demonstrate the accuracy and efficiency of the boundary element method results obtained when solving the Laplace equation have been compared against known analytical solutions Other chapters deal with problems such as steady and unsteady flow in addition to infiltration problems The applications demonstrate that the boundary element method provides a powerful solution technique which can be effectively applied to solve this type of problem

#### **Dynamic Analysis of Non-Linear Structures by the Method of Statistical Quadraticization** M.G. Donley,Pol Spanos,2012-12-06 1 1

Introduction As offshore oil production moves into deeper water compliant structural systems are becoming increasingly important Examples of this type of structure are tension leg platforms TLP s guyed tower platforms compliant tower platforms and floating production systems The common feature of these systems which distinguishes them from conventional jacket platforms is that dynamic amplification is minimized by designing the surge and sway natural frequencies to be lower than the predominant frequencies of the wave spectrum Conventional jacket platforms on the other hand are designed to have high stiffness so that the natural frequencies are higher than the wave frequencies At deeper water depths however it becomes uneconomical to build a platform with high enough stiffness Thus the switch is made to the other side of the wave spectrum The low natural frequency of a compliant platform is achieved by designing systems which inherently have low

stiffness Consequently the maximum horizontal excursions of these systems can be quite large The low natural frequency characteristic of compliant systems creates new analytical challenges for engineers This is because geometric stiffness and hydrodynamic force nonlinearities can cause significant resonance responses in the surge and sway modes even though the natural frequencies of these modes are outside the wave spectrum frequencies High frequency resonance responses in other modes such as the pitch mode of a TLP are also possible

Virtual Distortion Method Jan Holnicki-Szulc,2012-12-06 The theory of virtual distortions provides an efficient tool which can be used to treat many problems that differ from the physical point of view The objective of this book is to present a general concept of the Virtual Distortion Method with the necessary theoretical background and a variety of its applications to problems of structural analysis and design The book is focussed more on theoretical aspects of the problems than on the practical design of structur B Nevertheless a number of numerical algorithms discussed in the book has already been developed as a computational system capable to solve various problems of structural analysis

Boundary Element Analysis of Nonhomogeneous Biharmonic Phenomena Charles V. Camp,G.Steven Gipson,2013-04-17 At the date of this writing there is no question that the boundary element method has emerged as one of the major revolutions on the engineering science of computational mechanics The emergence of the technique from relative obscurity to a cutting edge engineering analysis tool in the short space of basically a ten to fifteen year time span is unparalleled since the advent of the finite element method At the recent international conference BEM XI well over one hundred papers were presented and many were published in three hard bound volumes The exponential increase in interest in the subject is comparable to that shown in the early days of finite elements The diversity of applications of BEM the broad base of interested parties and the ever increasing presence of the computer as an engineering tool are probably the reasons for the upsurge in popularity of BEM among researchers and industrial practitioners Only in the past few years has the BEM audience become large enough that we have seen the development of specialty books on specific applications of the boundary element method The present text is one such book In this work we have attempted to present a self contained treatment of the analysis of physical phenomena governed by equations containing biharmonic operators The biharmonic operator defines a very important class of fourth order PDE problems which includes deflections of beams and thin plates and creeping flow of viscous fluids

**Wave Breaking** Carlos M. Lemos,2013-03-13 In this monograph a finite difference algorithm for studying two dimensional wave breaking in the vertical plane is developed The essential feature of this algorithm is the combination of the Volume of Fluid VOF technique for arbitrary free surfaces and the k- $\epsilon$  turbulence model This methodology allows a self contained study for wave transformation processes in shallow water before during and after breaking This capability is illustrated in several calculations This book will be of interest for final year graduates postgraduates and researchers working in the fields of turbulence modelling wave hydrodynamics coastal engineering and oceanography of coastal regions

**Plate Stability by Boundary Element Method** Abbas Elzein,2013-03-07 1 1 Historical

Background Thin plates and shells are widely used structural elements in numerous civil mechanical aeronautical and marine engineering design applications Floor slabs bridge decks concrete pavements sheet pile retaining walls are all under normal lateral loading circumstances instances of plate bending in civil engineering The problem of elastic instability of plates occurs when load is applied in a direction parallel to the plane of the plate The deck of a bridge subjected to a strong wind loading the web of a girder under the action of shear forces transmitted by the flanges the turbine blade of a machinery undergoing longitudinal temperature differentials would all eventually buckle when the applied load or its temperature equivalent in the last case exceeds a certain limit that is the buckling load Although the plate may exhibit a considerable post buckling strength the buckling load is considered in many design instances especially in aeronautical and marine engineering as a serviceability limit because of the abrupt and substantial change in the dimensions and shape of the buckled plate Nevertheless the post buckling region retains its importance either as an essential safety margin or as a stage of loading actually reached under normal loading conditions The design engineer will therefore need rigorous tools of analysis to predict in addition to the buckling load the deflections and stresses at both buckling and initial post buckling stages

