

An Investigation of the Recent Developments in Reliability-based Structural Topology Optimization

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Abstract

Optimizing a structure's topology involves finding the best possible distribution of material and connections within a given design space. It has a significant effect on its performance, which is why there has been a meteoric rise in the number of articles published on the topic over the last two decades. This work offers an investigation of reliability-based topology optimization of structures, in light of the recent development of several topology optimization techniques for both linear and nonlinear systems. Therefore, the emphasis of this study is on the latest advancements, enhancements, and applications of reliability-based topology optimization. This paper's primary objective is to provide an overview of the latest advancements in the reliability-based topology optimization of structures, with a particular emphasis on the recent improvement of integrating reliability-based design into the bi-directional evolutionary structural optimization (BESO) method, which accounts for the topological optimization of geometric and material nonlinearity as well as thermoelastic problems.

Keywords

topology optimization, reliability-based design, BESO, geometrically nonlinear, elasto-plastic

1 Introduction

The goal of structural optimization is to find the structure that is the lightest, stiffest, strongest, and most frequency-resistant while still meeting certain requirements like volume, mass, and deflection [1]. At the moment, structural optimization can be split into three different subfields: size optimization, topology optimization, and shape optimization [2–4]. It is important to emphasize that the optimization of topology is distinct from the optimization of size and shape. In shape optimization, design variables are the values that determine the shape of the structure of a given topology. Size optimization uses the geometrical dimensions of structural components as design variables, such as the thickness and diameter of a predefined geometrical shape. Topology optimization (TO) finds the ideal material distribution, hole placement, shape, size, and connection in a design domain. It is the most generic structural optimization method and has no constraints on design domain size or boundary, giving engineers greater design flexibility and search space to find the best solution, particularly during early design [5].

In the presence of sources of uncertainty, the optimum performance attained using typical deterministic approaches for structure optimization problems in the actual world might be drastically diminished. Variations in applied loads, material properties, and manufacturing tolerances may be the cause of uncertainty [6–10]. When the uncertainty comes simply from the variable directions in which a load is applied, Csébfalvi [11] offered a novel metaheuristic technique, where the randomness of the load directions were treated as uncertain but constrained parameters. Besides, Csébfalvi [12] presented benchmark results by considering the worst load direction-oriented technique. Kaveh and Zaerreza [13] introduced a novel approach for reliability-based design optimization (RBDO) that takes into account unpredictable characteristics like applied loads and material properties. Considering that the suggested technique uses decoupled metaheuristic algorithms. Lógó [14] developed a novel kind of probabilistic optimum topology design approach for continuum-type structures with random load application points.

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July 2016 The total of 1287 papers and 186 posters presented at the HCII 2016 conferences and were carefully reviewed and selected from 4354 submissions The papers thoroughly cover the entire field of Human Computer Interaction addressing major advances in knowledge and effective use of computers in a variety of application areas The volumes constituting the full 27 volume set of the conference proceedings

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Table of Contents Recent Developments In Structural Optimization

1. Understanding the eBook Recent Developments In Structural Optimization
 - The Rise of Digital Reading Recent Developments In Structural Optimization
 - Advantages of eBooks Over Traditional Books
2. Identifying Recent Developments In Structural Optimization
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an eBook Platform
 - User-Friendly Interface
4. Exploring eBook Recommendations from Recent Developments In Structural Optimization
 - Personalized Recommendations
 - Recent Developments In Structural Optimization User Reviews and Ratings
 - Recent Developments In Structural Optimization and Bestseller Lists

5. Accessing Recent Developments In Structural Optimization Free and Paid eBooks
 - Recent Developments In Structural Optimization Public Domain eBooks
 - Recent Developments In Structural Optimization eBook Subscription Services
 - Recent Developments In Structural Optimization Budget-Friendly Options
6. Navigating Recent Developments In Structural Optimization eBook Formats
 - ePub, PDF, MOBI, and More
 - Recent Developments In Structural Optimization Compatibility with Devices
 - Recent Developments In Structural Optimization Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Recent Developments In Structural Optimization
 - Highlighting and Note-Taking Recent Developments In Structural Optimization
 - Interactive Elements Recent Developments In Structural Optimization
8. Staying Engaged with Recent Developments In Structural Optimization
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Recent Developments In Structural Optimization
9. Balancing eBooks and Physical Books Recent Developments In Structural Optimization
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Recent Developments In Structural Optimization
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Recent Developments In Structural Optimization
 - Setting Reading Goals Recent Developments In Structural Optimization
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Recent Developments In Structural Optimization
 - Fact-Checking eBook Content of Recent Developments In Structural Optimization
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
- Exploring Educational eBooks

14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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