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Biomimetics - Biomimetic structural optimization

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Foreword

This standard was drafted in accordance with the rules given in GB/T 1.1-2009.

This standard uses the translation method equivalent to ISO 18459.2015 "bionics bionic structure optimization".

The documents of our country that have a consistent correspondence with the international documents referenced in this standard are as follows.

---GB/T 14124-2009 Vibration and vibration measurement of mechanical vibration and impact buildings and their evaluation of buildings

Guide (ISO 4866.1990/Amd.2.1996, IDT)

This standard is proposed and managed by the China Machinery Industry Federation.

This standard was drafted. Beijing Machinery Industry Automation Research Institute Co., Ltd., Zhejiang University, Tsinghua University.

Introduction

The basis of the bionic optimization method is derived from the knowledge gained from the study of natural biological structures and processes.

As a special branch of optimization, structural optimization involves the ideal design of components while taking into account current boundary conditions. through

Commonly optimized attributes include weight, load capacity, stiffness or life. Its purpose is to optimize by maximizing or minimizing the value of an attribute.

One or more of these attributes.

In general, it is best to use the material as perfectly as possible while avoiding overload and underload areas. Given almost every skill

Surgical components will exhibit some changes in the cross section, ie, the gap, due to

functional reasons, thus causing a change in the notch, so, in the structure

It is especially important to minimize the load-bearing capacity of the gap in the optimization. In the traditional structural optimization, reduce the notch shape factor, that is, lack

The stress concentration factor above the mouth is achieved by either selecting the maximum curvature radius of the gap or using the phase of the gap

Interaction and increase the unloading groove. However, the shape of the notch does not change due to this step. As early as the 1930s

Suggestions for using other notch shapes (baud curves, ellipses, logarithmic spirals, etc.), but not widely used in technology, are only occasionally

use.

Computer-based bionic optimization tools, such as Computer Aided Optimization (CAO) and Soft Area Clearance (SKO), have improved components

The shape and topology are such that the forces are balanced by using finite element analysis (FEA). These tools have been used since their appearance in.1990.

In the industry. However, this need to optimize using finite element analysis actually limits the number of possible users because doing so

The operation requires powerful computers, specialized software and experts. Therefore, there needs to be a simpler and faster optimization method, not only

The home is operational and the design engineer can operate, and it is this demand that eventually led to the emergence of the "stretching triangle method." Despite the method

Development began in.2006, but it has been applied in practice because it is easy to understand and easy to apply. Wide range of bionic optimization methods

The universal application is relatively easy to operate, user-friendly and easy to apply, allowing users to perform component optimization operations early in the design process.

Work. With regard to the use of the stretched triangle method, it is possible to implement this method easily using a computer aided design (CAD) system.

Since each optimization means specializing in the selected load conditions, service loading can be well known. other

Load conditions that are not taken into account may cause the component to withstand greater forces.

Bionics bionic structure optimization

1 Scope

This standard points out the function and scope of the bionic structure optimization method. These methods involve lines under static and fatigue loading conditions.

Sexual structure problems. The methods described in this standard are illustrated by examples.

Computer-based biomimetic based on biological models of natural growth and by using technical component finite element method (FEM) optimization methods

Tools include Computer Aided Optimization (CAO), Soft Area Clearance (SKO), and Computer Aided Internal Optimization (CAIO). Of these methods

The goal is to reduce component weight or enhance component capabilities and extend component life to optimize material applications.

In addition, this standard also describes a simpler and faster "stretching triangle method". Bionic optimization method is widely used, and it is easier to add

Understanding and using, enabling users to implement component optimization early in the design process.

The purpose of this standard is to familiarize users with the bionic optimization method as an effective tool to extend the life of the part and reduce the weight of the part.

Promote the widespread use of these methods to support sustainable development.

This standard is not only for designers, developers, engineers and technicians, but also for those tasks that are assigned to design and evaluate load structures.

Prepared by personnel.

2 Normative references

The following documents are indispensable for the application of this document. For dated references, only dated versions apply to this article.

Pieces. For undated references, the latest edition (including all amendments) applies to this document.

ISO 2394 General Principles of Reliability for Structures (Generalprinciplesonreliabilityforstructures)

ISO 4866 Mechanical vibration and impact building vibration vibration measurement and its evaluation of the influence of buildings (Mechanical

vibrationandshock-Vibrationoffixedstructures-Guidelinesforthemeasurementofvibrationsand

Evaluationoftheireffectsonstructures)

ISO 13823 General Principles for Building Durability
(Generalprinciplesonthedesignofstructuresfordurability)

ISO 18458 Biomimetics-Terminology, concepts and methods

3 Terms and definitions

The following terms and definitions apply to this document.

3.1

Mechanical adaptive growth mechanicaladaptivegrowth

Biological structures such as trees and bones are locally added to the stressed area or removed from the small force range.

The appropriate response (such as mechanical load) made by the change.

Example. A thicker part of the tree ring.

3.2

Algorithm algorithm

Precisely describe the limited steps to complete a task.

3.3

Design space designspace

The amount of design permission for a part.

Note 1. When designing, the edges of the components should not exceed the design space.