**Computational Tensor Analysis of Shell Structures** Steve Naomis, Paul C.M. Lau, 2012-12-06 This book presents a method which is capable of evaluating the deformation characteristics of thin shell structures A free vibration analysis is chosen as a convenient means of studying the displacement behaviour of the shell enabling it to deform naturally without imposing any particular loading conditions The strain displacement equations for thin shells of arbitrary geometry are developed These relationships are expressed in general curvilinear coordinates and are formulated entirely in the framework of tensor calculus The resulting theory is not restricted to shell structures characterized by any particular geometric form loading or boundary conditions The complete displacement and strain equations developed by Flugge are approximated by the curvilinear finite difference method and are applied to computing the natural frequencies and mode shapes of general thin shells This approach enables both the displacement components and geometric properties of the shell to be approximated numerically and accurately The selection of an appropriate displacement field to approximate the deformation of the shell within each finite difference mesh is discussed in detail In addition comparisons are made between the use of second and third order finite difference interpolation meshes [An Artificial Intelligence Approach to Integrated Circuit](#)

[Floorplanning](#) Marwan A. Jabri, 2012-12-06 In 1984 while I was following his postgraduate course on VLSI design my supervisor Dr David Skellern asked me if I was interested in investigating intelligent approaches to automatic floorplanning He told me then a circuit that works always looks nice has a clever data and control flow A fast way to look at students' projects is by looking at their floorplans Later I took a course on Knowledge Engineering KE and Artificial Intelligence AI with Professor John Gero who encouraged me to investigate this area of design automation The resources for such development were really poor at IS E as KE was a relatively new field of research in Australia at that time Whatever the

difficulties a good programmer never blames his tools as David Skellern used to tell me I undertook the investigation of Knowledge Based approaches to floor planning as my PhD thesis subject with the help of my supervisor and John Gero and the encouragement of all researchers at IS E who provided an exciting environment for my research This volume reports the results of my research during 1984 1985 1986 and 1987 The volume deals with floorplanning from four perspectives floorplanning strategy Knowledge Engineering in the floor domain the development of knowledge based floorplanning processes and new floorplanning algorithms for use in the overall strategy

*Thermal Effects in Fracture of Multiphase Materials* Klaus P. Herrmann, Zbigniew S. Olesiak, 2013-03-08 This book contains a selection of the lectures presented at the Euromech Colloquium 255 held at the Liborianum Paderborn from 31 October to 2 November 1989 The subject of the Colloquium Thermal Effects in Fracture of Multiphase Materials attracted about 50 scientists from 13 countries Several well known scientists who are active in research on thermal effects in fracture processes were present at the Colloquium as lecturers 29 lectures were delivered as well as valuable participants of the intensive discussions which took part during the sessions coffee breaks and lunch times The closing session of the Colloquium was devoted to a general discussion on the trends in the development of the research in the field the prospects of the theoretical research new materials composites ceramics etc and the trends in technological applications Over twenty comments and remarks have been made during this final general discussion showing the interest of the auditorium in such an exchange of viewpoints However this discussion is not reflected in this volume The Colloquium has been subdivided into six sessions I Thermodynamics of Fracture Processes II Fracture of Nonhomogeneous Solids III Thermal Cracking of Heterogeneous Materials IV VI Fracture Phenomena in Composite Systems I III One of the main topics in session I consisted in the description of the influence of thermal effects on shear band localization failure Thereby shear bands nucleate due

**Boundary Element Analysis of Viscous Flow** Koichi Kitagawa, 2013-03-08 In recent years the performance of digital computers has been improved by the rapid development of electronics at remarkable speed In addition substantial research has been carried out in developing numerical analysis techniques Nowadays a variety of problems in the engineering and scientific fields can be solved by using not only super computers but also personal computers After the first book titled Boundary Element was published by Brebbia in 1978 the boundary element method BEM has been recognized as a powerful numerical technique which has some advantages over the finite difference method FDM and finite element method FEM A great amount of research has been carried out on the applications of BEM to various problems The numerical analysis of fluid mechanics and heat transfer problems plays a key role in analysing some phenomena and it has become recognized as a new research field called Computational Fluid Dynamics In particular the analysis of viscous flow including thermal convection phenomena is one of the most important problems in engineering fields The FDM and FEM have been generally applied to solve these problems because of non singularities of governing equations

**Proceedings**, 1990 **Shape Design Sensitivity Analysis and Optimization**



**Using the Boundary Element Method** Zhiye Zhao, 2012-12-06 This book investigates the various aspects of shape optimization of two dimensional continuum structures including shape design sensitivity analysis structural analysis using the boundary element method BEM and shape optimization implementation The book begins by reviewing the developments of shape optimization followed by the presentation of the mathematical programming methods for solving optimization problems The basic theory of the BEM is presented which will be employed later on as the numerical tool to provide the structural responses and the shape design sensitivities The key issue of shape optimization the shape design sensitivity analysis is fully investigated A general formulation of stress sensitivity using the continuum approach is presented The difficulty of the modelling of the adjoint problem is studied and two approaches are presented for the modelling of the adjoint problem The first approach uses distributed loads to smooth the concentrated adjoint loads and the second approach employs the singularity subtraction method to remove the singular boundary displacements and tractions from the BEM equation A novel finite difference based approach to shape design sensitivity is presented which overcomes the two drawbacks of the conventional finite difference method This approach has the advantage of being simple in concept and easier implementation A shape optimization program for two dimensional continuum structures is developed including structural analysis using the BEM shape design sensitivity analysis mathematical programming and the design boundary modelling

**Computerization and Networking of Materials Databases** Thomas Ian Barry, K. Reynard, 1992 Papers presented at the symposium on the Computerization and Use of Materials Property Data held in Cambridge UK September 1991 sponsored by the ASTM and the UK National Physical Laboratory The volume is divided into four sections standards and data representation integration of materials i

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